THE EFFECT OF APPROACH GRADIENT, WEATHER CONDITIONS AND QUEUE POSITION ON DISCHARGE HEADWAYS AT SIGNALIZED INTERSECTIONS IN THE CITY OF ST. JOHN'S

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The Effect of Approach Gradient, Weather Conditions and Queue Position on Discharge Headways at Signalized Intersections in the City of St. John's

by

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Abstract

This experiment was designed to determine the effect, if any, of approach gradient, weather conditions and queue position on discharge headways at signalized intersections in the City of St. John's.

Many of the factors that affect vehicle operation at signalized intersections were examined through an extensive search of the existing literature. These factors were considered during the selection process when the intersection approaches on which data was collected were selected.

A suitable mathematical model was selected and the appropriate hypotheses were generated.

Headway data was collected during the Spring of 1986 on five intersection approaches having a range in gradients from -7.2% to +7.2%.

This data was analyzed using the SPSS/X statistical software package. It was determined that the headway data that was originally collected did not meet the assumption of Normality. Accordingly, the data was transformed using a logarithmic transformation to produce a more Normal distribution, and was analyzed again.

The factorial experiment that was performed indicated a statistically significant interaction between weather conditions and approach gradient. However, subsequent attempts to formulate equations quantifying the relationship

between approach gradient and vehicle headways at each level of the weather factor were not successful. The regression procedure produced equations with very low values of the coefficients of determination. At the same time, the significance level of the F-test procedure results gave indications that a strong linear relationship existed between approach gradient and discharge headways.

It was concluded that the significant result of the F-test procedure was a result of the large number of residual degrees of freedom resulting from the very large database.

Consequent examination of the data revealed an error in the database that had been used during those regression procedures. However, when the regression procedures were performed on the corrected database, the results were largely unchanged.

It was, therefore, concluded that there is no practical quantifiable relationship between approach gradient and discharge headways on the approaches to signalized intersections in the City of St. John's.

However, a practical and statistically significant relationship was developed between the elapsed time from the start of the green phase, a quantity which is related to discharge headway, and vehicle position in the queue, and an appropriate prediction equation was developed that accounts for 93.5% of the variability in the data.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Introduction

It has long been recognized by traffic engineers that signalized intersections on arterial streets represent a key operational constraint to the movement of traffic in urban transportation systems. The level of service that can be attained on any arterial street network is heavily dependent on the efficiency of the traffic signal system throughout that network.

There are many factors that affect the operating characteristics of vehicles at signalized intersections, and, hence, the level of service that is provided to motorists. It was felt that an attempt should be made to better understand the impact of several of these factors on the operating characteristics of vehicles at signalized intersections in the City of St. John's. A better understanding of these factors would enable the City's Traffic Division to more accurately analyze the behaviour of vehicles at intersections in the City.

The specific factors that were studied in detail are approach gradient, weather conditions and queue position. The following sections discuss more fully why these factors were selected for study.

The City of St. John's has developed largely around its natural harbour. As the City developed, the Harbour has been the physical as well as the economic hub of the City. Accordingly, as the street pattern developed, streets generally led to the Harbour.

The resulting arterial street network can best be described as a semi ring-radial system with the street pattern stretching out to the north and west from the Harbour as shown in Figure 1. Significant development to the south and east has been precluded by the precipitous Southside and Signal Hills respectively.

The terrain upon which the City has been built consists of a series of rolling hills and valleys resulting from three main rivers which meander through the City. The presence of these rivers has also contributed to the ring-radial type street system in St. John's. Generally, the ring streets follow the river valleys and, therefore, have relatively flat gradients. The radial streets cross the valleys making their way to the Harbour. Because of this pattern the gradients on the radial arterials are generally more severe than those encountered on the ring arterial streets. This rolling terrain has resulted in a number of important signalized intersections in the City having approaches with greater than or less than the desirable maximum or minimum approach gradients.

One of the objectives of the experiment that was

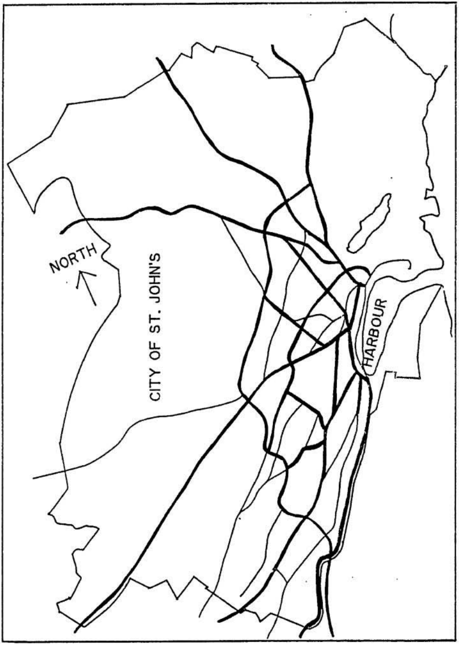

Figure 1 City of St. John's arterial street network

conducted, therefore, was to determine whether the gradient of an approach to an intersection significantly affected the operation of vehicles using that intersection. This information could then be taken into consideration by City staff when intersection operations in the City of St. John's were analyzed.

Another objective of the project related to the effect of weather conditions on vehicle operations at signalized intersections in the City of St. John's.

St. John's is located on the Avalon Peninsula on the east coast of the Province of Newfoundland and Labrador. The Avalon Peninsula extends out into the North Atlantic in an area where the warm Gulf Stream from the West Indies converges with the cold Labrador Current from the Arctic. The resulting temperate climate does not produce an abnormally large amount of precipitation as much as it produces a large number of precipitation events. It is not uncommon during certain times of the year to experience some degree of precipitation every day for extended periods.

It was decided that the effect of weather conditions on vehicle operations should be investigated to enable traffic analysts to better understand how weather affects vehicle performance at traffic signals in the City of St. John's. It was also decided to investigate the possibility of an interaction between weather conditions and approach gradient. Knowledge of this phenomenon, if it existed, would be useful to local traffic analysts as well.

A third factor, the position of a vehicle in the queue, was also included in the experiment. Other researchers have observed that the first several vehicles in a queue departing a signalized intersection after the start of the green phase behave differently than vehicles positioned later in the queue. This phenomenon has been called starting delay and relates to drivers' reaction times and the accelerating abilities of their vehicles, among other factors.

Because queue position could significantly affect the performance of a vehicle at a signalized intersection it either had to be neutralized as a variable or taken into consideration in the design of the experiment. It was felt that the effect of queue position was worth investigating in the local context and the variable, queue position, was included in the experiment for active consideration. Again, the interactions of queue position with approach gradient and weather conditions were also investigated to determine their significance.

Therefore, in summary, the objective of the experiment that was conducted was to determine, in the local context, the significance of the effects of the three variables of interest, approach gradient, weather conditions and queue position, on vehicle performance at signalized intersections.

In general terms, this objective was achieved by observing vehicle performance at a number of carefully selected signalized intersections and by careful comparison of that performance.

Subsequent chapters of this thesis deal with the precise statement of the problem being investigated, the selection of the actual intersection approaches upon which data was collected, the design of the experiment that was used to compare vehicle performance at the selected signalized intersection approaches, including the mathematical model that was selected, the data collection process, the comparison and analysis of the experimental data and a discussion of the results of the experiment and how these results relate to the experimental objectives.

CHAPTER TWO

2.0 PROBLEM STATEMENT

2.1 Introduction

The problem statement phase of experimental design allows the researcher to specify what it is hoped to achieve through the experimental process.

In this Chapter, the problem statement for the experiment discussed herein is developed, the selection of an appropriate response variable is discussed, a design for the experiment is stated in general terms, and many of the factors that influence traffic operations at signalized intersections are discussed in detail.

2.2 Problem statement

The Traffic Engineering division of the Department of Engineering and Public Works of the City of St. John's has to be able to accurately predict the level of service on approaches to signalized intersections in the City. As noted previously, many factors affect the behaviour of vehicles and, therefore, the level of service at signalized intersections.

Many of these factors have been studied, theoretically and experimentally.

The effect of vehicle size, the effect of vehicle performance, the effect of vehicle type and age, the influence of turning vehicles, the effect of community type, the effect of drivers' forward vision, the effect of traffic signal visibility, the effect of weather conditions , the effect of light conditions, the effect of lane width, the effect of crossroad width, and the influence of gradient among other factors have all been studied as they relate to traffic operations at signalized intersections.

For the reasons discussed in Chapter One, approach gradient, weather conditions and queue position were selected for study in this experiment.

The research of Helm, Dick, and Conley relative to the effect of gradient on traffic operations is of interest with respect to this thesis.[123]

Also of interest is the work of Berry and Ghandi and Helm relative to the effect of weather on discharge headways.[45]

The work of Evans and Rothery and Ancker, Garfarian and Gray on the effect of queue position on headway is also of interest.[67]

Helm in his paper, "Saturation Flow of Traffic at Light-Controlled Intersections", concluded that for the range of gradients encountered at his study intersections (between +6% and -6%) no significant effect due to gradient was apparent. The conclusions drawn by Conley based on experimental data and published in his paper, "Effect of Grade on Starting Headway Time", are similar. Conley concluded that the effect of grade on starting headway time did not appear to be significant. However, Dick's research, presented in a paper entitled, "Effect of Gradients on Saturation Flow at Traffic Signals", indicated that "an increase of 1% in gradient (in the range of -5.2% to +8.1%) produces a decrease of 3% in the saturation flow".[8]

This review of the current literature indicates that researchers have been unable to reach unanimous agreement on the effect that gradient has on traffic flow at signalized intersections.

The effect of weather conditions on discharge headways has also been studied by a number of researchers.

Berry and Ghandi in their paper, "Headway Approach to Intersection Capacity", concluded that adverse weather significantly increased headways. The research performed by Helm also indicated that inclement weather significantly affected the behaviour of vehicle drivers, although Helm cautioned that more data than he had collected would be required to obtain a better understanding of the behaviour of vehicles under poor weather conditions. Nevertheless, the trend in the results of previous research seems to indicate that weather conditions do affect vehicle headways.

The relationship between discharge headway and the position of a vehicle in the queue has been noted as well by several researchers.

Evans and Rothery in their paper, "Influence of Vehicle Size and Performance on Intersection Saturation Flow", noted that generally the first three vehicles in a queue used more green time to discharge than vehicles in other positions. This conclusion is reaffirmed by the work of Ancker, Garfarian and Gray whose data indicates that early queue positions have longer headways than later queue positions. The apparent trend is that queue leaders generally have longer discharge headways than vehicles further back in the queue. This trend has been attributed by others to the phenomenon of starting delay which is discussed in more detail later in this document.

The problem then is to determine the effect, if any, of these factors of interest; approach gradient, weather conditions and queue position, on the operation of vehicles at signalized intersections in the City of St. John's.

This problem statement, as defined, raises the question of how the effect of these factors on vehicle operation is to be measured, that is, what will be used as the response variable.

2.3 Selection of the response variable

From an operational point, one of the most important characteristics of a signalized intersection is its capacity. The question that operations personnel are chiefly concerned with is: "How many vehicles are able to pass through a signalized intersection during a given time period?". The term that has been developed by traffic engineers to represent

For example, if an intersection approach has a saturation flow of 1800 pcu/h, then the headways between vehicles on that approach when saturation flow conditions exist are given by 3600 s/1800 pcu or 2.00 s/pcu.

The saturation flow of an approach to a signalized intersection represents the continuous capacity of that approach.[14] Therefore, the capacity of an approach to a signalized intersection is a function of the headways between vehicles as they travel through the intersection.[15]

Because of this relationship between the capacity of an approach to a signalized intersection and the headways between vehicles as they travel through the intersection, vehicular headway was selected as the response variable to be used to measure the effect of approach gradient, weather conditions and queue position on vehicle operations at signalized intersections. The headways between vehicles that have queued at a traffic signal awaiting the start of the green phase are usually referred to as discharge headways.

Accordingly, the problem statement noted earlier can now be refined as follows:

The problem is to determine the effect, if any, of approach gradient, weather conditions and queue position on the discharge headways of vehicles on approaches to signalized intersections in the City of St. John's.

the maximum flow through an intersection is saturation flow.

For the purposes of this experiment, saturation flow is defined as the maximum flow, expressed as equivalent passenger cars, that can pass through an intersection approach when there is a continuous green signal indication and a continuous supply or queue of vehicles on that approach.[9] The normal unit for expressing saturation flow is passenger car equivalent units per hour of green time (pcu/h).

Closely related to saturation flow is the headway between vehicles at a signalized intersection. Headway is defined herein as the time-space between vehicles. It is the time that elapses between the front of one vehicle passing the reference point and the front of the succeeding vehicle passing that point. This definition is similar to the definition of headway used by many authorities, including the Institute of Transportation Engineers and the British Transport and Road Research Laboratory.[10,11]

An obvious relationship exists between headways on an intersection approach and the saturation flow on that approach. When saturation flow is expressed as passenger car equivalents per second (pcu/s), it becomes apparent that saturation flow in this form is the reciprocal of headway.[12]

Steuart and Shin agree, noting, "the capacity of a signalized intersection, expressed in vehicles per hour of green time, is the reciprocal of the average headway between vehicles during saturation flow." [13]

2.4 Experimental design

An experiment was designed that would enable the effects of the three factors of interest on discharge headways to be determined. It was intended to make this determination by comparing discharge headways recorded on approaches to several signalized intersections in the City of St. John's. A factorial experiment was designed to determine which of the factors of interest significantly affected the selected response variable, discharge headway.

A factorial experiment is an experiment performed to determine the effects of one or more factors on the response variable of interest. An additional benefit of the factorial experimental design is that it allows the significance of combinations of the factors of interest to be determined. It is possible that certain combinations of these factors may act together or interact to affect discharge headways. For example, poor weather conditions may have a greater effect on headways on steeper gradients than on flat gradients. This hypothesis is supported to some degree by the Canadian Capacity Guide for Signalized Intersections which notes that, "the effect of gradient is more significant during winter conditions."[16] The factorial experimental design addresses the effects, including the interaction effects, that the factors of interest have on the response variable.

The term "factor" denotes the feature of the experiment that is varied during different trials of the experiment.

The different values that are assigned to the various factors are the levels of the factor.[17]

The selected experimental design will allow the problem, as defined in the problem statement, to be addressed. A factorial experiment will determine which of the factors of approach gradient, weather conditions or queue position significantly affects the discharge headways of vehicles on approaches to signalized intersections in the City of St. John's.

2.5 Factors influencing traffic operations at signalized intersections

Apart from the three main factors of interest in this experiment, other factors also affect the headways of vehicles at signalized intersections. The headways of vehicles at any particular intersection approach at any particular time are dependent upon the prevailing conditions at that approach at that time. Among the general factors that constitute prevailing conditions are:

"-the various physical and operating characteristics of the roadway,

-the environmental conditions which have a bearing on the experiences and actions of the driver,

-the characteristics of the traffic stream, and

-traffic control measures."[18]

The 1985 edition of the Highway Capacity Manual categorized prevailing conditions as roadway, traffic or control conditions[19]. Some of the more specific factors that have an effect on headways are discussed in detail in following sections.

2.5.1 Lane width

A critical relationship exists between the width of an approach to a signalized intersection and the saturation flow attainable, and, therefore, the headways between vehicles, on that approach.

Although various road research authorities would agree with the preceding statement, there are differences in the way that the relationship between approach width and saturation flow is developed.

Generally, the Americans and British feel that the width of the approach that is available to traffic is the critical factor in determining intersection capacity. The Canadian and Australian methods for determining approach capacity, however, are based on the number of lanes on an approach and the lane width.

The American Highway Capacity Manual, 1965, states that, "the width of the approach, rather than the number of traffic lanes, has proved to have the most significant bearing on the capacity of a typical approach."[20]

The 1985 edition of the Highway Capacity Manual states that, "lane and shoulder widths can have a significant impact on traffic flow. Narrow lanes cause vehicles to travel closer to each other laterally than most drivers would prefer. Motorists compensate by slowing down or by observing larger longitudinal spacing for a given speed. This effectively reduces capacity and/or service flow rates."[21]

Research conducted by the British Road Research Laboratory has led that organization to conclude that there is a linear relationship between the saturation flow on an approach and the width of that approach. "Observations of traffic flow made by the Road Research Laboratory at intersections in the London area and also in some of the larger cities, supplemented by controlled experiments at the laboratory test track, have shown that the saturation flow, S, expressed in passenger car units per hour with no parked vehicles is given by

$$S = 525\ W \quad \text{pcu/h} \qquad \text{Equation 1}$$

where W is the width of the approach in metres.".[22]

The Australians counter with the following comment from A.J. Miller, who wrote the section of the Australian Road Capacity Guide dealing with signalized intersections,"the capacity of an intersection approach is closely related to the number of lanes....."[23]

The <u>Canadian Capacity Guide for Signalized Intersections</u> agrees stating that, "Saturation flow is directly affected by lane width,..."[24]

The Institute of Transportation Engineers does not initially appear to favour either side, stating at one point in their Transportation and Traffic Engineering Handbook that,"The width available for approach traffic is critical to intersection capacity; it may be considered either by lane and lane width or as a total approach width."[25] Yet at another place, the Institute's Handbook seems to favour the Australian methodology saying, "If, however, all parameters of level of service are considered, including driving comfort, it seems appropriate to consider lane width and configuration as factors [affecting capacity of an approach to a signalized intersection]."[26]

An examination of the signalized intersection capacity charts of the Highway Capacity Manual (1965) led Y.B. Chang and D.S.Berry to conclude that, "the Australian approach of analyzing intersection capacity by studying characteristics of flow by lane seems to have advantages [over the American method]."[27]

Intuitively, the Australian approach would seem the more logical. According to the 1965 Highway Capacity Manual capacity charts, a twenty metre wide approach to a signalized intersection would have the same capacity if it was delineated for four, five or six lanes. This would not appear to be a realistic expectation.

In fact, the 1985 Highway Capacity Manual recognizes the 12 foot (3.65m) lane width as the ideal condition. Narrower lane widths are penalized and wider lane widths up to 16 feet are rewarded. For lane widths greater than 16 feet the 1985 Highway Capacity Manual suggests using two lanes.[28]

However, if lane width is the correct parameter to consider when considering the capacity of an approach to a signalized intersection, it remains to determine what effect, if any, lane width has on headways.

It would seem that wider lanes would allow for greater saturation flows and, therefore, smaller headways on an approach because of reduced lateral friction. Indeed, Chang and Berry state that, "the saturation flow of a lane should increase as its width increases because of easier maneuverability of vehicles, more com rtable feeling on the part of drivers, etc."[29]

But research by Helm and Miller indicates that lane width has little impact on the capacity of an approach to a signalized intersection.

Helm notes that, "neither the range of gradients encountered nor the width of lane available to through traffic had a significant effect on any of the ... results."[30]

Miller agrees stating that, "...the width of these [approach] lanes has comparatively little effect [on capacity] over a range of approximately ten to thirteen feet."[31]

However, the Institute of Transportation Engineers does not agree that lane width is unimportant in its effect on capacity saying, "narrow lanes and intermittent hazardous obstructions near the edge of the roadway increase driver tension and frequently cause drivers to select larger than normal headways and/or lower speeds."[32]

Because of the uncertainty of researchers as to whether or not lane width has any effect on approach capacity it was decided to include it as one of the parameters for consideration when examining candidate intersection approaches for possible inclusion in the data collection phase of the experiment.

2.5.2 Turning movements

The effect that vehicles completing, or attempting to complete, turning maneuvers have on the rate of saturation flow at signalized intersections has been heavily researched and well documented.

Although researchers do not agree on the degree, there is consensus that turning vehicles,particularly vehicles that cross the path of opposing traffic, (left-turners in the North American convention, right-turners in British convention) have an impact on the saturation flows that can be attained on approaches to signalized intersections, especially when these vehicles are combined with vehicles travelling straight through the intersection and are not accommodated by a separate holding lane.

R.J.Salter in his text, Highway Capacity Analysis and Design, makes the following statement regarding the effects that vehicles turning across opposing traffic have when those vehicles are combined with straight-through traffic. Note that when Salter refers to right-turning vehicles he is in fact referring to vehicles turning across the oncoming traffic stream because of the British convention of driving on the left side of the roadway.

"When right-turning vehicles are mixed with straight - ahead and left-turning vehicles on the same approach then they have three effects on the traffic flow.

(a) Because they are delayed from turning right by other vehicles in the traffic stream, they delay straight-ahead vehicles that may be following them.

(b) The presence of right-turning vehicles in a particular lane tends to inhibit the use of this lane by straight-ahead vehicles.

(c) Those right-turning vehicles that remain in the intersection after the expiry of the green period delay the start of the next phase until they have completed their right-turning movement."[33]

Archer, Hall and Eilon also agree that turning vehicles have an effect on saturation flow. They approached the problem by developing a ratio of left-turning, right-turning and straight through vehicles under saturated flow. Again the British convention applies. "Hence, there is a strong indication that a .... relationship exists between left--turning, right-turning and straight ahead vehicles in saturated flow conditions; the ratio being 1.25 : 1.75

: 1.00."[34]

Pretty reached a similar conclusion as a result of his research stating that turning vehicles do effect the rate of saturation flow that can be reached on an approach to a signalized intersection. Again the reference is to the British convention. "Both ... show, however, that saturation flow is reduced by the presence of right-turning vehicles..."[35]

Research that has been conducted in the United States agrees with the results that have been obtained in Britain.

The Highway Capacity Manual, 1965, states,"Intersection approach capacity, like the capacity of other highway elements, is influenced by the inherent characteristics of the traffic being accommodated. These characteristics include the amount of turning traffic."[36]

The 1985 Highway Capacity Manual notes, "the impact of turns on saturation flow rates is very much dependent on the mode of turning operations".[37] The mode of turning operations refers to whether turns operate out of exclusive or shared lanes.

The Institute of Transportation Engineers also notes that vehicles turning across opposing traffic have a deleterious impact on the movement of through traffic on an intersection approach. "Major contributors to traffic delays are, as previously noted, left-turn and, to a lesser extent, right-turn movements....Higher service volumes can be accommodated if these movements are removed from the main through lanes by channelization or lane assignment."[38]

The Institute of Transportation Engineers also state that, "Left-turning vehicles not provided with a separate lane or phase must await gaps in the approaching traffic and thus create delays to themselves and to following vehicles in the same lane."[39]

Research that has been conducted into what happens at a signalized intersection when left turns are restricted is not conclusive. Bartle, Skoro and Gerlough found that saturation flow increased somewhat when vehicles wishing to turn across oncoming traffic were prevented from so doing. They state that, "...one intersection was studied at which left turns were prohibited, and the data, though inconclusive, indicate that time spacing was thus reduced."[40]

Work by both British and American researchers indicates that the impact of turning vehicles is more pronounced when successive vehicles in the traffic stream attempt a turning manoeuvre, or when the turning vehicle is a large vehicle lacking the acceleration capabilities of a passenger car.

Helm, as a result of his research, notes that,"In contrast with an observed twenty to thirty per cent increase in the time interval between successive vehicles turning freely from a stream through large acute angles, one such vehicle in isolation had no significant effect on the rate of discharge... Heavy vehicles turning through ninety degrees occupied approximately twenty-five per cent more time interval than if proceeding straight through the junction."[41]

Researchers generally agree that right turning vehicles do not have as severe an impact on the movement of through traffic as that produced by left turners, chiefly because a driver wishing to turn right does not have to wait for an acceptable gap in the oncoming traffic stream to complete his manoeuvre. The rate at which vehicles turn right at a signalized intersection is, generally governed by the curb radius and by the presence of pedestrians who may be crossing the street into which the vehicle is turning.

The Highway Capacity Manual, 1965, notes that, "Right turns also influence intersection capacity in varying degrees, depending on conditions at the intersection."[42]

The Institute of Transportation Engineers agrees stating that, "Right-turning vehicles have some effect on intersection capacity because, typically, a short-radius turn requires slowing considerably below through traffic speeds."[43]

Bartle, Skoro and Gerlough also agree, concluding in their work that, "...the extent of right turning movements may be [an] important factor in determining starting delay."[44]

As a result of this evidence that turning vehicles have a pronounced effect on the behaviour of traffic on an approach to a signalized intersection, it was decided that the presence, or absence, of turning traffic would be one of the factors considered when selecting intersection approaches upon which to collect data for this experiment.

2.5.3. Presence of pedestrians

The presence of pedestrians at a signalized intersection has a definite effect on the behaviour of drivers attempting to pass through that intersection.

If pedestrians crossing an approach are slow in clearing the crosswalk the effect on the flow of traffic is immediate and obvious. However, research by Greenshields, Shapiro and Erickson indicates that even after pedestrians have cleared the approach their presence may continue to affect drivers.

Greenshields, Shapiro and Erickson concluded that, "even after the pedestrians had moved out of the way for the first car, their nearness seemed to have an effect on the reaction time of succeeding drivers. This phenomenon held throughout the observations."[45]

Bartle, Skoro and Gerlough agree with this observation. As a result of their research they concluded that the volume of pedestrian cross traffic may be an important factor in determining the starting delay of vehicles entering signalized intersections.[46]

The 1985 Highway Capacity Manual notes that, "pedestrian flows [...] will interfere with permitted right-turn and left-turn movements."[47]

Because of these indications that the presence of pedestrians on approaches to signalized intersections may have an effect on how drivers behave, it was decided that the presence of pedestrians would be a factor considered when selecting candidate intersection approaches for collection of data.

2.5.4 Condition of the driving surface

Roadways with deteriorated driving surfaces generally operate at lower levels of service than roadways with well maintained pavements.

The Highway Capacity Manual notes that, "A deteriorated, poorly-maintained pavement adversely affects level of service, particularly in terms of speed, comfort, economy and safety..."[48]

If the approach to a signalized intersection and/or the section of street into which that approach empties, have driving surfaces of poor quality, vehicle operators may tend to accelerate from the traffic signal less quickly than normal in an effort, in the extreme case, to lessen the possibility of damage to their vehicles, and, in the routine case, to lessen discomfort to themselves and their passengers.

This potential reduction of the rate of acceleration translates into fewer vehicles negotiating the intersection during any given green period resulting in a lower rate of saturation flow.

To avoid the possibility of such an effect occurring in this study the driving surfaces of approaches considered for inclusion in this study were inspected to ensure that their condition had no effect on the headways of vehicles travelling on them.

2.5.5 Traffic operations

The manner in which traffic operates on an approach to a signalized intersection has an obvious effect on the capacity of that approach.

Among the operational factors that impact on intersection approach capacity are the type of operation on the approach, one-way or two-way, the presence and location of bus stops on the approach, and the parking conditions on the approach.

The first two factors are discussed in this section. The effect of parking on capacity and headways is discussed separately in Section 2.5.7.

It is agreed by traffic engineers that approaches to signalized intersections on one-way streets usually operate more efficiently than approaches on two-way streets.

The Institute of Transportation Engineers notes that, "Intersection conflicts and delays are a principal cause of congestion and reduced travel time on two-way urban streets."[49]

The Institute's Handbook continues, stating that, "One-way operation is generally more efficient than two-way operation for a given street width. Based primarily on data for signalized intersection approaches, it would appear that the advantage of one-way operation is of the magnitude of ten percent to twenty percent."[50]

The increase in capacity of intersection approaches on one-way streets over that attained on two-way streets is attributed (1) to elimination of friction with oncoming traffic and (2) to the elimination of conflicts between left-turning vehicles and oncoming traffic.

This is consistent with what the Institute of Transportation Engineers says when it notes that, "The principal benefit of one-way operation is to permit left turns (right turns in England and Australia) to be made without interference from opposing traffic."[51]

The Association of American State Highway and Transportation Officials agrees noting that, "One of the advantages of one-way streets is that, "traffic capacity in most cases is increased as a result of reduced medial and intersectional conflicts and more efficient operation of traffic control devices."[52]

The Highway Capacity Manual(1965) treats the type of operation on an intersection approach as one of the basic conditions under which other factors that influence the capacity of signalized intersections are evaluated. The Highway Capacity Manual(1965) handles separately the capacity analysis procedures for one-way and two-way approaches.

The presence and location of a bus stop on an approach to a signalized intersection also has an impact on the capacity that can be obtained on that approach. This is particularly true where there is no provision made to remove the bus from the travel lane during its stop.

Interestingly, the British and Australian capacity analysis procedures do not consider the effect of bus stops on the capacity of signalized intersections. The American Highway Capacity Manual(1965), however, includes a series of nomographs that are used to develop correction factors that give consideration to both the presence and location of bus stops.[53]

The 1985 Highway Capacity Manual uses the number of buses that stop per hour on an approach as a capacity consideration. "The bus blockage factor, f_{bb}, accounts for the impacts of local transit buses stopping to discharge or pick up passengers at a near-side or far-side bus stop."[54]

Generally, far-side bus stops have less impact on the capacity of an intersection than near-side stops, especially when right turns from the street under consideration are heavy. A far-side stop moves the bus out of the curb lane where these right turners would be.[55]

To eliminate the effects that traffic operations may have on intersection approach capacity, the factors discussed above were duly considered when various intersection approaches were examined for selection as approaches upon which data was collected.

2.5.6 Weather conditions

Weather conditions can seriously affect the operation of motor vehicles on approaches to signalized intersections.

At the extreme, blowing snow and blizzard conditions can greatly reduce intersection capacity while dramatically increasing vehicle headways. Icy conditions or heavy rainfall can produce similar results.

Research that has been conducted on the effect of less extreme weather conditions on vehicle headways and saturation flow is not conclusive, although most of the literature researched in the course of this experiment indicates that weather does significantly affect the behaviour of drivers.

As the Institute of Transportation Engineers state in their handbook, "When a driver's visibility is restricted by darkness or inclement weather, his choice of speed and headway can be expected to be affected."[56]

This statement is supported by the work of Berry and Ghandi, and by that of Helm.

As a result of their research, Berry and Ghandi concluded that, "The null hypothesis [that the mean headways for each set of adverse weather and visibility conditions were the same as for dry-daylight conditions] had to be rejected for all significance levels above one percent in both cases, indicating that adverse weather significantly increased headways."[57]

This result is as might intuitively be expected and supports Helm's observation based on his own limited data that, "Although rain was encountered during only seven out of more than three hundred hours of field work, the results obtained during these hours suggested that the behaviour of vehicles was significantly affected by the weather."[58]

Research has also been conducted in Canada into the effect of weather on saturation flow.

Teply at the University of Alberta has studied this phenomenon on a macroscopic scale and has found that, "There are significant differences in saturation flow rates caused by weather fluctuations typical for long lasting seasonal conditions in a given geographic region."[59]

This finding is included in the Canadian Capacity Guide for Signalized Intersections which notes that, "typical 'winter' saturation flows are significantly lower than 'summer' saturation flows for identical geometric and traffic conditions."[60]

However, some researchers, notably Miller in Australia, have concluded that weather does not significantly affect saturation flow. Miller studied the effect of three classes of weather (rain, overcast and fine) on the rate of saturation flow at signalized intersections and concluded that there was no significant difference between classes.[61]

These findings interestingly enough,are also supported by the Canadian Capacity Guide for Signalized Intersections which states that.".....minor weather changes have been found to have no significant impact on saturation flow in Canada, and can be ignored for all practical purposes."[62]

Nevertheless, it was decided that the effect of weather on headways would be investigated during the course of the experiment.

2.5.7 Parking conditions

Parking conditions on an approach to a signalized intersection have a definite effect on the capacity of that approach. As noted in the Institute of Transportation Engineers handbook, "Parked vehicles in the vicinity of a signalized intersection reduce the space available for traffic movement and thus the carrying capacity of the intersection."[63]

The Canadian Capacity Guide for Signalized Intersections agrees stating, "In addition to the obvious geometric effect of on-street parking, there is a "frictional" component introduced by parking and leaving manoeuvres, car door openings and the generally cautious behaviour of drivers as they proceed along the lane adjacent to the parked vehicles."[64]

The Canadian, British, Australian and American methods of calculating intersection approach capacity all consider the effect of parked vehicles on capacity.

The Canadian manual regards site observations as "essential" if the effect of parking is to be accurately determined.[65]

In the British system, the effect of a parked vehicle is considered as a reduction in the available approach width which, as has been noted in Section 2.5.1 is considered in the British method of determining intersection capacity as being directly proportional to saturation flow.

In the Australian system of calculating intersection approach capacity, which considers capacity by lane, the capacity of a curb lane is adjusted depending on the parking conditions that exist on that curb lane.

In the 1965 Highway Capacity Manual method, the effect of parking is accounted for by a series of basic curves for various conditions.[66]

As the Highway Capacity Manual(1965) notes, "...because parking conditions at or near an approach have such a pronounced effect on intersection capacity, the presence or absence of parking is considered to be a basic condition which should be defined initially before other factors are evaluated. The removal of parking provides a substantial gain in capacity."[67]

The 1985 Highway Capacity Manual recognizes the effect of parking on the capacity of intersection approaches by incorporating into its methodology the use of factors reflecting the number of parking maneuvers per hour.[68]

These conclusions are supported by research conducted by Bartle, Skoro and Gerlough who noted that, "Examination of the data indicates that the two factors having the greatest effect on time spacing "S" [headway] for the intersection approaches studied are (1) street width and (2) parking conditions."[69]

In light of the foregoing, parking conditions at intersection approaches being considered for study were taken into consideration during the intersection selection process.

2.5.8 Intersection Locations

It has been suggested that the location of a signalized intersection within a city and the size or population of that city both affect intersection approach capacity. However, not all researchers agree with both concepts.

While many agree that intersection location within a city can effect the rate of saturation flow and, hence, the capacity of an intersection, fewer support the idea of a correlation between the population of a city and the capacity of signalized intersections in that city.

The supporters of the first concept, that intersection location within a city influences approach capacity, argue that because of differing land uses and intensities of development, various parts of the same city can produce different intersection approach capacities, all factors other than location being constant.

The Highway Capacity Manual(1965) notes that, "For two-way streets, both with and without parking, approach capacities are about twenty-five percent higher in all other areas than in the Central Business District."[70]

In the 1985 edition of the Highway Capacity Manual, intersection location in a non-CBD area is considered an ideal condition.[71]

The Institute of Transportation Engineers agrees, stating that, "...the functional capacity and service volume of two physically identical intersections can be markedly different depending on these influences [from adjacent development] which are difficult to predict or quantify."[72]

These results are supported by the conclusions reached by Bartle, Skoro and Gerlough who studied the influence of intersection location on mean starting delay and concluded that the effect of location is significant at the 0.5% level."[73]

With regards to the second concept, that the size of a city affects the capacity of approaches to signalized intersections, there is disagreement among researchers.

The Highway Capacity Manual(1965) notes that, "One important finding from the analysis of the submitted intersection data was strong indication that approaches in any particular type of area within large metropolitan areas had higher capacities than those of similar geometrics located in equivalent areas of smaller cities."[74]

However, research conducted by Miller in relation to the ..stralian Road Capacity Guide led him to conclude that there is no correlation between capacity and city population.[75]

Regardless of which stand is correct, the effect, if any, of city population on approach capacity is not a factor of concern relative to this experiment since all observations were made on approaches located in the same city.

The first concept, however, that the location of a signalized intersection within a city affects approach capacity, will have to be considered when selecting intersections at which to collect data.

2.5.9 Vehicle size

There is no doubt that vehicle size has an impact on the headways of vehicles queued at a signalized intersection. This fact is the basis for the concept of equivalent passenger car units discussed in a later section.

The discussion in this section is limited to the effect that passenger cars of differing sizes might have on intersection capacity.

Much research has been conducted on the behaviour in traffic of cars smaller than the standard-sized car. This proliferation of research is a result of the increasing numbers of small cars on the road today.

Generally, the majority of researchers have concluded that the presence of small cars in the traffic stream at a signalized intersection can significantly increase the capacity of that intersection.

Evans and Rothery concluded as a result of their research at the General Motors Research Laboratories in Warren, Michigan, that, "Smaller cars give higher intersection saturation flow."[76] They continued stating, "The data...show that headway increases with vehicle size so that [saturation] flow, which is the reciprocal of headway, decreases with vehicle size."[77]

Evans and Rothery also offered a possible explanation for the higher saturation flow rates achieved at intersection approaches when small cars were present, noting that, "The magnitudes of the car-size effects [...] are larger than would result solely from physical differences in car size, suggesting that the small cars are driven differently."[78]

These conclusions are consistent with other work performed by the same researchers where they noted that, "Rear bumper to front bumper spacing for the small cars was found to be statistically smaller than for the standard sized cars at the one percent level."[79]

This latter work does not apply directly to the behaviour of small cars at signalized intersections; it relates to vehicle spacing in uninterrupted flow conditions, but it does indicate a general trend that small cars operate at smaller than normal headways, with "normal" being that maintained by drivers of standard-sized cars.

Research conducted in Canada by Steuart and Shin at signalized intersections in Toronto supports the conclusions reached by Evans and Rothery.

As a result of their research Steuart and Shin concluded that, "Measurements of headways between vehicles being discharged from a queue at signalized urban intersections show vehicle size to have an effect on headways during saturation flow."[80]

They found that the difference in headways due to vehicle size was such that saturation flow was increased. "The significant difference between average headways for a pair of small cars and a pair of full-sized cars for early vehicles in the queue suggests that capacity improvements are possible with small vehicles."[81]

Of interest in the work of Steuart and Shin was a comparison of the average vehicle size for different countries with the signalized intersection capacity predicted by those countries' capacity analysis methods. "In particular, as the average length of passenger cars increases (12.5 feet in Japan, 13 feet in the United Kingdom, 15 feet in Australia, 17.5 feet in the United States), the capacity procedures show a reduction in signalized intersection capacity."[82]

This is an interesting phenomenon that indicates the possible root cause for the variation in the different national capacity prediction models.

Steuart and Shin also attempted to quantify the effect that small cars have on intersection capacity, noting that, "...it is estimated that the capacity of a signalized intersection is increased by up to fifteen percent for a stream of small cars over a stream of full-sized cars."[83]

Other researchers have refuted the claim that smaller than standard-sized cars can yield higher saturation flow rates.

As a result of their work, Herman, Lam and Rothery reported that small cars could have an impact on urban traffic flow but that that impact was not significant. "The platoon experiments reported here...indicate that small cars could influence the characteristics of urban traffic. However, the effects that can be directly attributed to vehicle length are small."[84]

Forbes and Wagner noted that, "...no consistent increase or decrease of traffic headways or of highway capacity is to be expected from inclusion of small and compact vehicles in the traffic stream."[85]

Whitby agrees with this conclusion stating, "There appears to be no great difference in speed or consistent trend toward a higher or lower speed for compact or foreign cars as compared to standard American passenger cars at any of the locations."[86]

Regardless of which conclusion is correct, the possible effect that vehicle size may have on vehicle spacing will have to be considered in some manner during the intersection selection process.

Notable is the work of King and Wilkinson in a study conducted as part of the National Co-operative Highway Research Program. The main emphasize of their work was to determine how the number, size and location of traffic signal heads affected the headways of discharging vehicles at signalized intersections.

King and Wilkinson analyzed four major classes of signal configurations (all post-mounted, single overhead, multiple overhead and mixed) and two lens sizes (200mm and 300mm). They concluded that, "...except for lens size, no class of configurations can be considered better than any other class for any queue position."[90]

This result supports the stand taken by District 7 (Canada) of the Institute of Transportation Engineers that, "general phenomena such as signal head location.... have been found to have no significant impact on saturation flow in Canada, and can be ignored for practical purposes."[91]

Other researchers have noted that traffic signal configuration and signal head visibility may influence driver response at signalized intersections.

Bartle, Skoro and Gerlough examined several intersection characteristics in an attempt to identify factors that had an effect on starting delay of vehicles at signalized intersections. They concluded that, "Examination of the data indicates that starting delay is independent of ... the type of signal installation at the intersection. The visibility

2.5.10 Visibility of the traffic signal

In order for a signalized intersection to operate efficiently one of the many factors that has to be considered by the designer is the visibility of the traffic signal indications.

The Association of American State Highway and Transportation Officials notes that, "A basic requirement for all controlled intersections is that drivers must be able to see the control device soon enough to perform the action it indicates."[87]

The Institute of Transportation Engineers agrees stating that, "Traffic signals must always be easily seen and readily recognized by the road user and their meaning must be clearly understood."[88]

To prevent confusion and, hence, unsafe conditions from developing at signalized intersections, road authorities in many jurisdictions adopt a standard of design such as the Manual of Uniform Traffic Control Devices for Canada which details guidelines for traffic signal installations.

As is noted by the Institute of Transportation Engineers in their handbook, "Greatest observance is achieved by uniformity in the application and appearance of traffic signals..."[89]

There has been some research conducted into the effect of traffic signal design upon discharge headways on approaches to signalized intersections.

of the signal faces may be a factor, but this could not be evaluated from these data."[92]

Therefore, as it has been shown that signal lens size does affect vehicle performance at signalized intersections and that the visibility of signal faces may also have an effect, these factors will require due consideration when candidate approaches are considered for data collection.

?.5.11 Approach gradient

The effect of gradient on the acceleration abilities of vehicles is universally recognized.

Many road authorities recommend the use of factors or ratios to adjust the behaviour of vehicles on non-level terrain so that it approximates the behaviour of vehicles on level terrain.

The Canadian Capacity Guide for Signalized Intersections recommends that, "the saturation flow for each lane should be adjusted +1% for every 1% slope downhill, and -1% for every 1% gradient uphill..."[93]

The Association of American State Highway and Transportation Officials uses the ratios contained in Table 1 to compensate for the effect of gradient on vehicle operating characteristics.[94]

A similar table is contained in the Manual of Geometric Design Standards for Canadian Roads produced by the Roads and Transportation Association of Canada and reproduced here as

Table 1 Effect of grade on accelerating time at signalized intersections

Design vehicle	crossroad grade (percent)				
	−4	**−2**	**0**	**+2**	**+4**
P	0.7	0.9	1.0	1.1	1.3
SU	0.8	0.9	1.0	1.1	1.3
WB-50	0.8	0.9	1.0	1.2	1.7

Table 2.[95]

The result is, as would intuitively be expected, that negative grades tend to aid the accelerating abilities of vehicles while positive grades tend to make acceleration more difficult.

However, results of experiments conducted to determine the effect of gradient on the saturation flow of traffic at signalized intersections are not entirely supportive of that conclusion.

Research performed by A.C.Dick in Great Britain led him to conclude that gradient does affect the saturation flow rate that can be attained on an approach to a signalized intersection. "The results show that an increase of one percent in gradient (in the range of gradient of -5.2 percent to +8.1 percent) produces a decrease of three percent in the saturation flow."[96]

These results have been widely quoted by others, including Salter and the Institute of Transportation Engineers. However, research conducted by Helm, also in Great Britain, resulted in his conclusion that, "Neither the range of gradients encountered nor the width of lane available to through traffic had a significant effect on any of the ...results."[97]

This is an interesting result as it appears to contradict the effect that would be expected. Even more interesting are the results of research performed by R.A.Conley in the United

Table 2 Adjustment of length of speed change lanes for grade

direction	grade	ratio of length on grade to length on level
up	5%	0.8
up	3% to 5%	0.9
up & down	3%	1.0
down	3% to 5%	1.2
down	5%	1.4

States.

Conley studied the time spacing between vehicles entering signalized intersections from approaches having gradients ranging from +9 percent to -14 percent. He concluded that both positive and negative approach grades tended to increase slightly the capacity of an intersection.[98]

From his results Conley concluded that a negative grade on an approach resulted in increased capacity of that approach. This conclusion is in accordance with the anticipated result that downgrades aid acceleration.

But Conley's research also led him to conclude that a positive grade on an approach to a signalized intersection results in an increase in capacity above that of a level approach. A graph of Conley's results is included as Figure 2. Conley rationalized this result by hypothesizing that drivers of vehicles on positive approaches are more alert to the change of the traffic signal to green, and tend, consciously or subconsciously, to compensate for the effect of grade on their vehicle's performance.[99]

From the preceding discussion it is apparent that, although physical laws dictate that negative approach grades aid vehicle acceleration capabilities and positive approach grades detract from those capabilities, the behaviour of vehicle drivers on approaches to signalized intersections may, in effect, act to counteract those physical laws.

It is the intent of this research to investigate, among

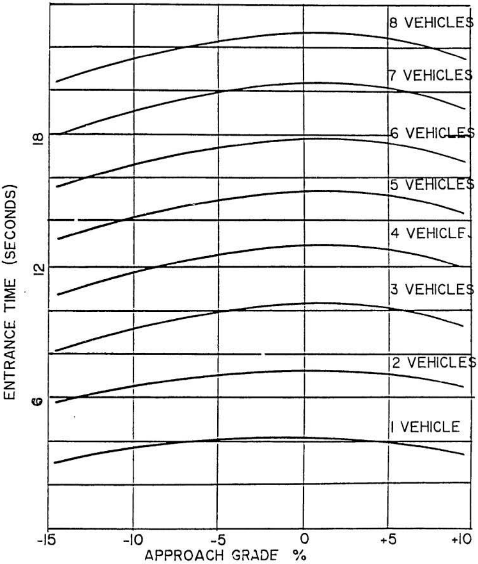

Figure 2 Results of Conley's experiment: Time for a Given Number of vehicles to enter Intersection

other factors, the effect of approach gradient on the behaviour of drivers at signalized intersections in the City of St. John's.

2.5.12 Queue position

As has been noted, several researchers have stated that headways of vehicles in early queue positions are generally larger than those of other vehicles. These larger headways have been attributed to a phenomenon called starting delay, which as its name implies, is the delay queue leaders experience in reacting to a signal change.

Evans and Rothery noted that headways in the first three queue positions were larger than those for other queue positions.[100]

Greenshields, in his classic work on traffic, Traffic Performance at Urban Street Intersections, found a levelling off trend in headways after the first five queue positions.[101]

And, Ancker, Gafarian and Gray noted that vehicle discharge headways decrease to queue position 7 but are not statistically significantly different from position 7 onward.[102]

This research by others indicated that discharge headway and queue position were related. Accordingly, the position of a vehicle in the queue had to be given consideration in this experiment as a factor that might influence discharge headways.

2.5.13 Additional factors

There are additional factors other than those discussed above which may also influence the operation of vehicles on approaches to signalized intersections. Several of these factors are discussed briefly in this section.

The speed limit posted on a street may have an effect on the behaviour of drivers leaving signalized intersections along that street. Drivers leaving intersections on high speed facilities may tend to accelerate more rapidly than drivers on streets having lower speed limits. Alternatively, drivers on the high speed street may simply maintain for a longer period the same rate of acceleration maintained by drivers on the street with the low speed limit. Because the rate of acceleration may impact on the departing vehicles' spacing, the speed limit on the approaches to signalized intersections that are candidates for observation will have to be given consideration as a factor that may influence headways.

Traffic interference, generally from downstream traffic, can also impact on the headways of vehicles leaving signalized intersections.

As noted by Ancker, Gafarian and Gray in a paper which was presented at the Thirty-First National Meeting of the Operations Research Society of America, "If a downstream bottleneck has caused vehicles to back up to the intersection of interest, the behaviour of the vehicle-driver combination undoubtedly differs considerably from behaviour when there is no downstream bottleneck."[103]

Accordingly, care will have to be taken when selecting the study intersections to ensure that they are spaced at an adequate distance from downstream intersections to prevent such interference from occurring.

The time of day may also have an influence on the behaviour of drivers at signalized intersections. Vehicles in peak traffic conditions may exhibit different headway characteristics than vehicles in off-peak conditions, although research by Teply does not support this assumption. He noted that, "Although some locations and some intervals indicate slightly lower values of saturation flow for off-peak conditions, this conclusion cannot be applied generally since the magnitudes lack the necessary stability."[104]

The Highway Capacity Manual(1965) does indirectly consider the time of day when computing the capacity of an approach to a signalized intersection through the use of peak hour factors.

However, the reality of the situation locally is that there are few saturated cycles experienced at times other than peak periods. Nevertheless, the time of day, peak versus off-peak, will be considered during the data collection phase of the experiment.

The classification of a particular street is another factor which may influence vehicular headways on approaches to signalized intersections on that street.

As a rule, traffic signals are not generally installed at intersections of local streets. But intersections of collector streets with arterial streets, and arterial streets with other arterial streets are prime candidates for signalization.

Because there is a basic difference in the degree of access to adjoining lands under these two classifications, traffic on a collector street might be subject to more friction from adjacent development than would traffic on an arterial street.

This friction may affect drivers to the extent that headways may be affected. Therefore, the classification of the streets being considered for data collection will also be considered during the intersection selection process.

2.6 Conclusion

In the preceding sections of this chapter many of the factors that have been proven to have an effect on vehicle headways on approaches to signalized intersections, and many of the factors which have been hypothesized to influence those vehicle headways, have been discussed.

The next phase of the experiment is to identify, for data collection, intersection approaches that have all these many factors, other than the factors of interest,neutralized or negated in some manner.

CHAPTER THREE

3.0 SELECTION OF STUDY INTERSECTIONS

3.1 Introduction

There were sixty-nine signalized intersections in the City of St. John's at the time this experiment was conducted. The locations of these intersections are shown in Figure 3.

Although much progress has been made by the City in recent years in an effort to standardize the application of traffic signals and their installation, there still exists a wide range of signalized intersection configurations in the City. Few intersections treat the factors discussed in Chapter Two and listed in Table 3 in exactly the same manner.

This Chapter outlines the methodology used to select intersection approaches as candidates for data collection. The Chapter contains a discussion of the levels that were assigned to each of the various factors that affect vehicle discharge headways at signalized intersections.

Each of the 240 intersection approaches in the City was considered during the analysis stage. The level of each factor was recorded for each candidate approach. The resulting database was analyzed in an attempt to produce a grouping of intersection approaches having the same levels for the various factors. This homogeneous grouping was then used for data collection.

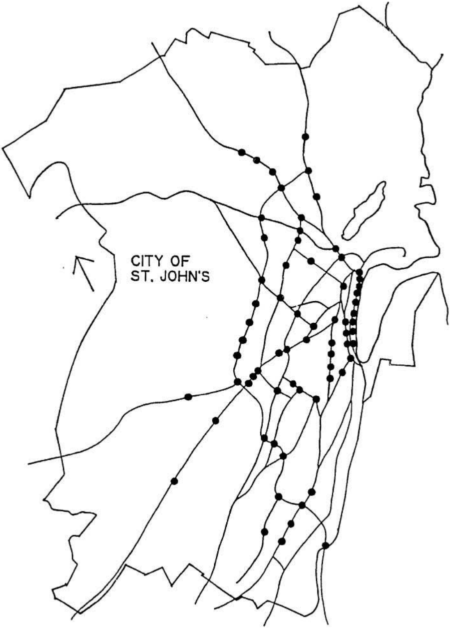

Figure 3 Location of signalized intersections in the City of St. John's

Table 3 Factors influencing traffic operations at signalized intersections

1. lane width
2. turning movements
3. presence of pedestrians
4. condition of the driving surface
5. traffic operations
6. weather conditions
7. parking conditions
8. intersection location
9. vehicle size
10. visibility of the traffic signal
11. approach gradient
12. queue position
13. speed limit
14. traffic interference
15. cycle length
16. time of day
17. street classification

3.2 Discussion of levels assigned to the various intersection approach factors

To enable each intersection approach to be evaluated on the basis of the factors listed in Table 3, levels had to be assigned to each factor to allow approaches having the same levels of the various factors to be identified.

The levels that were assigned to each factor are shown in Table 4 and are discussed -iefly in the following sections. Some of the levels are qualitative, somr are descriptive and some are quantitative.

3.2.1 Lane width

The levels that were assigned to the lane width factor are:

(1) adequate -indicating that the lane width is at least 3.0m, and

(2) inadequate - indicating that the lane width is less than 3.0m.

The 3.0m value for lane width was selected as the dividing criteria based on research conducted by Miller in Australia where he found, "...the width of these lanes [approach lanes to signalized intersections] has comparatively little effect [on capacity] over a range of approximately 10 to 13 feet."[105]

Table 4 Levels assigned to factors influencing traffic operations at signalized intersections

factor	levels			
1. lane width	adequate	inadequate		
2. turning movements	yes	no		
3. presence of pedestrians	major	minor		
4. condition of the driving surface	good	poor		
5. traffic operations	one-way	two-way		
6. weather conditions	fair	poor		
7. parking conditions	yes	no		
8. intersection location	CBD	RC	OCD	SRA
9. vehicle size	n/a			
10. visibility of the traffic signal	good	poor		
11. approach gradient	unsuit.	suitable		
12. queue position	1 through 12			
13. speed limit	30	50	60	70
14. traffic interference	yes	no		
15. cycle length	50	to		100
16. time of day	n/a			
17. street classification	local	collector	arterial	

3.2.2 Turning movements

The levels that were assigned to the turning movement factor are:

(1) yes - indicating that separate auxiliary lanes for left and right turning traffic have been provided on the approach to the signalized intersection, and

(2) no - indicating that such separate auxiliary lanes have not been provided and that through traffic on the approach under consideration has been combined with left turning traffic and/or right turning traffic.

3.2.3 Presence of pedestrians

The levels that were assigned to the pedestrian factor are:

(1) major - indicating that there were more than five pedestrians per cycle crossing the approach being considered, and

(2) minor - indicating that there were five pedestrians or less per cycle.

It must be recognized that the selection of five pedestrians as the border between a minor and a major pedestrian presence is arbitrary. However, it would not be unreasonable to assume that five pedestrians per cycle would not have a great impact on the operation of motor vehicles on an approach to a signalized intersection.

Information on the volumes of pedestrians at intersection approaches was gathered from data made available through the City of St. John's Engineering Depar. ent's traffic count program. Where information on a specific approach was not available from this program the author's judgement was used to decide which level should apply, based on such parameters as land use zoning in the area and the proximity of high volume pedestrian generators such as schools or neighbourhood malls.

As a check, during the data collection phase, observations were made on the numbers of pedestrians on the study approaches to ensure that the level of this factor that had been assigned during the selection process was in fact accurate. For all study approaches such was the case.

3.2.4 Condition of the driving surface

The levels that were assigned to the driving surface condition factor are:

(1) good -indicating a City of St. John's Engineering Department pavement condition rating of less than 150, and

(2) poor -indicating a pavement condition rating of more than 150.

The City of St. John's Engineering Department assigns a pavement condition rating to its streets as part of its pavement management system. Surface distress factors such as cracking, rutting and ravelling are recorded, along with various other data, for each street in the City. The rating numbers used to describe pavement surface condition range from 20 to 600 representing excellent and poor pavement conditions respectively. For the purposes of this experiment, after discussion with City staff, it was decided that the surface condition rating value of 150 be used as the breakpoint between good and poor driving surfaces. Generally, streets that have rating values higher than 150 are considered by City staff to be in poor condition and are candidates for resurfacing or other remedial measures.

3.2.5 Traffic operations

Based on the discussion in Section 2.5.5 the levels that have been assigned to this factor are:

(1) one-way operation, and

(2) two-way operation.

3.2.6 Weather conditions

The weather conditions on an approach to a signalized intersection are not an attribute of that intersection. The state of the weather is more a factor of when data was recorded than where it was recorded.

For this experiment, weather conditions were divided into "fair" and "poor" weather categories. Weather conditions were termed "poor" if there was sufficient precipitation to cause windshield wipers to be operating. Conditions fell into the "fair" category if vehicles did not have their wipers turned on.

Teply of the University of Alberta has examined the effect that weather conditions have on the rate of saturation flow at signalized intersections but he was more concerned with the effect of seasonal variations in the weather than with daily variations. That portion of his work is not directly applicable to this experiment.[106]

Helm, in Britain, who also researched saturation flow at signalized intersections, noted that, "although rain was encountered during only seven out of more than three hundred hours of field work, the results obtained during these hours suggested that the behaviour of vehicles was significantly affected by the weather."[107]

Helm's comments confirm to some degree that the presence or absence of precipitation may be the factor that affects vehicle behaviour.

Helm's observations on the effect of weather are reinforced by the conclusions drawn by Berry and Ghandi who noted that adverse weather significantly affected headways.

Based on the preceding discussion, the levels that were assigned to the weather conditions factor are:

(1) fair

(2) poor

3.2.7 Parking conditions

The levels that were assigned to the parking factor are:

(1) yes - indicating that parking is allowed within 75m of the intersection, and

(2) no - indicating that parking is not allowed within 75m of the intersection.

The 75m distance that is used as the dividing criteria between approaches that should be considered as having parking and those that should be considered as having no parking is that recommended by the Highway Capacity Manual(1965).[108]

3.2.8 Intersection location

The Highway Capacity Manual (1965) divides metropolitan areas into four land use and development classifications or types.[109] These classifications are detailed in Table 5. Unfortunately, these particular land use classifications are not directly applicable to the City of St. John,s.

Therefore, in an effort to more accurately reflect local conditions, the following four categories of land use were developed:

(1) CBD, Central Business District: the definition of this classification is similar to the one used in the Highway Capacity Manual (1965);

(2) RC, Residential Core: this classification applies to the older residential area of the City that developed around the CBD and which is located in the pre-1945 area of

Table 5 Land use classifications in the Highway Capacity Manual (1965)

1. Central Business District

That portion of a municipality in which the dominant land use is intense business activity.

2. Fringe Area

That portion of a municipality immediately outside the central business district in which there is a wide range of business activity.

3. Outlying Business District

That portion of a municipality or an area within the influence of a municipality, normally separated geographically by some distance from the central business district and its fringe area, in which the principal land use is for business activity.

4. Residential Area

That portion of a municipality, or an area within the influence of a municipality, in which the dominant land use is residential development, but where small business areas may be included.

the City;

(3) OCD, Outlying Commercial District: this classification describes the area of the City located between the older residential core and the newer suburban areas. Typical land uses in this district include retail, commercial and light industrial uses;

(4) SRA, Suburban Residential Area: this classification applies to the newer residential sections of the City of St. John's, typically those developed post-1945.

3.2.9 Vehicle size

No levels were assigned to the factor of vehicle size. As previously mentioned in Section 2.5.9, the vehicle size factor refers to the effect that passenger cars of differing sizes might have on the capacity of an approach to a signalized intersection. The effect that large trucks might have on capacity has been considered through the use of equivalent passenger car units as discussed in Section 5.5.2.

No levels were assigned to the factor of vehicle size based on the assumption that the percentage of small cars in traffic in the City of St. John's would be constant over the entire City. There is no reason to believe, for instance, that small cars constitute a larger proportion of the traffic stream on streets in the West End than they do on streets in the East End.

3.2.10 Visibility of the traffic signal

The levels that were assigned to the signal head visibility factor are:

(1) good: indicating that at least two separate signal indications having minimum lens sizes of 200mm face the approach being considered, and

(2) poor: indicating that the approach under consideration does not meet the above criterion.

3.2.11 Approach gradient

The vertical alignment of the approaches to a signalized intersection will generally fall into one of the four categories shown in Figure 4.

The levels that have been assigned to the approach gradient factor are:

(1) unsuitable: an approach was considered to have an unsuitable gradient if (a) it was level, (b) it was located on a crest vertical curve and,hence, had constantly changing gradient or (c) it was located on a sag vertical curve, for similar reasons; and

(2) suitable: an approach was considered to have a suitable gradient if (d) the grade was relatively constant through the intersection.

3.2.12 Queue p. . :ion

As with t' .eather factor, the position of a vehicle in

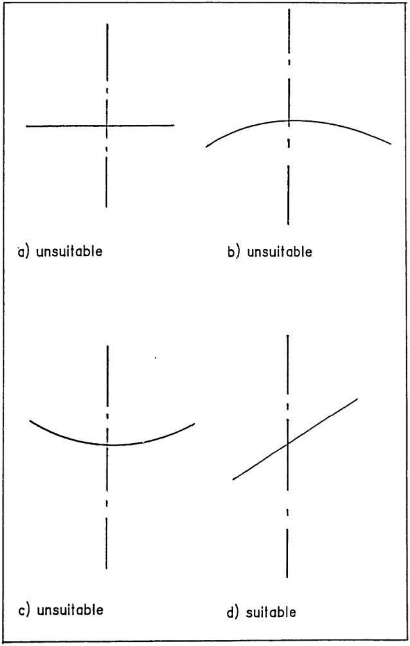

Figure 4 Suitability of approach gradient

a queue is not an attribute of an intersection. But, as has been previously noted, position does effect discharge headways.

Researchers have noted that headways of vehicles in early queue positions are generally larger than those of other vehicles. These larger headways have been attributed to a phenomenon called starting delay, which as its name implies, is the delay queue leaders experience in reacting to a signal change.

Evans and Rothery noted that headways in the first three queue positions were larger than those for other queue positions.[110]

Greenshields, in his classic work on traffic, Traffic Performance at Urban Street Intersections, found a levelling off trend in headways after the first five queue positions.[111]

And, Ancker, Gafarian and Gray noted that vehicle discharge headways decrease to queue position 7 but are not statistically significantly different from position 7 onward.[112]

The number of levels of the vehicle position factor was arbitrarily selected as twelve because, as can be seen from Table 6, after position 12 on approaches 16 west and 16 east the number of recorded cycles drops off quickly.

However, as stated above, research by others indicates that headways level off after the first several queued vehicles discharge. Therefore, by observing up to the first

Table 6 number of recorded cycles by queue position at approaches 16 west and east

	+7.2% no. of cycles	-7.2% no. of cycles
1	250	250
2	250	250
3	249	249
4	248	248
5	247	245
6	242	245
7	239	243
8	225	240
9	222	235
10	204	222
11	192	206
12	175	189
13	151	175
14	121	129
15	82	70
16	22	18
17	12	4
18	2	1
19	1	
20		

headways at the downstream intersection may cause a back-up that will interfere with traffic at the intersection of interest.

The parameters used during the selection process to determine if traffic interference was likely on an approach to an intersection were the proximity of the downstream intersection and the volume of traffic travelling between the intersections.

During the data collection process, occurrences of traffic interference on the study approaches, for whatever reason (for instance, a stalled vehicle) were to be noted so that the affected data could be discarded. No instances of such interference were recorded.

3.2.15 Cycle length

The levels that were assigned to the cycle length factor are:

(1) 50 s,

(2) 60 s,

(3) 70 s,

(4) 80 s,

(5) 90 s, and

(6) 100 s.

These values represent the cycle lengths in use at signalized intersections in the City of St. John's.

twelve vehicle positions in this experiment the point at which vehicle headways level off will likely be included in the experimental population.

3.2.13 Speed limit

The levels that were assigned to the speed limit factor are:

(1) 30 k/h,

(2) 50 k/h,

(3) 60 k/h, and

(4) 70 k/h.

These four speeds represent the allowable speed limits on streets in the City of St. John's.

3.2.14 Traffic interference

The levels that were assigned to the traffic interference factor are:

(1) yes: indicating that traffic interference from a downstream intersection was likely, and

(2) no: indicating that such interference was unlikely.

Traffic interference may be considered to have occurred if the presence of traffic queued at a downstream intersection affects the behaviour of vehicles leaving the intersection under observation.

Traffic interference at any particular intersection may be difficult to predict. Any factor which affects vehicle

3.2.16 Time of day

No levels were assigned to the time of day factor at this point in the experimental process. The time when data is recorded on an intersection approach is not an attribute of that particular approach. The effect of the time of day at which data is collected is discussed in more detail in Section 2.5.13.

3.2.17 Street classification

The levels that were assigned to the street classification factor are those generally used by road and traffic authorities throughout North America. These classifications are:

(1) local;

(2) collector; and

(3) arterial.

The City of St. John's Municipal Plan was used to determine which streets in the City have been designated as arterial streets. Streets classified as collectors were identified by staff of the City's Engineering Department. All other streets were designated as local streets.

3.3 Analysis and selection of study approaches

Each of the sixty-nine signalized intersections in the City of St. John's has been assigned an identifying intersection number. For each of the two hundred and forty signalized intersection approaches, this intersection number, plus a directional identifier, together with the applicable level of the factors listed in Table 3 for that particular approach were entered into a computerized relational database. The database that was developed is contained in Appendix A, Signalized intersection approach database.

Database management software was then used to search the database for approaches to signalized intersections that had the same levels of each of the factors identified in Chapter Two as influencing traffic operations at signalized intersections.

The first two criteria employed in the searching process were the suitability of the candidate approach with regards to the approach gradient factor and the turning movements factor, factors 2 and 11 in Table 3.

The suitability of the approach gradient was used as a criterion in the initial search because gradient is one of the factors of interest in this experiment. Approaches to signalized intersections that did not have suitable gradients, as defined in Section 3.2.11 and as illustrated in Figure 4, could be quickly discarded and the database size accordingly reduced.

The turning movements factor was also employed in the initial search of the database for acceptable approaches in an attempt to reduce its size. Many of the signalized intersections in the older, pre-1945 district of the City with its narrow street rights-of-way have approaches without separate dedicated turning lanes. Such approaches could also be quickly discarded from the database.

After this initial search was completed, only twenty-six intersection approaches remained as possible candidates for data collection. These approaches and the applicable levels of the various factors are shown in Table 7.

The database was next searched based on the criteria of traffic interference, driving surface condition and lane width. Completing this search eliminated from the database approaches that were subject to traffic interference, those having poor surface condition and those having inadequate lane width.

At the same time the two approaches on collector streets that remained in the database after the initial search (55 east and 61 north) were also removed since it was felt that the two by themselves would not provide a large enough range of gradients to allow for adequate study of the effect of grade on headways.

After this second search there were nineteen suitable approaches remaining in the database as indicated in Table 8. These remaining candidate approaches were then sorted in an effort to obtain homogeneous groupings of approaches containing the same levels of the various factors included in the database.

The first sorting was performed with the speed limit

Table 7 Suitable intersection approaches remaining after first search of approach database

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	3	E	adeq.	Y	min.	G	2	N	OCD	G	S	50	N	100	art.
2	3	W	adeq.	Y	min.	G	2	N	OCD	G	S	50	N	100	art.
3	4	E	adeq.	Y	min.	G	2	N	SRA	G	S	50	N	100	art.
4	4	W	adeq.	Y	min.	G	2	N	SRA	G	S	50	N	100	art.
5	5	N	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	art.
6	5	S	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	art.
7	7	N	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	art.
8	7	S	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	art.
9	12	E	adeq.	Y	min.	G	2	N	OCD	G	S	50	Y	100	art.
10	12	W	adeq.	Y	min.	G	2	N	OCD	G	S	50	Y	100	art.
11	16	E	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	art.
12	16	W	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	art.
13	21	E	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	art.
14	21	W	adeq.	Y	min.	G	2	N	SRA	G	S	70	Y	100	art.
15	54	N	adeq.	Y	min.	P	2	N	CBD	G	S	50	N	60	art.
16	54	S	adeq.	Y	min.	G	2	N	CBD	G	S	50	Y	60	art.
17	55	E	adeq.	Y	min.	G	2	N	CBD	G	S	50	N	80	coll.
18	60	N	adeq.	Y	min.	G	2	N	OCD	G	S	50	N	80	art.
19	60	S	adeq.	Y	min.	G	2	N	OCD	G	S	50	N	80	art.
20	61	N	inadeq	Y	min.	P	2	N	CBD	G	S	50	N	80	coll.
21	64	E	adeq.	Y	min.	G	2	N	OCD	G	S	50	N	80	art.
22	64	W	adeq.	Y	min.	G	2	N	OCD	G	S	50	N	80	art.
23	68	E	adeq.	Y	min.	G	2	N	SRA	G	S	50	N	70	art.
24	68	W	adeq.	Y	min.	G	2	N	SRA	G	S	50	N	70	art.
25	73	N	adeq.	Y	min.	G	2	N	OCD	G	S	50	N	100	art.
26	73	S	adeq.	Y	min.	G	2	N	OCD	G	S	60	N	100	art.

COL. DESCRIPTION

COL.	DESCRIPTION
1	intersection identification number
2	approach direction
3	lane width adequacy
4	turning movements present
5	presence of pedestrians
6	driving surface condition
7	type of traffic operation
8	is parking allowed on approach
9	location type
10	visibility of the signal
11	suitability of approach gradient
12	speed limit
13	traffic interference present
14	length of cycle
15	classification of street

Table 8 Suitable intersection approaches remaining after second search of approach database

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	3	E	adeq.	Y	min.	G	2	N	OCD	G	S	50	N	100	art.
2	3	W	adeq.	Y	min.	G	2	N	OCD	G	S	50	N	100	art.
3	4	E	adeq.	Y	min.	G	2	N	SRA	G	S	50	N	100	art.
4	4	W	adeq.	Y	min.	G	2	N	SRA	G	S	50	N	100	art.
5	5	N	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	art.
6	5	S	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	art.
7	7	N	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	art.
8	7	S	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	art.
9	16	E	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	art.
10	16	W	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	art.
11	21	E	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	art.
12	60	N	adeq.	Y	min.	G	2	N	OCD	G	S	50	N	80	art.
13	60	S	adeq.	Y	min.	G	2	N	OCD	G	S	50	N	80	art.
14	64	E	adeq.	Y	min.	G	2	N	OCD	G	S	50	N	80	art.
15	64	W	adeq.	Y	min.	G	2	N	OCD	G	S	50	N	80	art.
16	68	E	adeq.	Y	min.	G	2	N	SRA	G	S	50	N	70	art.
17	68	W	adeq.	Y	min.	G	2	N	SRA	G	S	50	N	70	art.
18	73	N	adeq.	Y	min.	G	2	N	OCD	G	S	50	N	100	art.
19	73	S	adeq.	Y	min.	G	2	N	OCD	G	S	60	N	100	art.

COL.	DESCRIPTION
1	intersection identification number
2	approach direction
3	lane width adequacy
4	turning movements present
5	presence of pedestrians
6	driving surface condition
7	type of traffic operation
8	is parking allowed on approach
9	location type
10	visibility of the signal
11	suitability of approach gradient
12	speed limit
13	traffic interference present
14	length of cycle
15	classification of street

factor as the sorting criterion. This sort resulted in three groups; those having speed limits of 70k/h, 60k/h and 50k/h. These groupings are shown in Table 9. Because there was only one suitable approach remaining that had a speed limit of 60k/h (73 south) this approach was deleted from the database. This deletion was performed for reasons similar to those mentioned previously when the two remaining collector street approaches were removed from the database.

As can be seen from Table 9, the remaining approaches that have a speed limit of 70k/h constitute a homogeneous grouping. However, the group of approaches that have a speed limit of 50k/h do not. There are differing levels of the location factor and the cycle length factor contained in this section of the remaining database. Therefore, this portion of the database was sorted using the criteria, firstly, of location and, secondly, of cycle length. The resulting database, which now contains five homogeneous groupings of approaches, is shown in Table 10.

Although all five groupings as shown in Table 10 are homogeneous, there are in fact three approaches (21 east, 4 east and 4 west) contained in this database that are located at intersections where the control device is traffic activated. Because of the possibility of extensions to or interruptions in the cycle length at these approaches they were deleted from the database. The revised database as shown in Table 11 has four homogeneous groupings of approaches. The

Table 9 Intersection approach groupings after first database sorting operation

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	16	W	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	art.
2	21	E	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	art.
3	5	S	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	art.
4	7	N	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	art.
5	7	S	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	art.
6	16	E	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	art.
7	5	N	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	art.
1	73	S	adeq.	Y	min.	G	2	N	OCD	G	S	60	N	100	art.
1	3	W	adeq.	Y	min.	G	2	N	OCD	G	S	50	N	100	art.
2	64	W	adeq.	Y	min.	G	2	N	OCD	G	S	50	N	80	art.
3	3	E	adeq.	Y	min.	G	2	N	OCD	G	S	50	N	100	art.
4	68	E	adeq.	Y	min.	G	2	N	SRA	G	S	50	N	70	art.
5	60	N	adeq.	Y	min.	G	2	N	OCD	G	S	50	N	80	art.
6	68	W	adeq.	Y	min.	G	2	N	SRA	G	S	50	N	70	art.
7	64	E	adeq.	Y	min.	G	2	N	OCD	G	S	50	N	80	art.
8	60	S	adeq.	Y	min.	G	2	N	OCD	G	S	50	N	80	art.
9	4	E	adeq.	Y	min.	G	2	N	SRA	G	S	50	N	100	art.
10	73	N	adeq.	Y	min.	G	2	N	OCD	G	S	50	N	100	art.
11	4	W	adeq.	Y	min.	G	2	N	SRA	G	S	50	N	100	art.

COL. DESCRIPTION

COL.	DESCRIPTION
1	intersection identification number
2	approach direction
3	lane width adequacy
4	turning movements present
5	presence of pedestrians
6	driving surface condition
7	type of traffic operation
8	is parking allowed on approach
9	location type
10	visibility of the signal
11	suitability of approach gradient
12	speed limit
13	traffic interference present
14	length of cycle
15	classification of street

Table 10 Intersection approach groupings after second sorting operation

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	5	S	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	art.
2	5	N	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	art.
3	7	N	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	art.
4	7	S	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	art.
5	16	W	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	art.
6	16	E	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	art.
7	21	E	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	art.
1	4	E	adeq.	Y	min.	G	2	N	SRA	G	S	50	N	100	art.
2	4	W	adeq.	Y	min.	G	2	N	SRA	G	S	50	N	100	art.
1	68	W	adeq.	Y	min.	G	2	N	SRA	G	S	50	N	70	art.
2	68	E	adeq.	Y	min.	G	2	N	SRA	G	S	50	N	70	art.
1	3	W	adeq.	Y	min.	G	2	N	OCD	G	S	50	N	100	art.
2	3	E	adeq.	Y	min.	G	2	N	OCD	G	S	50	N	100	art.
3	73	N	adeq.	Y	min.	G	2	N	OCD	G	S	50	N	100	art.
1	60	S	adeq.	Y	min.	G	2	N	OCD	G	S	50	N	80	art.
2	60	N	adeq.	Y	min.	G	2	N	OCD	G	S	50	N	80	art.
3	64	E	adeq.	Y	min.	G	2	N	OCD	G	S	50	N	80	art.
4	64	W	adeq.	Y	min.	G	2	N	OCD	G	S	50	N	80	art.

COL. DESCRIPTION

COL.	DESCRIPTION
1	intersection identification number
2	approach direction
3	lane width adequacy
4	turning movements present
5	presence of pedestrians
6	driving surface condition
7	type of traffic operation
8	is parking allowed on approach
9	location type
10	visibility of the signal
11	suitability of approach gradient
12	speed limit
13	traffic interference present
14	length of cycle
15	classification of street

Table 11 Revised database after deleting approaches having traffic-actuated signals

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	5	S	adeq.	Y	min.G		2	N	SRA	G	S	70	N	100	art.
2	5	N	adeq.	Y	min.G		2	N	SRA	G	S	70	N	100	art.
3	7	N	adeq.	Y	min.G		2	N	SRA	G	S	70	N	100	art.
4	7	S	adeq.	Y	min.G		2	N	SRA	G	S	70	N	100	art.
5	16	W	adeq.	Y	min.G		2	N	SRA	G	S	70	N	100	art.
6	16	E	adeq.	Y	min.G		2	N	SRA	G	S	70	N	100	art.
1	4	E	adeq.	Y	min.G		2	N	SRA	G	S	50	N	100	art.
2	4	W	adeq.	Y	min.G		2	N	SRA	G	S	50	N	100	art.
1	3	W	adeq.	Y	min.G		2	N	OCD	G	S	50	N	100	art.
2	3	E	adeq.	Y	min.G		2	N	OCD	G	S	50	N	100	art.
3	73	N	adeq.	Y	min.G		2	N	OCD	G	S	50	N	100	art.
1	60	S	adeq.	Y	min.G		2	N	OCD	G	S	50	N	80	art.
2	60	N	adeq.	Y	min.G		2	N	OCD	G	S	50	N	80	art.
3	64	E	adeq.	Y	min.G		2	N	OCD	G	S	50	N	80	art.
4	64	W	adeq.	Y	min.G		2	N	OCD	G	S	50	N	80	art.

COL. DESCRIPTION

1	intersection identification number
2	approach direction
3	lane width adequacy
4	turning movements present
5	presence of pedestrians
6	driving surface condition
7	type of traffic operation
8	is parking allowed on approach
9	location type
10	visibility of the signal
11	suitability of approach gradient
12	speed limit
13	traffic interference present
14	length of cycle
15	classification of street

intersection approaches upon which data was to be collected would have to be contained in one of these homogeneous groups.

The second and third groupings in Table 11 were rejected as potential candidates because it was felt that they, too, would not provide a large enough base to allow for adequate study of one of the factors of interest, the effect of gradient on headways. The second grouping contained only two intersection approaches while the third contained only three.

Of the remaining two groupings, the first and fourth in Table 11, one, the first contained six approaches and the other, the fourth, contained four. In addition to offering additional approaches for data collection, the first grouping had the advantage of having all the approaches located on the same street in relatively close proximity to one another as is shown in Figure 5. This meant that observations recorded at these approaches would, in effect, be observations on the same traffic stream. This would help nullify the possible effect of other factors, such as the percentages of female drivers and commuters in the traffic flow, which might potentially have some effect on the headways of vehicles leaving signalized intersections.

Accordingly, the first grouping of approaches in Table 11 was selected for data collection. In addition, it was decided to add one intersection approach having a relatively flat gradient to the first grouping to allow observations to be made on an approach having, in effect, no gradient.

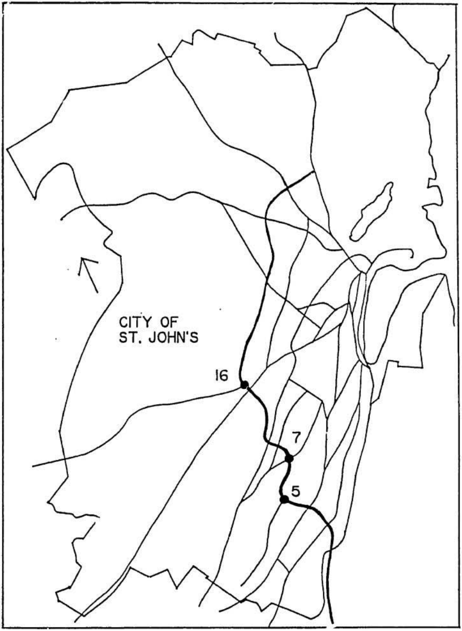

Figure 5 Location of intersection approaches contained in first grouping of Table 11

The intersection immediately east of intersection 16 contained an approach that had the same levels for the various factors in the database as those assigned to the approaches contained in the first grouping in Table 11 with the exception of the approach gradient factor. This approach was added to the six initially selected.

The seven approaches finally selected for data collection and the corresponding levels of the database factors applied to them are shown in Table 12. Note that the "unsuitable" level of the approach gradient factor was assigned to approach 71 west based on category (a) of Figure 4, Suitability of approach gradient.

The location of the seven selected approaches is shown in Figure 6.

3.4 Study approaches

The seven intersection approaches that were selected for data collection are drawn from the approaches to four different signalized intersections, intersections 5,7,16 and 71, as can be seen from Figure 6.

These four intersections are located on a limited access arterial street that connects residential suburban areas to the north-east and south-west with several major industrial, commercial and institutional land uses. This commuter corridor passes adjacent to or through two major regional shopping malls, a large, light industrial park, the Province's

Table 12 Intersection approaches selected for data collection

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	5	S	adeq.	Y	min.G	2	N	SRA	G	S	70	N	100	art.
2	5	N	adeq.	Y	min.G	2	N	SRA	G	S	70	N	100	art.
3	7	N	adeq.	Y	min.G	2	N	SRA	G	S	70	N	100	art.
4	7	S	adeq.	Y	min.G	2	N	SRA	G	S	70	N	100	art.
5	16	W	adeq.	Y	min.G	2	N	SRA	G	S	70	N	100	art.
6	16	E	adeq.	Y	min.G	2	N	SRA	G	S	70	N	100	art.
7	71	W	adeq.	Y	min.G	2	N	SRA	G	U	70	N	100	art.

COL. DESCRIPTION

1 intersection identification number
2 approach direction
3 lane width adequacy
4 turning movements present
5 presence of pedestrians
6 driving surface condition
7 type of traffic operation
8 is parking allowed on approach
9 location type
10 visibility of the signal
11 suitability of approach gradient
12 speed limit
13 traffic interference present
14 length of cycle

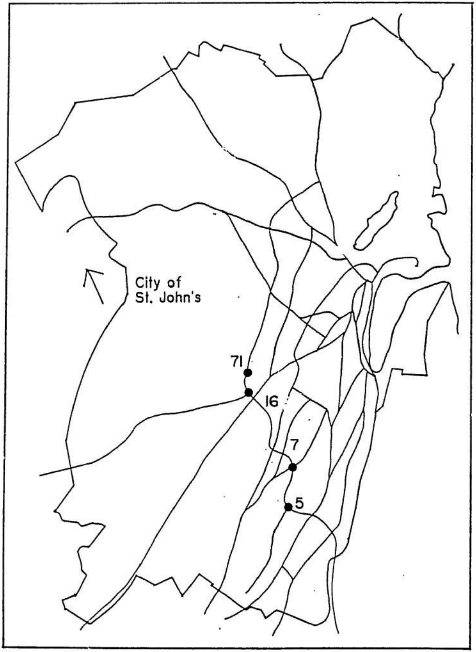

Figure 6 Location of intersection approaches selected for data collection

main health care facility, the Province's only university, a large polytechnical institute and the seat of the Provincial Government.

This street has an average daily traffic volume (ADT) in excess of 38,000 vehicles. Peak hour volumes are in the range of 3,000 vehicles per hour.

The seven selected approaches and the gradients of each are presented in Table 13. The gradients range from -7.2% to +7.2%. In all cases, the approaches that were selected are considered the main street approaches.

Plan and profile drawings for intersections 5, 7, 16 and 71 are displayed in Figures 7, 8, 9 and 10 respectively. The shaded intersection approach lanes are those upon which data were collected. These specific lanes were selected to ensure that circumstances were as similar as possible at each approach. Each of the approach lanes that was observed has a through and/or right-turn lane to its right and a left-turn lane to its left.

Table 13 Gradients on selected approaches

intersections	approach	gradient
5	north	-4.0%
5	south	+4.0%
7	north	-3.0%
7	south	+3.0%
16	east	+7.2%
16	west	-7.2%
71	west	+0.6%

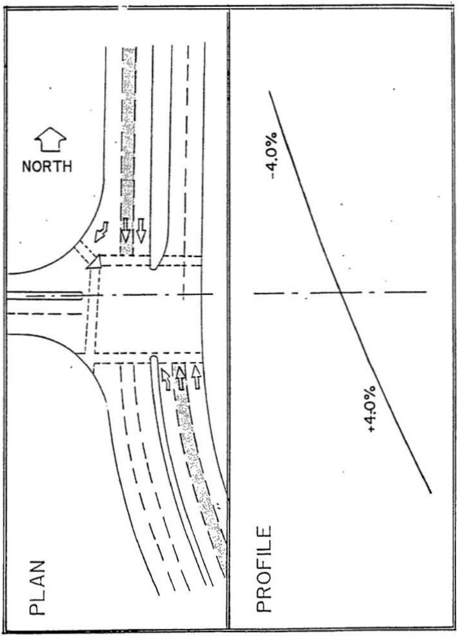

Figure 7 Plan-profile drawing of intersection 5

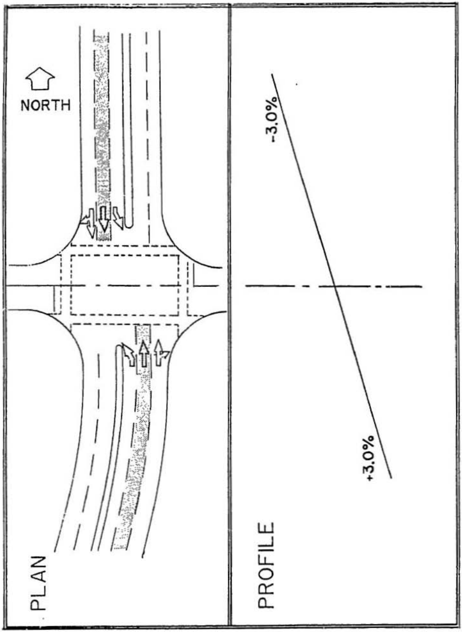

Figure 8 Plan-profile drawing of intersection 7

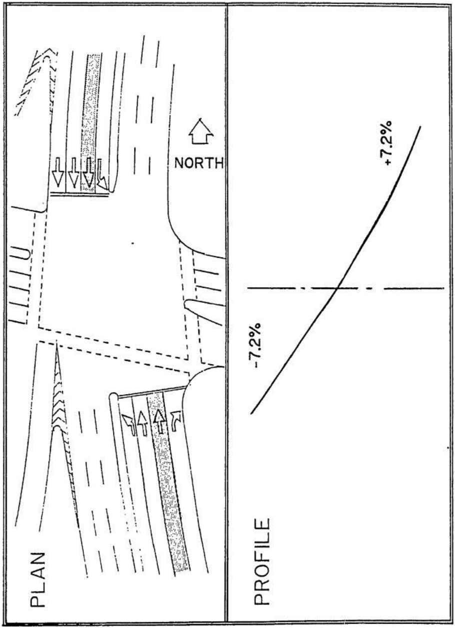

Figure 9 Plan-profile drawing of intersection 16

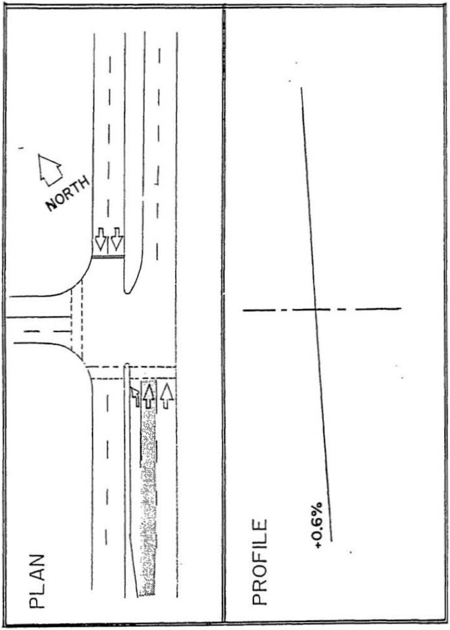

Figure 10 Plan-profile drawing of intersection 71

CHAPTER FOUR

4.0 EXPERIMENTAL DESIGN

4.1 Introduction

In Chapter Two the problem statement was defined as follows:

The problem is to determine the effect, if any, of approach gradient, weather conditions and queue position on the discharge headways of vehicles on approaches to signalized intersections in the City of St. John's.

Chapter Two also contained a brief discussion of the design of an experiment that will allow the effects of the three factors of interest on discharge headways to be determined. This discussion was very general in nature, concluding that a factorial experiment would determine which of the factors of approach gradient, weather conditions or queue position significantly affected discharge headways of vehicles on approaches to signalized intersections in the City of St. John's.

This Chapter contains a discussion of the experimental design in more detail including discussion of the mathematical model, the setting up of the null hypotheses for the main effects and interactions, a discussion of how these hypotheses will be rejected or accepted, and a discussion of the various follow-up procedures that were used.

4.2 Mathematical model

When conducting an experimental procedure, it is often helpful to establish a mathematical model to describe the physical situation that is being studied.

A suitable mathematical model for a three-factor factorial experiment where **n** observations are made on each of three factors, **A, B, C** having **a,b,**and **c** levels respectively, is given by

$$X_{ijkl} = u + A_i + B_j + C_k + (AB)_{ij} + (AC)_{jk} + (BC)_{jk} + (ABC)_{ijkl} + E_{ijkl}$$

$i = 1...a,\ j = 1...b,\ k = 1...c,$ and $l = 1...n$

where A_i, B_j, C_k = the main effects of factors A,B,C respectively

$(AB)_{ij}\ (AC)_{ik}\ (BC)_{jk}$ = the two-factor interaction effects

$(ABC)_{ijk}$ = the three-factor interaction effect

E_{ijkl} = random error.

Several assumptions are made about this model.

The assumption of additivity is made. This says that the value of the response variable is equal to a quantity depending on the environmental conditions and the experimental unit plus a quantity depending on the treatment used.

Further assumptions about the distribution of the random errors are necessary. These assumptions are:

1. the errors are normally distributed with mean zero;
2. the error variance is homogeneous; and

3. successive random errors are uncorrelated.

In order to ensure that the analysis is valid, these assumptions will have to be checked during the analysis stage to make certain that this model does apply to the situation being studied.[113]

The mathematical model expressed above is a fixed-effects model. This type of model applies when the factors being studied are considered to be fixed since the experimenter is interested only in the factors that have been selected and in no others.[114]

Of the three factors under investigation in this experiment, the approach gradient and queue position factors are clearly fixed factors. A fixed factor implies that the experimenter can exactly replicate that factor. However, the weather conditions factor, depending upon the approach that is taken, might be considered either as a fixed factor or as a random factor.

If the situation is considered in the context that the weather conditions that existed when data were recorded are a random sample from the population of all possible weather conditions, then the weather condition factor can be considered as a random factor. In this case, the appropriate mathematical model for the experiment conducted here would be a mixed model as some of the factors are fixed and some are random.

However, because of the way in which the weather conditions factor was treated in this experiment, it can be considered as a fixed factor.

Two levels, fair and poor, have been assigned to the weather factor. An objective criterion has been selected as the dividing point between these two levels. By treating the weather factor in this manner, it becomes a fixed factor in that the fair and poor levels of the weather factor can be replicated over the course of the experiment.

Therefore, all three factors being investigated are fixed and the fixed-effects mathematical model expressed above is applicable to the situation under investigation.

4.3 Null hypotheses

A number of hypotheses have to be tested to determine if the factors of interest, approach gradient, weather conditions and queue position, have a statistically significant effect on the response variable, discharge headways.

Given the mathematical model expressed in the previous section:

$$X_{ijkl} = u + A_i + B_j + C_k + (AB)_{ij} + (AC)_{jk} + (BC)_{jk} + (ABC)_{ijkl} + E_{ijkl}$$

$i = 1...a$, $j = 1...b$, $k = 1...c$, and $l = 1...n$

where $A_i B_j C_k$ = the main effects of factors A,B,C respectively

$(AB)_{ij}$ $(AC)_{ik}$ $(BC)_{jk}$ = the two-factor interaction effects

$(ABC)_{ijk}$ = the three-factor interaction effect

E_{ijkl} = random error.

the various null hypotheses that have to be tested are:

1. $H_{01} : A_i = 0$
2. $H_{02} : B_j = 0$
3. $H_{03} : C_k = 0$
4. $H_{04} : (A \times B)_{ij} = 0$
5. $H_{05} : (A \times C)_{ik} = 0$
6. $H_{06} : (B \times C)_{jk} = 0$
7. $H_{07} : (A \times B \times C)_{ijk} = 0$.

The first null hypothesis, for instance, says that the first factor, approach gradient, represented by the variable A, does not have any effect on the response variable. In a similar fashion, the fourth null hypothesis says that the interaction of the approach gradient and weather condition factors does not have any effect on the response variable. The other null hypotheses can be interpreted in a similar manner. The alternative hypotheses, of course, state that the various main effects and interactions do affect discharge headways.

The null hypotheses are assumed to be true until the data indicates otherwise.[115]

A series of F-tests are used to test the validity of the various hypotheses. The F-tests compare the mean squares of the main effects and the interactions with the residual mean square. Table 14 contains the mean squares for the various

Table 14 Mean squares for the various sources of error

source	df	mean square
Blocks	$r-1$	$s^2+abc \quad p^2/(r-1)$
A	$a-1$	$s^2+rbc \quad A^2/(a-1)$
B	$b-1$	$s^2+rac \quad B^2/(b-1)$
C	$c-1$	$s^2+rab \quad C^2/(c-1)$
AB	$(a-1)(b-1)$	$s^2+rc \quad (AB)^2/(a-1)(b-1)$
AC	$(a-1)(c-1)$	$s^2+rb \quad (AC)^2/(a-1)(c-1)$
BC	$(b-1)(c-1)$	$s^2+ra \quad (BC)^2/(b-1)(c-1)$
ABC	$(a-1)(b-1)(c-1)$	$s^2+r \quad (ABC)^2/(a-1)(b-1)(c-1)$
Error	$(r-1)(abc-1)$	s^2

sources of error. If the calculated F-test statistic exceeds the tabulated F-test statistic at the selected level of significance then the null hypothesis is rejected at that level of significance and the alternative hypothesis is accepted.

The entire procedure of performing the required F-tests is referred to as an Analysis of Variance procedure or ANOVA.

4.4 Level of significance

As mentioned in the preceding section, the hypotheses that have been postulated are either accepted or rejected based upon the results of a series of F-tests. With any F-test, a level of significance has to be established before the calculated value of the F-test statistic can be compared with the tabulated value of the statistic.

The significance of a test, denoted here by **a**, represents the risk that the experimenter is prepared to accept of saying that the null hypothesis is false when in fact it is not. Generally, **a** is called the level of significance of the result. If a result is significant at the 5% level it is usually taken as "reasonable evidence" that the null hypothesis is untrue. Therefore, if the result obtained is significant and the null hypothesis is rejected, there will be a 5% chance that the wrong decision has been made.[116]

However, it is also possible to make a wrong decision by accepting the null hypothesis when in fact it is false. The probability of this type of error is usually denoted by B. The quantity B is related to the sensitivity of a test. As stated, the analysis of variance technique that is used in factorial experimental designs, generally to test the hypothesis of equality of treatment means, is based on the comparison of the mean squares (variation) of the various treatments or factors with the residual mean square by means of an F-test.

If the residual mean square or experimental error variance is too large the procedure is insensitive to differences among the treatments of interest. The sensitivity of a test describes the ability of the procedure to detect differences in the treatments or factors and is measured by the power of the test which is merely 1-B, where B is the possibility of accepting the null hypothesis when it is false. When the power of a test is low, the scope of the inferences that can be drawn from the experimental data is severely limited.[117]

In this experiment B has been selected as 10%, meaning that there is a 10% chance of making a wrong decision should a result be obtained that is not significant. The power of the test then is 90% which should be adequate to ensure the necessary sensitivity of the test to changes in the factor effects.

4.5 Follow-up procedures

The ANOVA procedure discussed above will indicate which of the main effects and/or interactions are statistically significant. However, the results produced by the analysis of variance still require interpretation.

If the analysis of variance indicates that there is no significant interaction, the main effects can be examined more closely. Qualitative factors that produce significant main effects can be examined to find the level or levels which give the largest values of the response variable. With quantitative factors that produce significant main effects, the problem is to determine the functional relationship between the response variable and the factor. This is achieved through regression procedures.

If the analysis of variance indicates that there is a significant interaction between two or more of the factors being investigated, the main effects cease to have much meaning by themselves since the effect of one factor depends on the level of the other factor. Qualitative factors should be examined at each level of the factor. If one of the interacting factors is quantitative, or continuous, and the other qualitative, the functional relationship between the response variable and the continuous variable will have to be investigated at each level of the qualitative variable. If both interacting factors are continuous variables, then the problem becomes one of multiple regression with two controlled variables.[118]

Depending upon the results produced by the analysis of variance technique for this experiment, one of the above noted follow-up procedures will be used to interpret the results.

CHAPTER FIVE

5.0 DATA COLLECTION

5.1 Introduction

This Chapter contains discussion on the data collection process including discussion on the selection of the reference line location, the data collection procedure including the deletion from the list of study approaches of approaches 5 North and 5 South, and the generation of the final headway database including the procedure for adjusting heavy vehicle headways using the concept of passenger car equivalencies.

5.2 Location of reference line

The location in the field of the point at which elapsed time readings are recorded, generally referred to as the reference line, has been shown to have an effect on the starting delay values that are generated for an approach and, to a lesser extent, on vehicular headways on that approach. As noted by Berry,"the choice of a screen-line definition affects headways for both queue position 1 (starting delay) and queue position 2."[119]

Obviously, the farther the reference line is located from the point at which vehicles stop for a red indication, the greater will be the time that elapses between the start of the green phase and the passing of the reference line by the first vehicle. This time that élapses prior to the first vehicle crossing the reference line is referred to as the starting delay.

Starting delay on an approach to a signalized intersection is one of the components that has to be considered when attempting to determine approach capacity, the other important component being headways. As noted by Carstens, "Intersection capacity is a function of the spacing of vehicles as they cross the stop line. The amount of starting delay inherent in starting movement of a queue of stopped vehicles also affects capacity."[120]

The relationship between starting delay and headways and the location of the reference line has been studied by Berry and Ghandi and by King and Wilkinson. The relationships reported by Berry in his discussion of the research of King and Wilkinson are shown in Figure 11. The definitions of the various reference line locations are indicated in Figure 12.

Figure 11 clearly shows, as expected, that starting delay does increase with increasing distance from the stopped position to the reference line. Figure 11 also shows that after vehicle position 3 headways are approximately the same regardless of the location of the reference line.

King and Wilkinson support Berry's conclusions. Their data base represented a mix of reference line locations Ib and IIa, as defined in Figure 12. The results they achieved by superimposing their data on Berry's are plotted in Figure

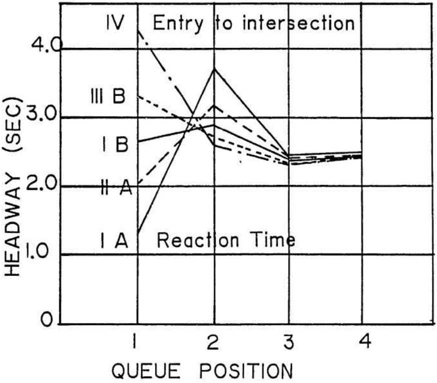

Figure 11 Relationship between starting delay and reference line location

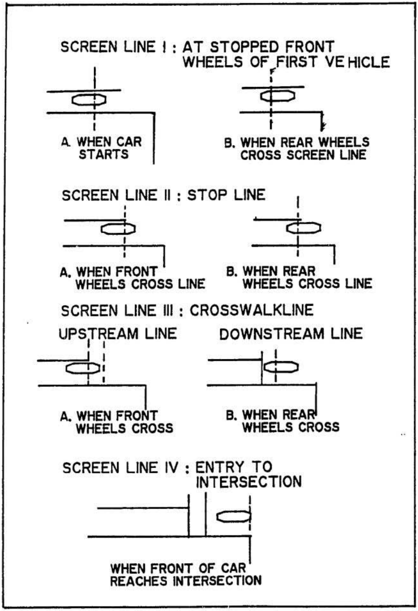

Figure 12 Definition of reference line locations

13.

The location of the reference line is, to some degree, a function of the parameter that is being investigated. If the reaction time of drivers in responding to the change of the signal indication to green is the quantity of interest, then the reference line should be placed at position Ia. As noted by Berry, in this instance, "the elapsed time from the beginning of the green interval would include reaction time, but no acceleration time."[121]

However, if capacity analysis is the desired objective, Berry recommends, "making queue discharge measurements at the entry to the intersection, corresponding to screen-line definition IV [in Figure 12]."

The objective of this experiment is to determine the effects, if any, of approach gradient, weather conditions and queue position on discharge headways. As defined in this experiment, the headway of the queue leader is a quantity unaffected by starting delay. It is the difference between the elapsed time from start of green to the crossing of the reference line by the queue leader and the elapsed time from start of green to the crossing of the reference line by the following vehicle. As such, the starting delay is not of direct interest, but is merely used in the calculation of the queue leader's headway.

Therefore, provided that it is located near enough to the point of departure that vehicles are still in the process

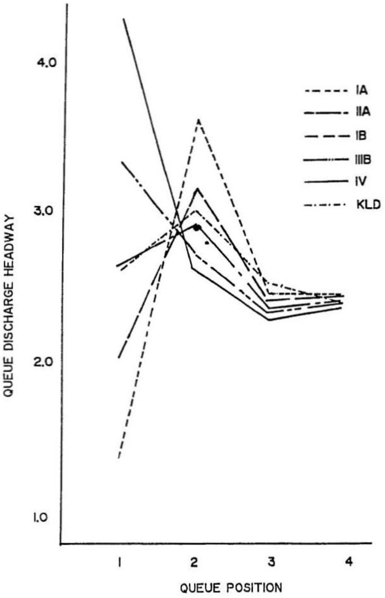

Figure 13 Plot of King's data superimposed on Berry's data

of accelerating when they cross it and that it is located on the section of approach having a gradient classified as suitable in terms of Figure 4, the location of the reference line is of no real significance relative to this experiment.

There are, however, two practical considerations regarding the reference line location that must be considered. Firstly, it must be located so that the observer has a clear view of vehicles crossing it, and, secondly, the distance to the reference line from the point of departure must be the same on all approaches to ensure that vehicles have the same distance over which to accelerate prior to their elapsed times being recorded.

The location of the reference lines for the seven selected approaches are shown in Figures 14 through 20.

5.3 Data collection procedure

Data was collected on the seven intersection approaches noted in Table 15 during Spring, 1986. The data collection process began in April and continued until June. Data was collected on weekdays during peak hour conditions in fair and poor weather conditions. The field data that was collected consisted of elapsed time readings recorded by an observer positioned on the various selected intersection approaches. The observer was equipped with an audio tape recorder and a digital stopwatch that was accurate to one-hundredth of a second.

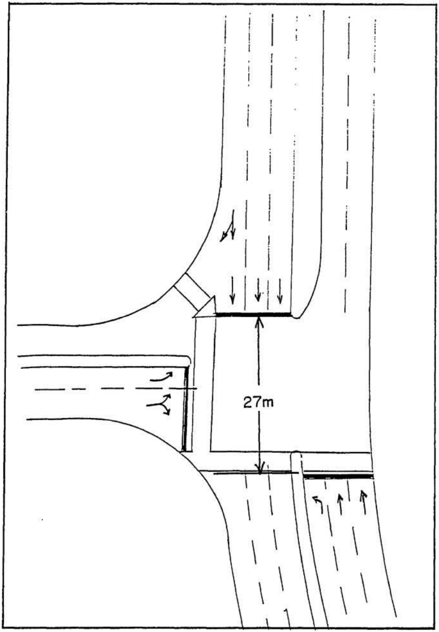

Figure 14 Location of reference line for approach 5 north

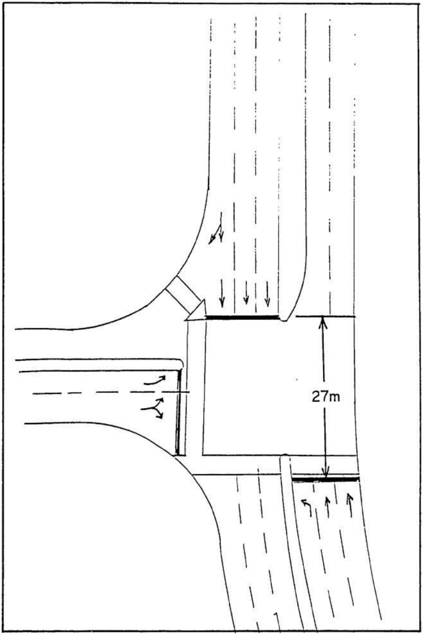

Figure 15 Location of reference line for approach 5 south

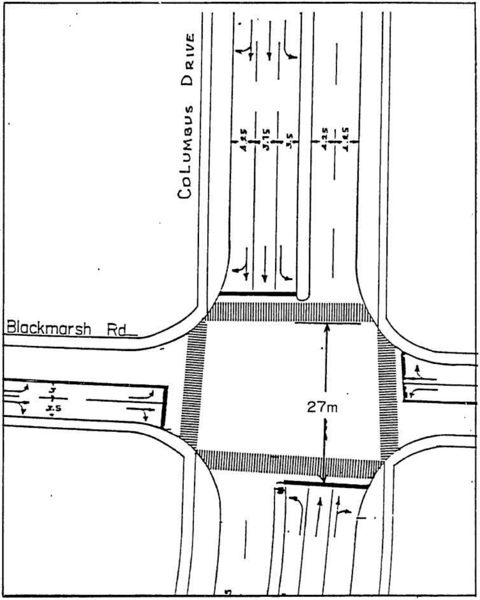

Figure 17 Location of reference line for approach 7 south

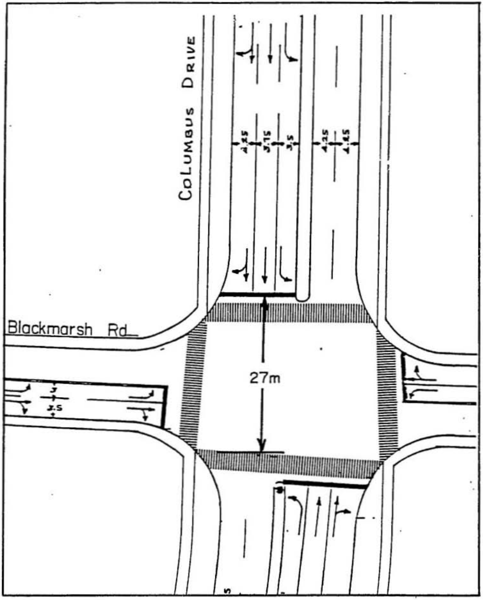

Figure 16 Location of reference line for approach 7 north

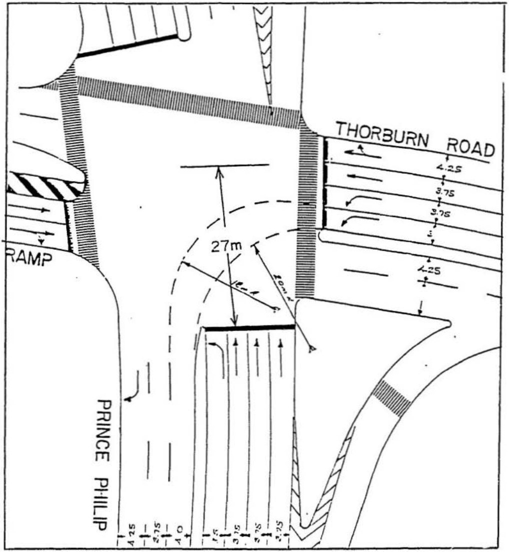

Figure 18 Location of reference line for approach 16 east

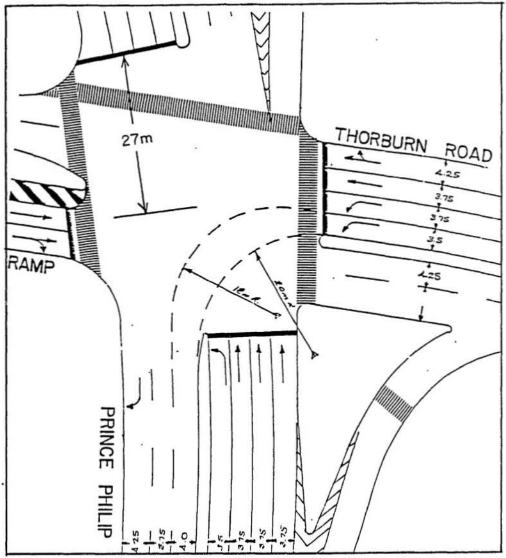

Figure 19 Location of reference line for a proach 16 west

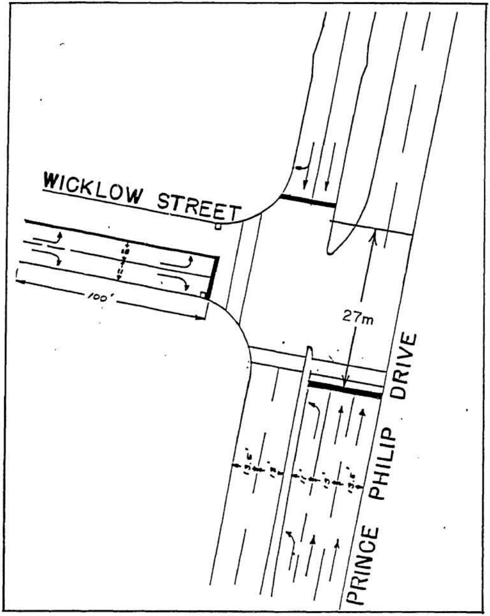

Figure 20 Location of reference line for approach 71 west

Table 15 Gradients on the selected approaches

intersections	approach	gradient
5	north	-4.0%
5	south	+4.0%
7	north	-3.0%
7	south	+3.0%
16	east	+7.2%
16	west	-7.2%
71	west	+0.6%

When the traffic signal controlling the intersection approach under observation changed to green the observer started the stopwatch. When the front of the first vehicle in the queue crossed the reference line, the elapsed time from the start of the green phase was recorded audibly by the observer. Similarly, when the front of the second vehicle passed the reference line, the elapsed time from the start of green was recorded, and so on, until the green phase for the observed approach ended or the vehicles that had been initially queued had all passed the reference line. The audible elapsed time data that was recorded in this manner was transcribed daily onto data collection sheets, an example of which is shown as Figure 21.

This data collection process continued until sixty observations on each queue position had been recorded. In order to record at least sixty observations on vehicle position 12 at approaches 16 east and 16 west approximately two hundred and fifty cycles had to be observed at each of the selected approaches.

5.4 Deletion of intersection approaches 5 north and 5 south

Very early in the data collection process, it became apparent that there were not sufficient vehicles queuing on the north and south approaches to intersection 5 to allow for a steady rate of saturation flow to be attained at that particular intersection. A sample count of the number of

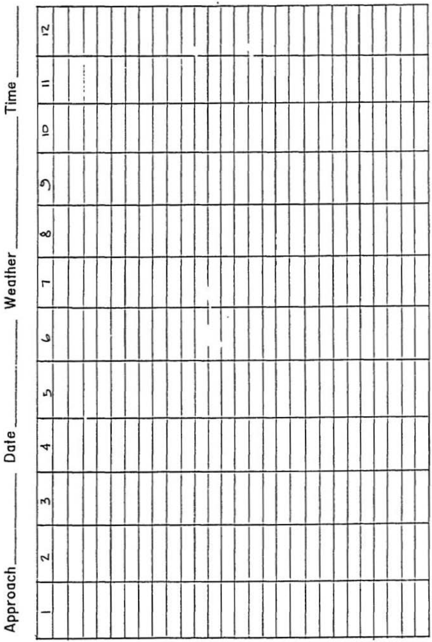

Figure 21 Example of data collection sheet

vehicles queued at this intersection awaiting the start of the green phase during peak period is included in Table 16.

It can be seen from Table 16 that the highest number of vehicles that queued at this approach on 1986-04-28 was eight during the twentieth recorded cycle on the north approach. The average number of queued vehicles was four. This did not represent enough vehicles to allow steady state flow conditions to develop.

Initially, these low counts on the north and south approaches to intersection 5 represented a puzzling phenomenon, particularly in light of the fact that this intersection was located on the high volume commuter facility described in Section 3.4.

A check of the traffic count inventory maintained by the City of St. John's Engineering Department, Traffic Division, produced an explanation for the low volumes using the approach lanes of interest at this particular intersection; approaches 5 north and south. The most recent traffic count information for this intersection is shown in graphical form in Figure 22.

As can be readily seen from Figure 22, the majority of the traffic passing through intersection 5, which is a tee-intersection, enters the intersection from approach 5 west, the perpendicular leg of the "tee". This particular approach draws traffic from three main sources:

1. traffic generated by a large residential development

Table 16 Number of vehicles queued on approaches 5 North and 5 South during peak hour

		number of cars queued	
time	cycle	south	north
4:15	1	0	2
	2	1	2
	3	1	1
	4	2	4
	5	0	5
	6	0	3
	7	3	3
	8	0	3
	9	1	5
	10	0	5
	11	0	6
	12	0	5
	13	1	2
	14	2	4
	15	0	5
	17	0	5
	18	1	6
	19	2	6
5:00	20	1	8

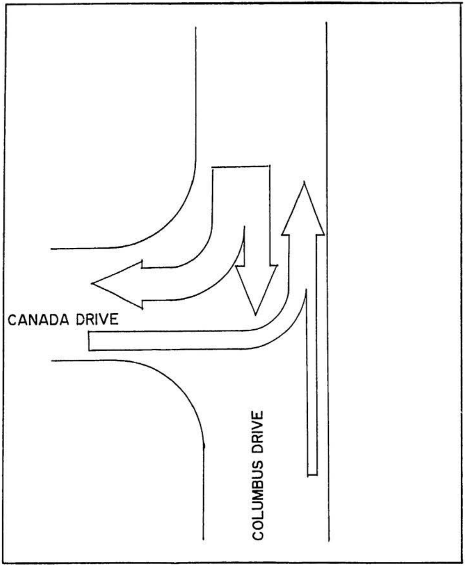

Figure 22 Graphical representation of traffic volumes in peak period at intersection 5

known as Cowan Heights;

2. traffic generated by a major regional mall located in the area; and

3. traffic using the street upon which approach 5 west is located as a by-pass route to avoid a more heavily congested parallel arterial street.

Figure 23 shows the street network in the immediate area of intersection 5 and indicates the position of these three generators.

The effect of this traffic flow pattern on the experiment was that there was not sufficient traffic using approaches 5 north and 5 south to enable them to be included in the data collection process. Accordingly, they were deleted from the approaches upon which data was to be collected, leaving the five intersection approaches shown in Table 17 to be utilized for data collection.

The deletion of approaches 5 north and 5 south from the pool of suitable intersection approaches was unfortunate. However, because these approaches represented intermediate approach grades, +4.0% and -4.0%, the actual range of gradients that were observed remained unchanged at +7.2% to -7.2%.

After the removal of approaches 5 north and 5 south from the experimental process, data collection proceeded without incident. The elapsed time data that was recorded at the remaining five approaches over the course of the data

Table 17 Intersection approaches remaining for data collection after deletion of approaches 5 North and 5 South

intersections	approach	gradient
7	north	-3.0%
7	south	+3.0%
16	east	+7.2%
16	west	-7.2%
71	west	+0.6%

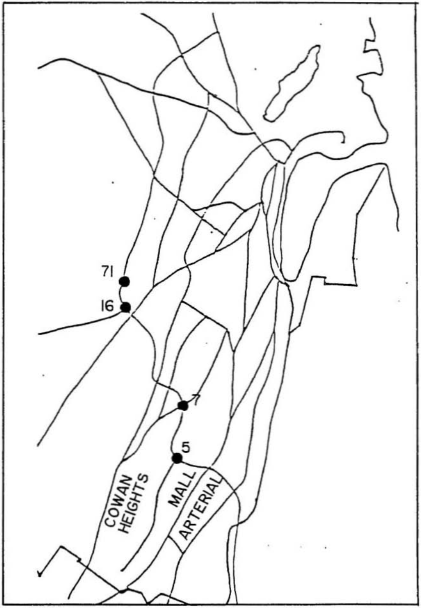

Figure 23 Street network in the immediate vicinity of intersection 5

collection process is contained in Appendix B, Recorded elapsed time data.

5.5 Generation of headways

The data that is contained in Appendix B is the raw elapsed time data that was collected at the various selected intersection approaches. This elapsed time data had to be transformed into vehicular headways.

Headway has previously been defined as the time-space between vehicles. It is the time that elapses between the front of one vehicle passing the reference line and the front of the succeeding vehicle passing that point.

To make the transformation from elapsed time data to headway data a computer subroutine was written within a commercially available spreadsheet software package. This subroutine was designed to perform the necessary calculations on the recorded elapsed times and generate the required headways.

The headway for the first vehicle in a queue was computed by subtracting the elapsed time reading for that vehicle from the elapsed time reading for the second vehicle. The headway for the second vehicle in the queue was then determined by subtracting its elapsed time reading from that of the third vehicle, and so on through the entire data field of 18,296 elapsed times.

For each cycle that was recorded the number of headways that has been generated is one less than the number of vehicles that had their elapsed times recorded. This situation arises because, by definition, the last vehicle in any queue has no headway as there is no following vehicle.

5.5.1 Adjustment of heavy vehicle headways

During the data collection process it was observed,as expected, that heavy vehicles in the traffic stream often failed to keep up with the vehicles preceding them. This caused the preceding vehicles' headways to be larger than would normally be the case if passenger cars were being followed by other passenger cars. The concept of passenger car equivalencies was used to adjust the headways of the vehicles that preceded heavy vehicles to factor out the effect of the presence of these heavy vehicles.

5.5.2 Equivalent passenger car units

Passenger car unit equivalents are employed in traffic flow analysis to compensate for the e fects of slower vehicles in the traffic stream.

When a large vehicle moves with a stream of traffic it often fails to keep up with the vehicle in front of it, and so the headway, H_c, of the vehicle that precedes the slower moving vehicle is greater than the average headway, H_{avg}, for vehicles in that position in the queue.

The phenomenon is usually localized. Generally, the headways of other cars in the stream are not affected.

The Canadian Capacity Guide for Signalized Intersections notes that, "For analytical purposes it is convenient to represent flow rates (which are comprised of a variety of vehicle types) as a homogeneous entity. This is achieved by converting various vehicle types to a common unit termed a 'passenger car unit' (pcu)."[122]

Greenshields, Shapiro and Erickson state that, "the concept of a traffic unit [equivalent passenger car unit] implies that the quantitative values of various vehicular characteristics and movements may be measured and related to one another."[123] Salter agrees with the use of equivalent passenger car units, stating that, "The effect of traffic factors on the capacity of an approach is allowed for by the use of passenger car units, which represent the effect of varying vehicle types relative to the passenger car."[124]

The use of equivalent passenger car units also simplifies analysis of traffic flows, "...by applying unit values to various components of a traffic stream, rather than by thinking of it as composed of various vehicles of different types."[125]

However, there is disagreement among traffic engineers regarding the values assigned as passenger car unit equivalencies to various types of slower moving vehicles. This disagreement is not unexpected as it is reasonable to assume that the behaviour of these slower vehicles would differ under varying circumstances, resulting in corresponding different passenger car unit equivalencies being assigned to vehicles of similar type. A sampling of the lack of consensus is indicated in Table 18.

For the purpose of this experiment, values of passenger car equivalents have been determined experimentally, using methodology developed by the British Transport and Road Research Laboratory.[126] The Transport and Road Research Laboratory method of calculating passenger car equivalents of trucks uses the formula:

$$PCU = \frac{H_c - H_{avg} + H_t}{H_{avg}} \qquad \text{Equation 2}$$

where H_c is the headway of the vehicle preceding the slower moving vehicle

H_{avg} is the average headway for vehicles in the position in the queue of the preceding car

H_t is the headway of the slower vehicle.

The Transport and Road Research Laboratory method of calcнlating equivalent passenger car units was selected for use because it considers the headway of the slower vehicle as well as the headway of the car preceding it.

Figure 24 indicates graphically what each term in Equation 2 represents.

Table 18 Lack of consensus in literature on passenger car equivalencies

source	medium truck	large truck	tractor-trailer	bus
I.T.E.	1.75	1.75	1.75	2.25
Dick,A.C.			1.70	
Evans,L. and Rothery,R.W.	1.04	1.83		
Teply,S.	1.30	1.80	2.60	1.40
Archer,R.J.G., Hall,R.I. and Eilon,S.	1.75	1.75	1.75	2.25
Ontario M.T.C.	1.50	1.50	1.50	1.50
Carstens,R.	1.63			

The sum of H_t and H_c represents the time-space between vehicles 1 and 3. This quantity is the total time that elapses between vehicle 1 crossing the point of observation and vehicle 3 crossing the point of observation. Ordinarily, if vehicle 2 were a passenger car, this quantity would equal, or closely approximate twice the average headway.

The term in the numerator of Equation 2 represents this time-spacing minus the average headway for one vehicle for vehicles in that position in the queue. The balance of the time-space remaining between vehicles 1 and 3 represents the average time-spacing for one vehicle for vehicles in that position plus any additional time-space resulting from the presence of the slower vehicle. Dividing this quantity by the denominator, the average headway, results in the equivalent passenger car units for the slower vehicle. The value of the equivalent passenger car unit that is assigned to a slower moving vehicle is actually the number of average headways, for vehicles in that queue position, represented by that slower vehicle.

Because the Transport and Road Research Laboratory Method of calculating passenger car equivalencies considers the headways of both the preceding car (H_c) and the truck, or slower vehicle, (H_t), it has several interesting elements included in it.

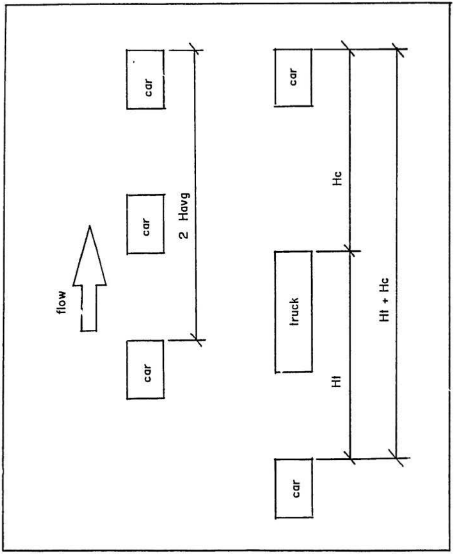

Figure 24 Graphical representation of terms in Equation 2

For example, if the truck being considered achieves an acceptable rate of acceleration, the headway of the preceding car, H_c, may approximate the average headway for vehicles in that position in the queue and then Equation 2 reduces to:

$$PCU = H_t/H_{avg} \qquad \text{Equation 3}$$

Then, if the car following the truck trails by the average headway, H_t will equal H_{avg} and the passenger car equivalent for the truck in question will be unity. This means that a truck that is able to maintain average spacing is treated as a passenger car in the analysis. Another intriguing aspect of the Transport and Road Research Laboratory method occurs if the headway of the car preceding the truck is close to H_{avg} (i.e. again, if the truck has sufficient power to maintain its position relative to the preceding car) and, if the headway of the truck is less than the average headway (a phenomenon that would occur if the following car had less than an average time-spacing between it and the truck), then the passenger car equivalent of the truck would theoretically be less than unity. However, the usual occurrence is that, as a result of the poor accelerating ability of many larger vehicles, the headway of the car preceding the truck, H_c, is somewhat larger than the average headway for vehicles in that position in the queue. These larger than normal headways resulting from the presence of slow moving vehicles were factored using the procedure described in the following section.

5.5.3 Adjustment procedure

During the collection of the elapsed time data, the location of heavy vehicles in the traffic stream was noted by the observer. Heavy vehicles were considered to be those vehicles having more than two rear wheels. This definition covered a wide range of vehicles, including dual rear wheel trucks, tandem axle trucks, buses and tractor-trailer combinations. Nevertheless, the percentages of heavy vehicles in the traffic stream at the intersection approaches where data was collected was low, ranging from a low of 0.5% at approach 7 north to a high of 1.3% at approach 16 west.

Another computer subroutine was written that worked through the newly generated headway database, adjusting the headways of the vehicles that had preceded those flagged as heavy vehicles. This subroutine computed the passenger car equivalency of a heavy vehicle using the methodology discussed in the previous section and then factored the preceding vehicle headway. An example of this procedure is contained in Appendix C, Adjustment of heavy vehicle headways.

The final headway data that resulted from the manipulation and adjustment of the recorded elapsed time database, as noted above, is included in Appendix D, Headway data.

CHAPTER SIX

6.0 ANALYSIS OF HEADWAY DATA

6.1 Introduction

As has been previously noted, the objective of this experiment is to analyze the effects that the factors of weather conditions, vehicle queue position and approach gradient may have on discharge headways at signalized intersections.

This analysis was performed through examination of the headway data that has been collected. The data is examined graphically and numerically in the sections that follow. As well, the results of a factorial experiment that was conducted on the data are discussed and the assumptions that were made about the mathematical model are checked to ensure the validity of that model.

The final headway data that was employed in the analysis procedures is contained in Appendix E, Data for analysis. The data in this Appendix is organized by study approach. For each of the five study approaches headway data is provided for each of the twelve queue positions under each of the two weather conditions. As there are sixty observations at each queue position, there is a total of 7200 headways contained in the final data set.

6.2 Descriptive statistics

As the term implies, descriptive statistics generally refer to statistics that describe some characteristic of the sample that has been drawn by the experimenter from the population he is studying. Descriptive statistics are usually divided into two broad categories: graphical and numerical methods of presenting the data.

6.2.1 Graphical presentation of the data

Among the more common methods of graphically presenting data are bar charts, histograms and frequency distributions.

Possible frequency distributions of headway data have been studied by several researchers including Buckley who notes in his paper,"Road Traffic Headway Distributions", that the most noticeable characteristic of vehicular headways is their obvious variability. Because of this, he continues, attempts to understand headways have often been attempts to determine the probability distribution which would account for observed frequency distributions.[127]

In his paper Buckley discusses the goodness of fit of several distributions to observed frequencies, including the negative exponential distribution, the displaced negative exponential distribution, the Erlang distribution, the gamma distribution, the generalized Pearson type III distribution and the semi-random distribution. He concludes, as a result of Chi-Squared Goodness-of-Fit tests that," the generalized

Pearson type III distribution and a semi-random distribution are shown to afford acceptable fits," with the best fit being obtained with the semi-random model.[128]

It must be noted that Buckley's observed headway data was recorded under freeway conditions and, therefore, can not be directly compared to the data recorded in the course of the experiment being discussed here which was collected at signalized intersections.

However, in a discussion of Buckley's work, Leong notes that," it is most likely that this distribution [the semi-random distribution] would also fit the "modified" headway distribution observed at signalized intersections under saturation flow conditions. From the writer's [Leong's] observations it appears that the modification required is the exclusion of headways of the first four vehicles after the start of a green signal together with those headways influenced by the presence of commercial vehicles and right-turning vehicles."[129]

Leong's decision to exclude the headways of the first four vehicles after the start of the green phase is a result of the starting delay phenomenon discussed previously.

Figure 25 contains the distribution of headways observed by Leong in which the effects of starting delay and turning vehicles have been deleted. This distribution closely matches the semi-random distribution contained in Buckley's paper.[130]

The frequency distribution of all headways observed

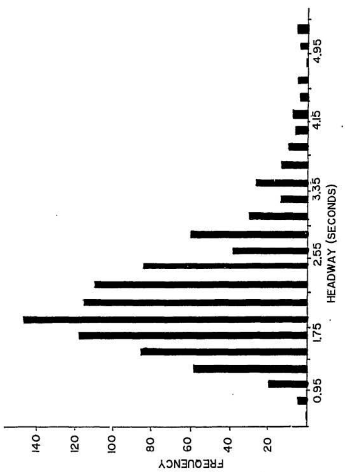

Figure 25 Distribution of headways observed by Leong at signalized intersections (headways of first four vehicles deleted)

during the data collection phase of this experiment is shown in Figure 26. There is obviously a marked likeness between the shapes of these two distributions. The frequency distribution of observed headways recorded as part of this experiment with the headways of the initial four vehicles removed, as suggested by Leong, is shown in Figure 27, and the frequency distributions of headways recorded in fair and poor weather conditions are shown in Figures 28 and 29 respectively. In all cases the shape of the distribution is similar to the semi-random distribution proposed by Buckley indicating that the distribution of the headway data observed in this experiment is in agreement with the distribution of headway data observed by others.

It is worthwhile noting that a cursory examination of the distribution of headway data under fair and poor weather conditions indicates that there were more headways of less than 1.5Ø seconds recorded in the fair weather category than there were recorded under poor weather conditions. And that, conversely, there were more headways of greater than 1.5Ø seconds recorded under poor weather conditions than under fair weather conditions. Although this observation seems to support the hypothesis that vehicle headways are affected by the weather, with longer headways more evident under poor conditions, there is at this point in the analysis, no statistical evidence to support that hypothesis.

It is also worth noting at this point that the observed

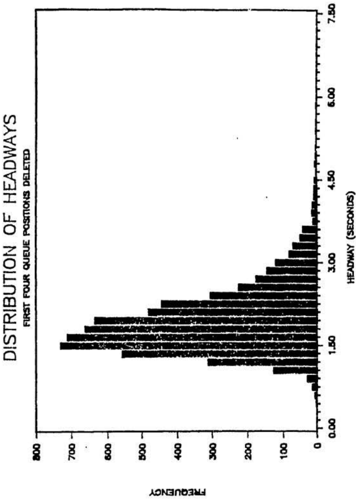

Figure 27 Distribution of observed headways - first four queue positions deleted

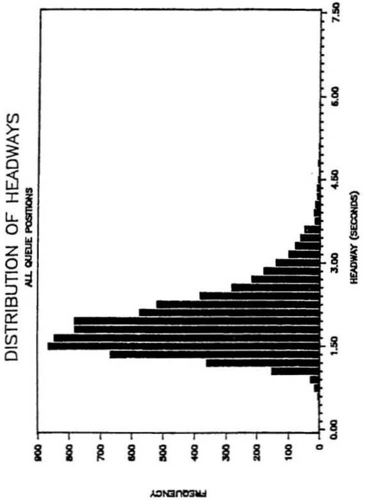

Figure 26 Distribution of observed headways - all queue positions

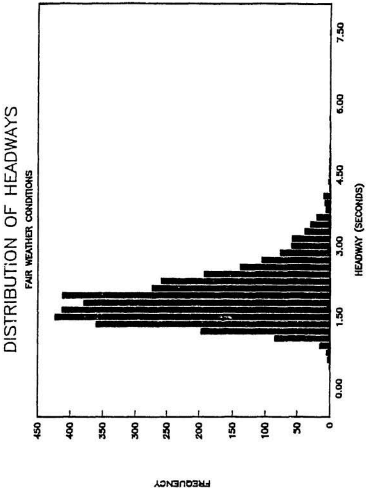

Figure 28 Distribution of observed headways - fair weather conditions

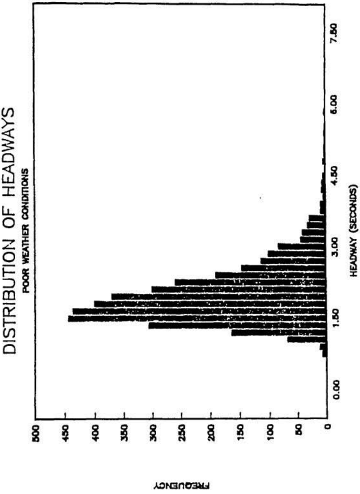

Figure 29 Distribution of observed headways - poor weather conditions

headways do not appear to be Normally distributed. This phenomenon will be discussed in detail in a later section.

6.2.2 Numerical presentation of the data

Numerical descriptive statistics can be divided into two types: firstly, quantities which are typical of the data, and, secondly, quantities which measure the variability of the data. The former are usually called measures of location and the latter are usually called measures of spread.[131]

6.2.2.1 Measures of location

Two of the more commonly used measures of location are the mean and the median. The mean of a sample is often referred to as the average of the observations that make up that sample. While the mean is generally accepted as the most important measure of location the median is also useful, particularly if the frequency distribution is skewed as it has been shown the observed headway distribution is. The median is the value of the observation that is located in the middle of the range that is formed when all observations are arranged in ascending order of magnitude. Thus half of the observations are numerically greater than the median and half are smaller.[132]

The values of the mean and the median under fair and poor weather conditions for each of the five approaches on which data was collected are shown in Tables 19 through 23.

Table 19 Summary of descriptive statistics for headways recorded at Approach 16 East

queue	mean		median	
position	fair	poor	fair	poor
1	2.03	2.08	1.95	2.02
2	1.83	1.95	1.70	1.78
3	1.83	1.93	1.77	1.93
4	1.87	2.08	1.84	2.03
5	1.64	1.87	1.55	1.80
6	1.69	1.97	1.51	1.90
7	1.68	1.78	1.56	1.67
8	1.73	1.87	1.70	1.80
9	1.75	1.96	1.57	1.92
10	1.82	1.80	1.68	1.66
11	1.79	2.05	1.71	2.00
12	1.70	1.97	1.57	1.89

Table 20 Summary of descriptive statistics for headways recorded at Approach 7 South

queue	mean		median	
position	fair	poor	fair	poor
1	1.87	1.88	1.69	1.73
2	1.94	1.97	1.81	1.86
3	1.83	1.79	1.78	1.66
4	1.70	1.78	1.59	1.57
5	1.98	1.73	1.83	1.61
6	1.77	1.91	1.68	1.69
7	1.89	1.75	1.62	1.63
8	1.88	1.76	1.86	1.58
9	1.79	1.78	1.73	1.70
10	1.70	1.80	1.68	1.67
11	1.69	1.82	1.64	1.64
12	1.72	1.74	1.57	1.71

Table 21 Summary of descriptive statistics for headways recorded at Approach 71 West

queue	mean		median	
position	fair	poor	fair	poor
1	2.06	2.07	1.94	1.96
2	2.03	2.13	1.92	1.97
3	2.03	1.95	1.90	1.87
4	1.83	1.86	1.68	1.83
5	1.94	1.75	1.79	1.68
6	1.81	1.85	1.68	1.76
7	1.92	1.87	1.86	1.73
8	1.99	1.92	1.87	1.74
9	1.87	2.07	1.75	1.90
10	1.85	1.99	1.81	1.85
11	2.06	2.13	1.86	1.88
12	1.86	2.11	1.81	2.02

Table 22 Summary of descriptive statistics for headways recorded at Approach 7 North

queue	mean		median	
position	fair	poor	fair	poor
1	2.06	1.87	1.96	1.74
2	2.06	1.86	1.96	1.77
3	1.85	1.85	1.67	1.79
4	1.95	1.92	1.89	1.80
5	1.93	1.79	1.85	1.71
6	1.82	1.86	1.79	1.80
7	1.76	1.78	1.80	1.61
8	1.71	1.81	1.69	1.79
9	1.88	1.74	1.75	1.62
10	1.89	1.91	1.84	1.80
11	1.91	1.86	1.80	1.72
12	1.74	1.83	1.62	1.77

Table 23 Summary of descriptive statistics for headways recorded at Approach 16 West

queue	mean		median	
position	fair	poor	fair	poor
1	1.81	1.88	1.68	1.80
2	1.94	2.10	1.82	1.96
3	1.91	1.96	1.84	1.83
4	1.95	1.92	1.71	1.85
5	1.94	1.90	1.89	1.88
6	1.83	1.99	1.66	1.82
7	1.85	1.90	1.75	1.78
8	1.96	2.03	1.92	1.89
9	1.89	1.98	1.91	1.83
10	1.84	1.93	1.63	1.78
11	2.15	1.90	2.06	1.89
12	1.87	2.07	1.60	1.92

From these Tables it can be seen that on each of the study approaches for each queue position under both fair and poor weather conditions the mean headway value is never less than the median value. This phenomenon is a result of the skewed nature of the headway distribution as discussed in the previous section. In a positively skewed distribution, such as those contained in Figures 26 to 29, the mean will be larger than the median.[133] Because of the skew in the distribution of observed headways, numerically more than one-half of the observations have values that are less than the value of the mean. This occurs because the mean may be considerably affected by large outlying headway observations. In this case it could be argued that, as numerically more than one-half of the observations are less than the mean, the median is actually "more typical" of the data.[134]

However, in all instances the value of the mean and median are close, and in one case are actually equal (approach 16 east, queue position 3, poor weather conditions). Generally, the difference between the value of the mean and the value of the median is always well less than one standard deviation, usually being in the range of tenths of a second or less.

Because of this closeness of mean and median, and because of the importance of the mean in statistical theory, it was decided to accept the mean statistic as the more important measure of location for the purposes of this experiment.

Included in Appendix F, Output from "cell means" procedure of SPSS/X software, is an analysis of the headway means generated using the software package SPSS/X operating on a Digital VAX mainframe system. To enable the use of the powerful analytical package of SPSS statistical software, the 7200 headway records in the final data set had to be transformed to ASCII format and downloaded into the DEC system.

When this process was complete the "cell means" procedure of SPSS/X was used to generate the contents of Appendix F. This procedure produced the total population mean, the mean headway for each level of the approach gradient factor, the mean headway for each level of the weather factor and the mean headway for each level of the queue position factor. The procedure also produced the mean headways of the cells developed by the two-way interactions of weather/gradient, position/gradient and position/weather, and by the three-way interaction of position/weather/gradient.

The mean headway of the total population of 7200 headways is 1.88 seconds. Examination of the mean headways for each of the five approach gradients indicates that the mean headways on approaches 71 West, 0.6%, and 16 West, -7.2%, are significantly greater than the overall mean headway at the 1% level, while the mean headways on approaches 16 East, +7.2%, 7 South, +3.0%, and 7 North, -3.0% are less than the overall mean headway with the mean headway on 7 south significantly less at the 1% level.

Intuitively, if it is assumed that positive approach grades adversely affect headways, it would be expected, for example, that approach 16 East with a gradient of +7.2% would have a mean headway greater than the overall mean and that approach 16 West, gradient -7.2%, would have a mean headway less than the overall mean. However, at this preliminary stage in the analysis, the data indicates that this assumption is not valid.

The mean headway values under fair and poor weather conditions are 1.86 seconds and 1.91 seconds respectively. In the case of the weather factor, the intuitive assumption that poor weather conditions adversely affect headways does appear valid as the mean headway under poor weather conditions is, in fact, greater than the mean headway under fair weather conditions. However, the mean headway under either weather condition is not significantly different from the overall mean at the 1% level.

The mean headways by position in the queue are also contained in Appendix F. Generally, the first three queue positions have mean headways greater than the overall mean and the remaining nine queue positions have mean headways less than or equal to the overall mean headway. This result is as was anticipated in the earlier discussion on the phenomenon of starting delay. However, only the first two queue positions have mean headways that are significantly greater than the overall mean headway, and then only at the 5% level of significance. The remainder of the positions have mean headways that are not significantly different from the overall mean.

Of course, if the analysis of the factorial experiment results indicates that interactions exist then the main effects of approach gradient, weather conditions, and queue position as discussed above will cease to have much meaning by themselves as the effect of one factor will depend on the level(s) of the other factor(s) involved in the interaction.[135]

6.2.2.2 Measures of spread

As well as determining the values of the measures of location, it is important when analyzing data to know how spread out the data is. The two more important measures of spread are the variance and its square root, the standard deviation. These two measures are complementary, although the standard deviation is preferred to the variance as a descriptive statistic since it has the same units as the original measurements.[136] The larger the value of the standard deviation, the more spread out about the mean the data will be. And, conversely, the smaller the standard deviation, the less spread out about the mean the data will be.

Standard deviations for the total population of 7200 headways and for the subsets of data differentiated by gradient, weather and position are included in Table 24, Standard deviations of headway subsets classified by main factors.

The standard deviation for the total population of 7200 headways is 0.61 seconds.

Examination of the variability of headways at the various study approaches indicates that on approaches 16 East, 7 South and 7 North, with gradients of +7.2%, +3.0% and -3.0% respectively, the variances of the recorded headways were less than the total population variance. However, the variances on approaches 71 West and 16 West, +0.6% and -7.2% respectively, were greater than the total population variance. There is no apparent trend nor any apparent reason for these results.

The variances of headways under the two levels of weather condition, fair and poor, are 0.36 and 0.38 respectively. The difference in these variances, with the variability being greater under poor weather conditions, is not unexpected. It can be argued that given poor weather conditions vehicle headways would cover a larger range of values as drivers adjust their driving habits to reflect operating conditions. The two values of variance for fair and poor weather conditions appear to support this assumption.

Examination of the variances calculated by queue position indicates that there is greater variability in headways for

Table 24 Standard deviations of headway subsets classified by main factors

factor	standard deviation
approach gradient	
+7.2%	0.58
+3.0%	0.59
+0.6%	0.66
-3.0%	0.54
-7.2%	0.68
weather conditions	
fair	0.60
poor	0.62
queue position	
1	0.64
2	0.64
3	0.57
4	0.61
5	0.59
6	0.60
7	0.60
8	0.59
9	0.60
10	0.58
11	0.68
12	0.62

queue positions 1 and 2 than for the remaining queue positions with the exception of position 11. The higher variances for positions 1 and 2 can be explained if it is assumed that drivers who find themselves in one of these two queue leader positions tend to react in different ways to their being in that position. Some drivers undoubtedly accelerate rapidly with the change of signal display from red to green while others may accelerate more gradually. Drivers in queue position 1 in particular are totally unrestrained from limits on acceleration because there is no preceding vehicle to provide that restraint.

The high variance observed for queue position 11 can not be readily explained. Examination of Appendix F, Output from cell means procedure of SPSS/X software, indicates that for some reason the mean headways at queue position 11 range from a low of 1.76 seconds at approach 7 South, +3.0%, to a high of 2.09 seconds at approach 71 West, +0.6%.

Table 25 contains descriptive statistical information on the data recorded at each of the twelve queue positions that have been included in the analysis. The data recorded at position 11 has considerably more variability than the data at any other queue position including positions 1 and 2 where the greatest variability might have been expected.

In light of this large variance the headway data that were recorded for queue position 11 were closely reexamined. The distribution of headways at position 11 is contained in Figure

Table 25 Summary of descriptive statistics for headways by queue position

position	mean	variance
1	1.96	0.42
2	1.98	0.41
3	1.89	0.33
4	1.88	0.38
5	1.85	0.35
6	1.85	0.36
7	1.82	0.36
8	1.87	0.34
9	1.87	0.36
10	1.85	0.33
11	1.93	0.46
12	1.86	0.39

30. When this distribution is compared to the distribution of all recorded headways contained in Figure 26 it can be seen that there is a second peak in the distribution of headways observed at position 11 at the 2.20 second mark. This second peak would explain the high value of the mean headway at position 11.

The shape of the distribution shown in Figure 30 also helps explain the large variance at position 11. Variance is a measure of how much. on average, the individual observations deviate from the mean. The broader and more gently sloping the distribution curves, the greater the variance of the population represented by that curve because more observations would be recorded further from the mean.

An interesting trend is apparent when the headway data that were observed at queue position 11 are classified by approach. A statistical breakdown by approach is contained in Table 26. Notable among the information contained in Table 26 is that the variance on approach 71 West, +0.6%, is 0.70. The variance at approach 16 West is also high at 0.54, but not nearly as high as that for approach 71 West. When the coefficient of variation is calculated for the headway data at the five study approaches for queue position 11 the value for approach 16 West falls more in line with those of the other study approaches, again with the exception of approach 71 West which remains high. The coefficient of variation is considered to be a useful parameter for measuring spread in

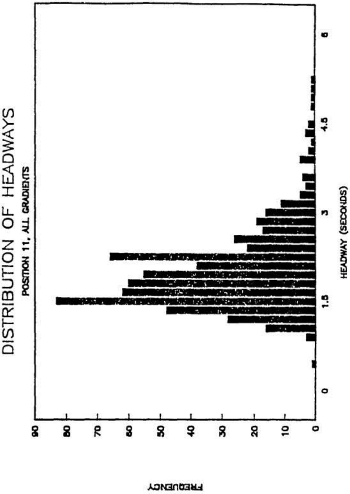

Figure 30 Distribution of observed headways - position 11

Table 26 Summary of descriptive statistics for headways at queue position 11 by approach

approach	mean	variance	coefficient of variance
overall	1.93	0.46	0.35
16 East	1.92	0.28	0.28
7 South	1.76	0.34	0.33
71 West	2.09	0.70	0.40
7 North	1.88	0.38	0.33
16 West	2.02	0.54	0.36

relative terms.[137] Here it reaffirms that there is indeed more spread of the data at position 11 on approach 71 West than at the other study approaches. This fact is further affirmed by the shapes of the distribution curves for position 11 for each of the five study approaches. These curves are presented in Figures 31 to 35.

The preceding examination of the headway data for queue position 11 has indicated that the high mean value for headways at that position is due, in large part, to the high mean value of the headways observed at approach 71 West, +0.6%. Additionally, the large variance at queue position 11 is also due chiefly to the large variance in headways on approach 71 West.

However, as to whether the data for position 11 on approach 71 West are invalid, there is no reason to believe that they are. The observations on position 11 at that approach are undoubtedly more variable than observed data for position 11 on the other study approaches but there is no apparent reason to discard them as invalid.

6.3 Factorial test results

6.3.1 Introduction

A factorial experiment is an experiment performed to determine the effects of one or more factors on the response variable of interest. The term 'factor' is used to denote

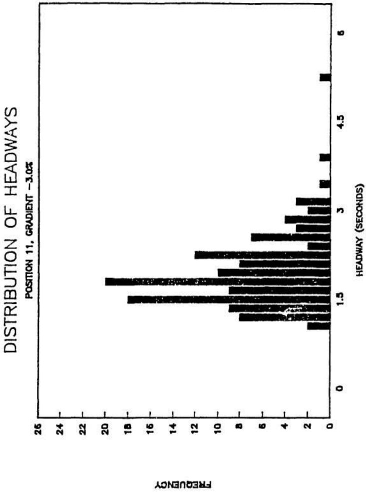

Figure 31 Distribution of observed headways at queue position 11 - approach 7 north

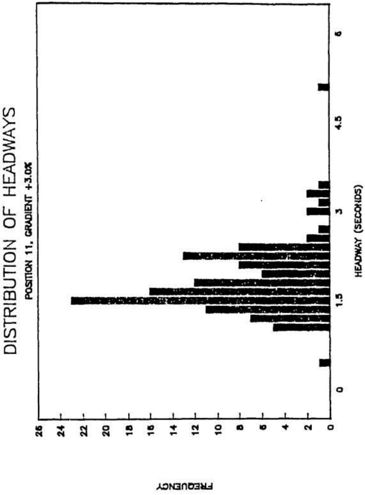

Figure 32 Distribution of observed headways at queue position 11 - approach 7 south

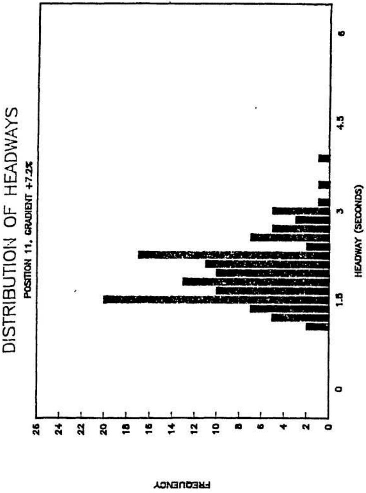

Figure 33 Distrib[illegible]tion of observed headways at queue position 11 - approach 1 [illegible]ast

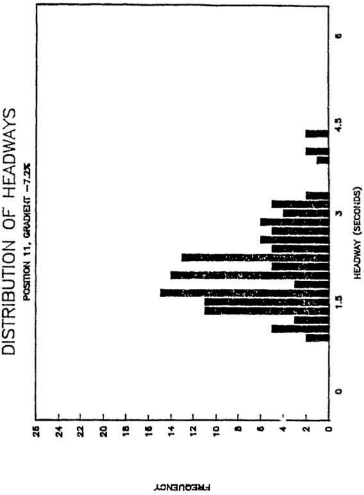

Figure 34 Distribution of observed headways at queue position 11 - approach 16 west

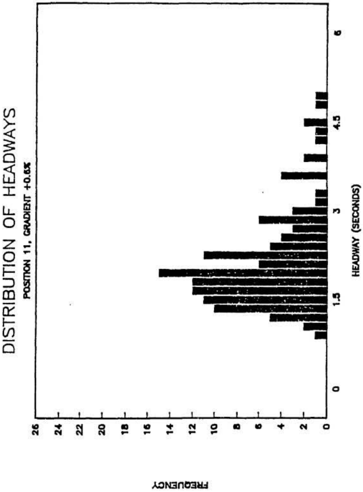

Figure 35 Distribution of observed headways at queue position 11 - approach 71 west any feature of the experimental conditions which may be assigned at will from one trial to another.

The experiment discussed here is a three-factor factorial experiment, the factors of interest being approach gradient, weather conditions and position in the queue.

There are two main types of factor: qualitative and quantitative. A qualitative factor is one in which the different levels of the factor cannot be arranged in order of magnitude, while a quantitative factor is one whose values can be arranged by magnitude. The approach gradient and queue position factors in this experiment are quantitative and the weather condition factor is qualitative.

The various values of a factor that are examined in an experiment are known as levels.. The levels assigned to the three factors in this experiment are shown in Table 27.

The number of levels of the approach gradient factor has been revised from the seven levels shown in Table 15 to the five levels as discussed in Section 5.4.

The effect of a factor on the variable of interest is the change in the response produced by a change in the level of the factor. For example, the effect of the weather factor on headway would be the change in headway that resulted from a change from fair weather conditions to poor weather conditions. This represents the main effect of weather on vehicular headways.

If the effect of one factor is different at different levels of another, the two factors are said to interact. The effect of one factor then depends on the level of another factor.

The analysis of variance (ANOVA) technique is used to test the null hypotheses that were originally postulated in Chapter Four. The ANOVA procedure determines if the main effects of the factors or if any interaction effects are statistically significant. The analysis of variance assesses by significance tests whether the observed values of the effects of the factors can be accounted for by experimental error. This assessment is performed by a series of F-tests, one for each main effect and interaction, comparing the mean square of a factor or interaction with the error mean square. If an F-test shows the mean square of a factor or interaction to be significantly greater than the error mean square, it can be inferred that changing the level of that factor does affect the response, or in the case of an interaction, that that interaction does affect the response.[138]

6.3.2 Discussion of test results

The SPSS/X software package was used to perform the analysis of variance procedure on the 7200 vehicle headways in the final data set. The output from this procedure is included as Appendix G, Output from ANOVA procedure of SPSS/X software. A summary of the results contained in this output is included in Table 28, Summary of output from ANOVA

Table 27 Revised levels assigned to factors influencing traffic operations at signalized intersections

factors:	weather conditions	approach gradient	queue position
levels:	1. fair	1. +7.2%	1. 1
	2. poor	2. +3.0%	2. 2
		3. +0.6%	3. 3
		4. -3.0%	4. 4
		5. -7.2%	5. 5
			6. 6
			7. 7
			8. 8
			9. 9
			10. 10
			11. 11
			12. 12

Table 28 Summary of output from ANOVA procedure

source of variation	d.f.	calc F	tabulated F at 1%	remarks
gradient	4	14.202	3.32	significant
weather	1	8.164	6.63	significant
position	11	3.937	2.25	significant
gradient/ weather	4	5.695	3.32	significant
gradient/ position	44	1.398	1.57	not significant
weather/ position	11	1.707	2.25	not significant
gradient/ weather/ position	44	0.851	1.57	not significant

procedure.

Table 28 indicates that the main effects of approach gradient, weather conditions and queue position on vehicle headway are all significant at the 1% level with approach gradient being highly significant. However, because the interaction of the factors of approach gradient and weather conditions is also significant at the 1% level the main effects cease to have much meaning by themselves and the effect of approach gradient on vehicle headway must be examined at each level of the weather condition factor.

The mean assessments for approach gradient and weather conditions are expressed in the two-way table contained in Table 29.

It can be seen from this Table that generally the mean headway values under fair weather conditions on the five study approaches are less than or equal to the mean headway values under poor weather conditions. The only exception is on approach 7 North, -3.0%, where, for some reason, the reverse is true and the mean headway is less under poor weather conditions.

Except for approach 7 North, the observed relationship is in line with the intuitive assumption that poor weather conditions adversely affect headways.

The analysis of variance has indicated that weather conditions do significantly affect vehicular headways, generally increasing them under poor weather conditions.

Table 29 Mean assessments for weather conditions and approach gradients

approach gradient	weather conditions		
	fair	poor	mean
16 East +7.2%	1.78	1.94	1.86
7 South +3.0%	1.81	1.81	1.81
71 West +0.6%	1.94	1.98	1.96
7 North -3.0%	1.88	1.84	1.86
16 West -7.2%	1.91	1.96	1.94

However, the presence of a significant interaction between approach gradient and weather conditions indicates that the effect of weather on headway depends to a significant degree on the gradient of the approach being considered. This is shown clearly in Figure 36.

In situations such as this, when there is an interaction between two factors and one of the factors is qualitative, as the weather factor is, the problem is to determine the functional relationship between the response variable (headway) and the continuous variable (gradient) at both levels of the qualitative factor (weather).[139] This is a problem of regression and is considered in detail in Chapter Seven.

The results of the analysis of variance also indicate that the interaction of approach gradient and queue position is barely significant at the 5% level, while the two-way interaction of weather condition and queue position is not significant. The three-way interaction of approach gradient, weather conditions and queue position is also not significant.

It is concluded that the slight interaction of approach gradient and queue position can be ignored, particularly in light of the magnitude of the interaction between approach gradient and weather conditions.

6.3.3 Verification of the factorial experimental model

In Chapter Four several assumptions were made about the

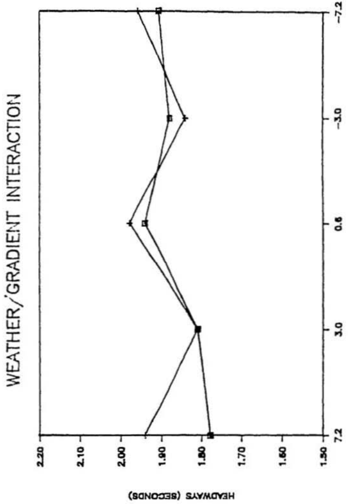

Figure 36 Interaction of weather and gradient on headways

factorial experiment's mathematical model.

The assumption of additivity was made. This says that the value of the response variable is equal to a quantity depending on the environmental conditions and the experimental unit plus a quantity depending on the treatment used.[140]

Further assumptions were made about the distribution of the error terms or residuals. The residual of an observation is the difference between the observation and the value predicted by the model.[141] The assumptions that were made are:

1. the errors were assumed to be independent (that is to say that the value of the error in one observation is not influenced by the value of the error in another);
2. the error variances were assumed to be homogeneous; and
3. the errors were assumed to be Normally distributed.

The first assumption, that of additivity, is usually considered a reasonable assumption to make.[142] Each of the three remaining assumptions is checked in the following sections.

6.3.3.1 Assumption of independent errors

In the mathematical model used to describe the factorial experiment the error terms are assumed to be distributed independently. That is, successive error terms are assumed to be uncorrelated.

To ensure, as far as possible, that there was no correlation of error terms, that there was no systematic error in the experimental results, the simple but powerful technique of randomization was used. As noted by Davies, "the artificial introduction of a chance component by allocating the treatments at random makes it appropriate to analyze the data as though the errors were independent."[143]

Nevertheless, it was thought prudent to perform a check to determine whether the residuals were independent.

An effective method of checking for correlation of successive error terms involves examining the signs of the residual terms. A pattern of positive values followed by negative values would mean that some uncontrolled factor was systematically affecting the results which would make any conclusions suspect.[144] Accordingly, the error terms were examined for patterns and none were evident, leading to the conclusion that there is no correlation of error terms and that the residuals are distributed independently. This conclusion validates the second assumption of the mathematical model that was employed in this experiment.

A sample of the residual database is included as Appendix H, Excerpt from database of residuals resulting from initial ANOVA procedure.

6.3.3.2 Assumption of homogeneous error variances

Another assumption of the factorial experiment mathematical model is that the population variance for each group of observations is the same. Visual inspection of the group variances is usually sufficient to determine if this assumption of variance homogeneity is valid.[145] Such an inspection of the data contained in Table 30, Variances of residuals, indicates that there is no reason to doubt their homogeneity.

Alternative methods of verifying variance homogeneity are Bartlett's Test and Cochran's Test. There is a hazard in applying Bartlett's Test in that "it is very sensitive to the Normality assumption. In fact, [a significant result] may result from a deviation from Normality as well as from heterogeneity of variances."[146] For this reason Cochran's Test was used to test for variance homogeneity. Cochran's Test has the requirement that sample sizes be equal. Fortunately this requirement is met. The results of this test are contained in Appendix I, Cochran's Test for variance homogeneity. These results indicate that the variances are homogeneous and that the third assumption made about the mathematical model is valid. The calculations used to perform Cochran's Test are also contained in Appendix I, Cochran's Test for variance homogeneity.

6.3.3.3 Assumption that errors are Normally distributed

The last assumption made about the factorial experiment's mathematical model is that the error terms are distributed in a Normal manner. "If the errors are not Normally distributed

Table 30 Variances of residuals

factor	level	variance
weather	fair	0.37
	poor	0.38
gradient	+7.2%	0.33
	-7.2%	0.46
	+0.6%	0.43
	+3.0%	0.35
	-3.0%	0.30
position	1	0.42
	2	0.41
	3	0.33
	4	0.38
	5	0.35
	6	0.36
	7	0.36
	8	0.34
	9	0.36
	10	0.33
	11	0.46

the true probability of chance occurrence will not be given exactly by the significance tables."[147]

The distribution of the errors is shown in Figure 37, Distribution of residuals after first ANOVA procedure. It can be seen from this figure that the distribution is roughly Normal in shape but is skewed slightly to the left, or positively, as the distribution of the original headway data.

Fortunately, Davies notes that "...for the majority of planned experiments, the use of the Normal theory tables of significance will provide an adequate approximation even when fairly large departures from Normality occur."[148]

He re-affirms this statement when he notes that the F-test in an analysis of variance is, "not very sensitive to departures from Normality."[149]

It is assumed, therefore, that the departure from Normality indicated in Figure 37 will not seriously affect the analysis and that the final assumption about the mathematical model may be considered valid.

6.4 Conclusions

The foregoing sections have validated the mathematical model used to perform the analysis of variance technique. It is now in order to determine what, if any, functional relationships exist between the factors that it has been concluded have significant effects on the response variable, vehicular headway, namely the factors of approach gradient in

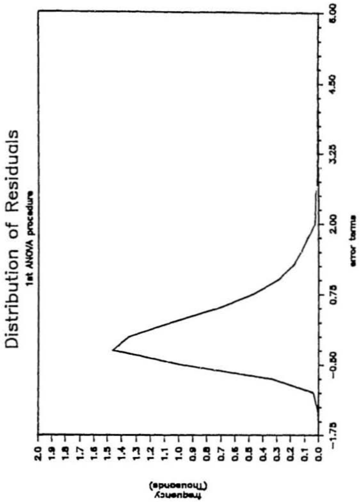

Figure 37 Distribution of residuals - first ANOVA procedure

interaction with weather.

CHAPTER SEVEN

7.0 FOLLOW-UP PROCEDURES

7.1 Introduction

The analysis conducted in the previous chapter indicated that the headway of a vehicle leaving a signalized intersection is significantly affected by the interaction of the approach gradient at the intersection with weather conditions. In other words, the effect of approach gradient on vehicle headways depends on the weather conditions.

In this chapter an attempt will be made to determine if this effect on headway can be described in terms of a functional relationship between the two factors of gradient and weather and the response variable of headway. The relationships will be developed through regression analysis.

Regression analysis is concerned with investigating the relationship between variables in the presence of random error. In particular, a model is constructed in which the dependent variable is expressed as a combination of other variables, referred to as independent variables, and the unknown parameters in the model are estimated using observed values of the dependent and independent variables.[150]

In simple terms, the result of regression analysis, the regression equation, is a statistical relationship between observed values of two or more variables.[151]

Regression analysis is distinguished from other types of statistical analyses in that the goal is to express the response variable as a function of the predictor variables. Once such an expression is obtained the relationship can be utilized to predict values of the response variable, identify which variables most affect the response or verify hypothesized causal models of the response.[152]

The intent of this phase of the experiment is to arrive at an expression through regression that performs the function first mentioned above, that is, that predicts headways of vehicles queued at signalized intersections. When the principal aim of regression analysis is to develop a prediction equation..."it is not of paramount importance that any specific set of predictor variables be included in the model nor that the regression coefficients are estimated precisely. All that is required is accuracy of prediction."[153]

With this in mind, the following sections of this chapter deal with the regression model postulated for the relationship being investigated in this experiment and the assumptions that must be met to ensure that the statistical relationships developed to fit the model are valid.

7.2 Regression of vehicular headway on the interaction of gradient and weather

The results of the factorial experiment that has been described in the previous chapter indicated that the position of a vehicle in a queue on an approach to a signalized intersection significantly affects the headway of that vehicle. This is a reasonable result considering the previous discussion in Section on starting delay. It would be expected that the headways of the vehicles in leading queue positions would be greater than those of vehicles further back in the queue as a result of the reaction time of drivers in the early queue positions to the start of the green phase. Thus, there appears to be a relationship between position in the queue and headway.

Similarly, the factorial experiment led to the conclusion that the main effects of approach gradient and weather conditions also significantly affected vehicle headways.

However, because the analysis of variance identified the existence of a significant interaction, these main effects ceased to have much meaning since the effect of one factor is influenced by the level of another factor.

Specifically, at any one time, the effect of approach gradient on headways depends on the weather conditions that exist at that time. Thus, there appears to be a relationship between weather, gradient and headway. The task is to attempt to specify the form of this relationship. Because weather is a qualitative variable the effect of approach gradient on headways must be examined separately at both levels of the weather factor.[154]

7.3 Model specification

7.3.1 Preliminary data analysis

To obtain correct model specification in a regression analysis two important aspects have to be considered; "all relevant variables must be contained in the database and the proper functional form of each predictor must be defined in the prediction equation."[155]

With regards to the first aspect, many of the variables that affect headways were neutralized at the experimental design phase by ensuring that they were at the same level on each of the study approaches. This matter is discussed in Chapter Three. The variables of interest, those whose effects were not nullified, were analyzed by the analysis of variance technique, as discussed in the previous chapter. This analysis of variance led to the conclusion that the variable of approach gradient interacting with the variable of weather conditions significantly affects the vehicular headways of vehicles leaving signalized intersections. These two relevant variables are contained in the database.

With regards to the second aspect of correct model specification, before attempting to specify the form of the regression equation that models the relationship between dependent and independent variables it is often useful to plot the independent or predictor variables, in this case, weather and approach gradient, against the dependent or response variable, headway, to see if the form of the model suggests itself. Figures 38 and 39 contain plots of approach gradient versus mean headway r' each level of the weather condition factor. Figure 38 shows the plot of approach gradient versus mean headway for fair weather conditions and Figure 39 shows the plot of gradient versus mean headway for poor weather conditions.

Examination of Figure 38 indicates that, with the exception of the mean headway data point for approach 71 West which has a gradient of +0.6%, the data points lie roughly in a straight line having a negative slope. This is contrary to what would intuitively be expected (ie. that headways would decrease on negative grades). This phenomenon of headways being greater on negative gradients may be the result of drivers maintaining more of a cushion between themselves and preceding vehicles on downgrades than on upgrades in an effort to compensate in some degree for the effect of gravity. However, the phenomenon is not as pronounced under poor weather conditions, although a regression line superimposed on the mean headways under poor weather conditions does have a slight negative slope as shown in Figure 39.

The data plotted in Figures 38 and 39 are contained in Table 31. There are several points that can be noted about this data.

Firstly, under both weather conditions the mean headway value is largest at approach 71 West, +0.6%, which is the most level of the approach grades studied. This result would not

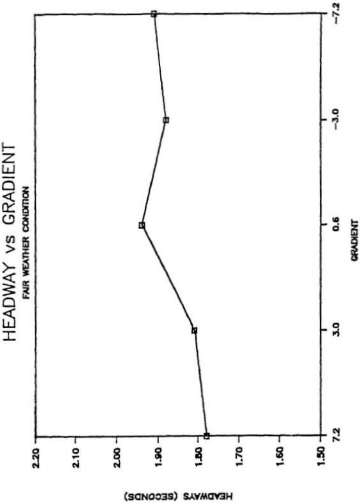

Figure 38 Approach gradient versus mean headway for fair weather condition

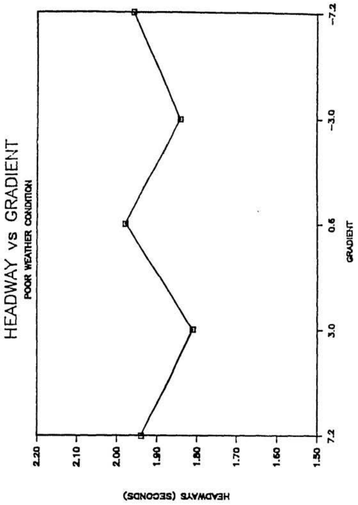

Figure 39 Approach gradient versus mean headway for poor weather condition

Table 31 Means of observed headways by weather condition and approach gradient

		weather conditions			
		fair		poor	
approach	gradient	mean	variance	mean	variance
16 East	+7.2%	1.78	0.31	1.94	0.34
7 South	+3.0%	1.81	0.37	1.81	0.33
71 West	+0.6%	1.94	0.40	1.98	0.46
7 North	-3.0%	1.88	0.28	1.84	0.29
16 West	-7.2%	1.91	0.44	1.96	0.47

intuitively be expected.

Secondly, as a general trend, headways are slightly higher under poor weather conditions, as might be expected.

Thirdly, and most importantly, from the point of view of model specification, no numerical transformation of the data to make the relationship more linear suggests itself.

7.3.2 Smoothing of the data

There are two problems that complicate the specification of a regression model in the case at hand. The first, that there are only five data points with which to work, results from the fact that only five intersection approaches qualified as successful candidates for data collection under the criteria outlined in Chapter Three, Selection of study intersections. With so few data points it is difficult to see trends develop in the data.

The second problem is the scatter of the data. In an effort to get a better idea of the form of the relationship between headway and gradient the technique of "smoothing" was employed.

"Data smoothing techniques aid in specifying the form of response or predictor variables by reducing the variability of plotted observations and enabling trends to be more clearly recognized."[156] Median smoothing was used to reduce the variability of the observations in this case.

The mean headway values before and after smoothing are contained in Tables 32 and 33 for fair and poor weather conditions respectively. The plots of the smoothed values are contained in Figures 40 and 41.

The median smoothing technique involves ordering the data from first to last according to the magnitude of the gradient. The first two columns of Tables 32 and 33 exhibit this arrangement. Next, the first and last headways are rewritten in the third column of the tables. The second headway is replaced by the median of the first, second and third headways. Then the third headway is replaced by the median of the second, third and fourth headways. Each headway is replaced in column three of Tables 32 and 33 by the median of the three headways including the ones immediately before and after it. Smoothing can be repeated until no changes occur in the smoothed values.[157]

The plots of the smoothed data contained in Figures 40 and 41 reinforce the conclusion reached earlier that no numerical transformation of the data resulting in a more linear relationship is suggested.

Therefore, it is postulated that the functional relationship between approach gradient and headway is of the form

$$Y = A + BX$$

for both fair and poor weather conditions.

7.3.3 The linear model

Linear regression is based on the hypothesis that a

Table 32 Mean headways before and after data smoothing for fair weather condition

fair approach	gradient	mean headway	smoothed headway
16 East	+7.2%	1.78	1.78
7 South	+3.0%	1.81	1.81
71 West	+0.6%	1.94	1.81
7 North	-3.0%	1.88	1.88
16 West	-7.2%	1.91	1.91

Table 33 Mean headways before and after data smoothing for poor weather condition

poor approach	gradient	mean headway	smoothed headway
16 East	+7.2%	1.94	1.94
7 South	+3.0%	1.81	1.94
71 West	+0.6%	1.98	1.84
7 North	-3.0%	1.84	1.96
16 West	-7.2%	1.96	1.96

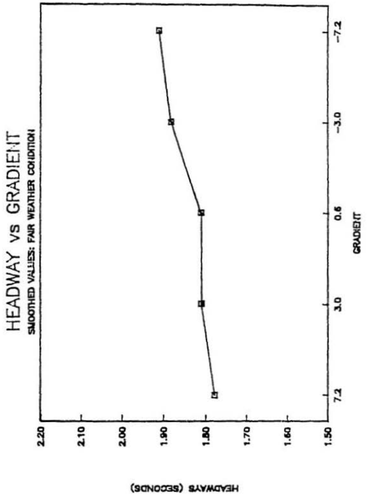

Figure 40 Approach gradient versus smoothed mean headway for fair weather condition

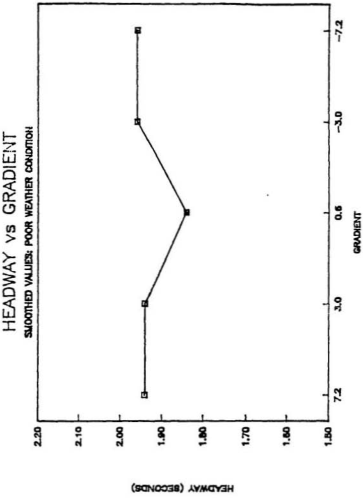

Figure 41 Approach gradient versus smoothed mean headway for poor weather condition

linear relationship exists between the response and predictor variables. The linear relationship takes the form

$$Y = A + BX + E$$

where Y = the response variable, headway

X = the predictor variable, approach gradient

A,B = the regression coefficients, and

E = the error

The error, E, reflects the fact that the observed vehicular headways are subject to variability and cannot be expressed exactly as linearly dependent on approach gradient. "The error, E, can be due to only random fluctuation of the responses, to predictor variables that have erroneously been left out of the relationship, to incorrect specification of the relationship or to some combination of these."[158]

Because of the qualitative nature of the weather predictor variable, there will be two equations of this form; one for each level of the weather factor.

7.4 The regression procedure

As with the analysis of variance, or ANOVA procedure discussed in Chapter Six, the SPSS/X software package was used to perform the regression analysis. The data set was separated into two data sets representing poor and fair weather conditions. For each data set the response variable, headway, was regressed on the approach gradient factor. The output from this procedure is included in Appendix J, Output from regression procedure of SPSS/X software. A summary of the results contained in the output is included in Table 34, Summary of output from regression procedure.

7.4.1 Least squares parameter estimation

"Among the many possible estimators of coefficients in a linear regression model, least squares parameter estimation is overwhelmingly the most popular. Least squares estimation has been accepted almost universally as the best estimation technique for linear regression models."[159]

If one is using a prediction equation of the form

$$y = a + bx$$

to predict responses for the model discussed in Section 7.3.3,

$$Y = A + BX + E$$

a measure of how well "y" predicts the response variable "Y" is the magnitude of the residual, "r", defined as the difference between "Y" and "y":

$$r = Y - y$$

The least squares estimators of the regression coefficients, "a" and "b", are chosen so that the sum of the squared residuals is as small as possible.[160]

However, within this strength of the least squares parameter estimation technique lies one of its greatest weaknesses. Using least squares estimation, "the prediction equation can be computed regardless of whether the true model has been completely and properly specified. Least squares

Table 34 Summary of output from regression procedure

parameter	fair	poor
R-square	0.00378	0.00067
standard error	0.61298	0.61540
F-test statistic	29.3922	5.25577
constant	1.86688	1.89383
slope of regression line	-0.7367	-0.3323
SSE, sum of squares due to error	2909.80	2980.55
SSR, sum of squares due to regression	11.0441	1.99048

estimation merely guarantees that the sum of squared residuals will be minimized by the estimates of the parameters for the model used to obtain a predictor. It neither guarantees that the model used is the correct one nor that the sum of the squared residuals for the resulting prediction equation will be small (only that they will be as small as possible for the model used).[161] The analyst must be aware that least squares estimation will always produce a prediction equation, but that whether that prediction equation fits the data or whether other possible predictors should be included in the equation must also be considered.

7.5 Measures of fit

Because the least squares estimation technique will always produce a prediction equation regardless of whether the specified model is correct, measures of the adequacy of the fit should be examined prior to an attempt to interpret the prediction equation.[162] "While the ultimate decision of whether the fitted model does adequately predict the response variable often must be based on the purpose of the investigation and the degree of accuracy desired by the experimenter or data analyst, statistical measures of the fit are also available to aid in the assessment."[163]

7.5.1 Partitioning the variability

"Statistical analysis of data occurs because responses are variable."[164] One measure of this variability in data is a quantity called the Adjusted Total Sum of Squares, TSS(adj). This quantity is the sum of the squares of the differences between each observation in a data set and the mean of all observations.

In a similar fashion to that employed in the Analysis of Variance technique discussed in Chapter Six, the Adjusted Total Sum of Squares can be broken down or partitioned as follows:

$$TSS(adj) = SSR + SSE$$

where SSR = Sum of Squares due to Regression of Y on X

SSE = Sum of Squares due to Error

The Residual Sum of Squares (SSE) measures the variability in the responses that cannot be attributed to the responses all falling on the fitted regression line. If the regression line gives a "good" fit, the value of SSE would be very small compared to the value of SSR. A large residual variation, SSE, may mean that the residuals are large and the fit of the prediction equation to the observed data is poor. In similar fashion, a small value for SSR may mean the predictor variable is of little use in predicting the response.[165]

The Sum of Squares due to Regression and the Sum of Squares due to Error are contained in Table 34, Summary of output from regression procedure, for both levels of the weather condition factor.

In both cases the value of SSE is much larger than the value of SSR, although for the fair weather case the results are marginally better. However, the magnitude of the differences between the SSE and the SSR is such that, in both instances it can be concluded that the calculated regression line does not yield a statistically "good" fit to the observed data.

7.5.2 Analysis of variance

The partitioning of the total variation enables the testing of the following hypothesis:

Ho: B equals Ø   Ha: B does not equal Ø

This amounts to testing the null hypothesis of no linear relationship between the predictor variable and the response against the alternative of such a relationship. This test may be referred to as testing the significance of the regression relationship.[166]

The calculated F-statistics for both levels of the weather factor are contained in Table 34, Summary of output from regression procedure. In both cases, there is a highly significant acceptance level for the alternative hypothesis. In other words, there is strong indication that a linear relationship exists between the predictor variable and the response.

For the fair weather condition, the level of significance is Ø%. For poor weather it is 2.2%.

These levels of significance seem to indicate that without a doubt a statistically significant linear relationship exists, particularly in the case of the fair weather scenario.

7.5.3 Analyzing the standard error of the estimate

The fact that for any population of observations, virtually 90% or more of the population lies within three standard deviations of the population mean can be used to give a better idea of how accurately the prediction equation can be expected to perform. For a fitted model, a response that is predicted for a specific value of the independent variable should not be considered a precise estimate. The true response can crudely be expected to lie within three standard deviations or standard errors of the predicted response.[167]

The standard errors calculated by the regression procedure are contained in Table 34, Summary of output from regression procedure. The standard error of the estimate under fair weather conditions is 0.613 seconds, and under poor weather conditions, which are slightly more variable, is 0.615 seconds.

Three standard errors in both cases is approximately 1.84 seconds, meaning that there is a range of 3.68 seconds around the predicted values of headways when approach gradient is used as the predictor variable. This indicates that there is reason to doubt the ability of the model that has been specified to accurately predict headways.

7.5.4 Coefficient of determination

The coefficient of determination, R-Square, is a measure of the association between two variables. It is helpful when attempting to determine or quantify in some form the strength of a relationship between two variables.

Although it is actually the square of Pearson's r, a computational simplification makes it possible to define R-Square as

$$\text{R-Square} = SSR/(SSR + SSE)$$

In this form, R-Square can be seen to be the proportion of the adjusted variation in the responses that is attributed to the estimated regression line. If the residuals are small, then R-Square approaches a value of 1.0. If the residuals are large, then R-Square approaches a value of 0.[168]

The values of R-Square for the regressions performed under both fair and poor weather conditions are also contained in Table 34, Summary of output from regression procedure.

The coefficient of determination for the fair weather case indicates that only 0.38% of the variability of the responses can be attributed to the regression of headway on gradient. Similarly, a negligible 0.07% of the variability can be assigned to the regression under poor weather conditions. Such small values of R-Square in equations that are to be used to make predictions are causes for concern.

"...the coefficient of determination [is] one of the most important measures of the adequacy of prediction equations...before confidence can be placed in predictions from a fitted model, R-Square must be considered sufficiently large by the data analyst. A large value of R-Square does not necessarily guarantee accurate prediction [...] but it should be required before undue claims are made about the fitted model.[169]

Obviously, the values of R-Square that have been calculated in this experiment indicate that the prediction equations that have been produced by the regression of headway on approach gradient under both fair and poor weather conditions are not able to produce accurate predictions of headway. In the case of poor weather conditions, 99.93% of the variability is still left unexplained. The results are not much better in the fair weather case where 99.62% of the variability remains unaccounted for.

7.5.5 Concluding discussion on measures of fit

It is apparent from the preceding sections that the prediction equations that have been generated during the regression analysis are not capable of accurately predicting vehicular headways. The variability in the responses that cannot be attributed to the responses all falling on the regression line (SSE) is much larger than that which is accounted for by the regression of headway on gradient (SSR), there are large standard errors of the estimate under both fair and poor levels of the weather factor indicating a wide variability in the range of predicted responses at any one value of the predictor variable, and the coefficient of determination, R-Square, is very small for both levels of the weather factor, reinforcing the fact that little of the variability of the responses can be accounted for by the regression of headway on gradient.

However, the analysis of variance sub-procedure in the regression procedure does indicate at a highly significant level that a linear relationship between headway and gradient does in fact exist. These conclusions appear to be contradictory. Therefore, before attempting further discussion on this apparent contradiction, it may be prudent to examine the assumptions upon which the regression procedure is based to ensure that the model, as specified, is actually valid so that the inferences that are drawn about the model are also valid.

7.6 Assumptions of regression

The essential problem of regression is to find the most suitable form of equation to predict one variable from the values of one, or more, other variables. This involves estimating the unknown parameters of the regression equation. When certain conditions exist, the parameters estimated by the least squares method are the maximum likelihood estimates.[170]

These conditions are:

1. predictor variables are nonstochastic and are measured without error,
2. the model is correctly specified,
3. model error terms have zero means, are uncorrelated and have constant variances, and
4. model error terms follow a Normal probability distribution.[171]

If these conditions exist the least squares method will lead to optimum estimates of the unknown parameters.[172]

It should be noted that the last two assumptions are identical to the assumptions made about the mathematical model for comparative experiments. In fact, these same assumptions apply to many models used in statistical analysis.[173]

7.7 Verification of assumptions by analysis of residuals

7.7.1 Assumption that predictor variables are nonstochastic

The assumption that the predictor variables are nonstochastic and are under the control of the data analyst implies that the analyst can exactly record the value of all predictor variables in the database.[174]

As was discussed in detail in Chapter Three, Selection of study intersections, considerable care was taken when selecting the intersection approaches upon which data was collected to neutralize all but the factors of interest. The five approaches that were finally selected had gradients that were recorded with sufficient exactness to ensure that no bias was incurred.

Therefore, the assumption that the predictor variables are not random and are under the control of the data analyst is valid.

7.7.2 Assumption that the model is correctly specified

The assumption that the model is correctly specified states that the model is functionally correct, that all relevant predictor variables are included in the model and that, apart from random error, the exact form of the relationship between response and predictor variable is known.[175]

Model misspecification will obviously result in poorly estimated regression parameters. However, detecting model misspecification is not an easy task. A number of useful graphical techniques employing an analysis of residuals to detect model misspecification do exist.

From the definition of residuals, it can be shown that the correlation between the residuals and the predictor variable is zero. Hence, there should be no discernable trend in the plot of residuals versus the predictor, only a random scatter of points about the line: residual = 0.[176]

Standardized scatterplots of the residuals versus the predictor variable, gradient, are contained in Figures 42 and 43 for fair and poor weather conditions respectively. Neither

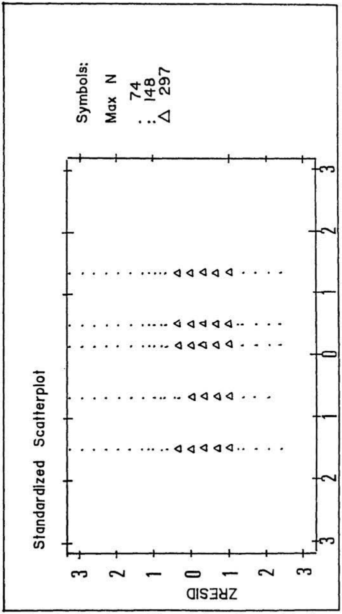

Figure 42 Standardized scatterplot of residuals versus predictor variable for fair weather condition

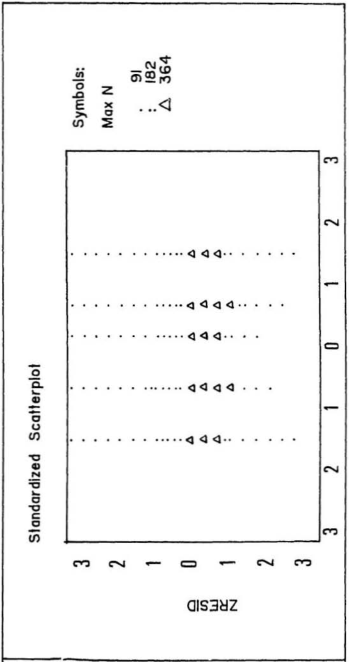

Figure 43 Standardized scatterplot of residuals versus predictor variable for poor weather condition

plot contains a trend that might indicate that the error variances are not homogeneous or that some type of transformation is needed (wedge-shaped plots), nor does either plot have a curvilinear trend indicative of the need for a higher power term in the prediction equation. Both plots appear randomly scattered along a horizontal band indicative of correct model specification. However, in both plots, slightly more than one-half of the points fall below the line on which the residuals equal zero.

Nevertheless, the plots contained in Figures 42 and 43 indicate that the regression model does not appear to have been grossly misspecified.

7.7.3 Assumption of zero mean

The checking of the last two assumptions about the model's error terms includes determining whether the errors are correlated, have the same constant variance, have zero mean and are Normally distributed. Because the residuals, "are multiples of the error terms, they [the residuals] should serve as good indicators of violations of these assumptions."[177] With this in mind the residuals are analyzed in detail in the following sections.

"For regression models containing intercept terms [the assumption that the error terms have zero means] is not at all restrictive since models of the form

$$Y = A + BX + E$$

where "E" has a population mean, d, not equal to zero can always be rewritten as

$$Y = (A + d) + BX + (E - d).$$

The error term (E - d) has mean zero. This model is indistinguishable from the usual linear regression model in which the assumption of zero mean is valid. Hence, the two models are equivalent and one can always assume the errors have mean zero when regression models are specified with constant terms."[178]

Because the regression model that has been specified does have an intercept term, the assumption that the error terms have zero mean can be accepted as valid. This is confirmed by examination of Tables 35 and 36, Residual statistics resulting from regression of headway on gradient under fair and poor weather conditions respectively, which shows that in both cases the mean of the residuals is zero.

7.7.4 Assumptions that error terms are uncorrelated

The assumption that the error terms are uncorrelated means that the errors are independent of one another, that the magnitude of the error for one response does not affect the magnitude of the error of any other response.

Generally, it can be said that, "databases compiled from...random samples of populations can often be assumed to have uncorrelated errors."[179] This is reiterated by Davies who notes that, "the artificial introduction of a chance

Table 35 Residual statistics resulting from regression of headway on gradient under fair weather condition

Statistic	Mean
predicted value	1.86
standardized predicted value	0.00
residual	0.00
standardized residual	0.00
studentized residual	0.00

Table 36 Residual statistics resulting from regression of headway on gradient under poor weather condition

Statistic	Mean
predicted value	1.89
standardized predicted value	0.00
residual	0.00
standardized residual	0.00
studentized residual	0.00

component by allocating the treatments at random makes it appropriate to analyze the data as though the errors were independent."[180]

A random sample of one hundred and twenty consecutive residuals was examined for any patterns that might exist. A sample of this size was arbitrarily selected for examination because of the cumbersome sizes of the databases for poor and fair weather conditions. The results of this analysis are contained in Appendix K, Examination of residuals for autocorrelation after first regression procedure.

The results indicate that the error terms are uncorrelated and that, therefore, this assumption is valid.

7.7.5 Assumption of constant variance

The assumption that all error terms have the same variance will automatically be true if the errors are independent observations from the same population.[181] As the results of the previous section indicated that the errors are in fact independent it follows that the variance is constant.

However, although variances that are not constant do not bias the estimates of the regression coefficients, they do bias the estimates of the standard errors of the coefficients, resulting in biased tests of hypotheses about those regression coefficients. Because of this an examination of the plot of residuals against predicted values was undertaken to doubly ensure that heteroscedasticity does not exist.[182]

These plots are contained in Figures 44 and 45, Plot of standardized residuals versus standardized predicted values of headway, fair and poor weather conditions respectively. The fact that the points in these plots lie roughly in a horizontal band is proof that the variances are not heteroscedastic and that the assumption of constant variance is valid.[183] This conclusion can be reached because the correlation coefficient between the residuals and the predicted values is always zero for prediction equations with intercepts, meaning that any plot of residuals versus predicted values should reflect a random scatter of points about a line with zero slope as Figures 44 and 45 do.[184]

7.7.6 Assumption of Normality

The assumption that the error terms are Normally distributed is the basis for the tests of hypothesis that form part of the regression analysis. Normality of the distribution of the errors is required for the significance tests which usually follow the least squares fitting procedure.[185]

One method of checking the validity of the Normality assumption is to plot the residuals as a histogram which can then be examined to check that the residual distribution " 'looks' approximately Normal".[186] Figures 46 and 47 contain histograms of the standardized residuals for fair and poor weather conditions respectively. Examination of these plots

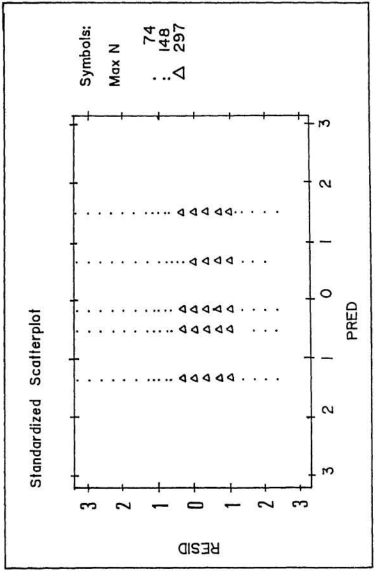

Figure 44 Standardized residuals versus standardized predicted values of headway for fair weather conditions

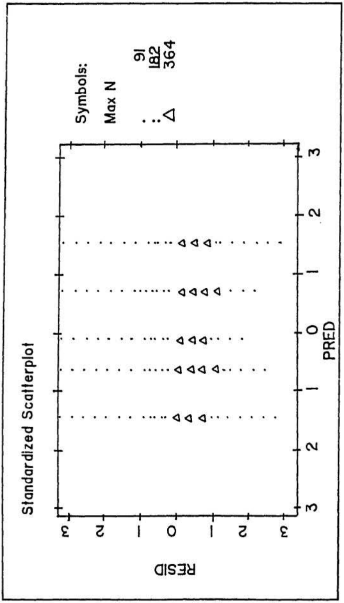

Figure 45 Standardized residuals versus standardized predicted values of headway for poor weather conditions

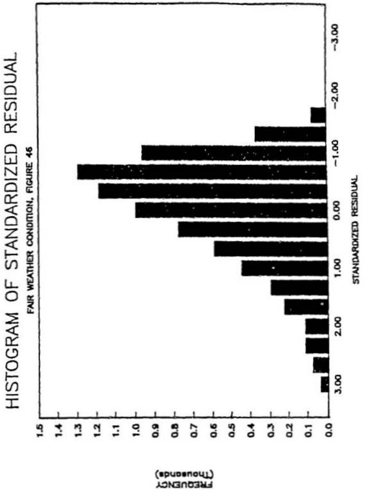

Figure 46 Histogram of the standardized residuals for fair weather condition

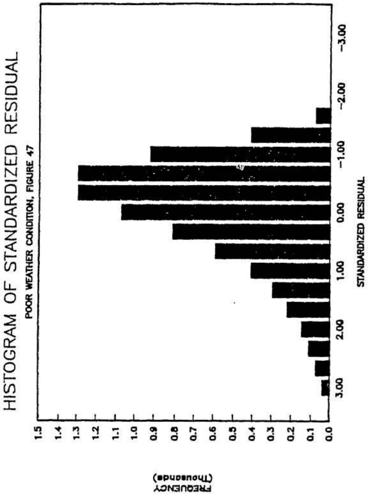

Figure 47 Histogram of the standardized residuals for poor weather condition

indicates that the distributions in both cases are skewed as were the original headway distributions. However, Davies notes that tests of significance are not very sensitive to departures from Normality, especially if the sample size is large.[187]

This is further confirmed by Gunst and Mason who note that the assumption that the residuals are Normally distributed is difficult to guarantee and that, "violations of this assumption may not be readily detectable. Fortunately, such violations often do not seriously affect the probability distributions of the least squares estimators or inferences made for these probability distributions.[188]

However, the skew of the frequency histograms in Figures 46 and 47 may be outside tolerable levels. This observation is given further weight when the Normal probability plots of the standardized residual are examined. These plots are included as Figures 48 and 49. For Normally distributed residuals, the plots should follow straight lines drawn from corner to corner on the plots. The probability plots for both weather conditions start below the theoretical line but then quickly climb above it in a systematic S-shape.

This trend in the Normal probability plots indicates that the residuals are not Normally distributed.

Therefore, it appears that the assumption that the error terms are Normally distributed is not valid for the model under consideration. This lack of Normality means that the

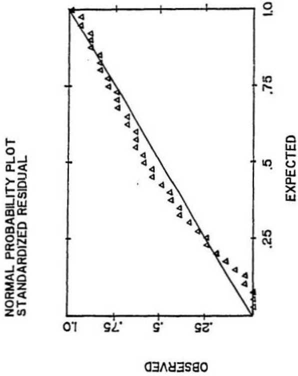

Figure 48 Normal probability plot of the standardized residual for fair weather condition

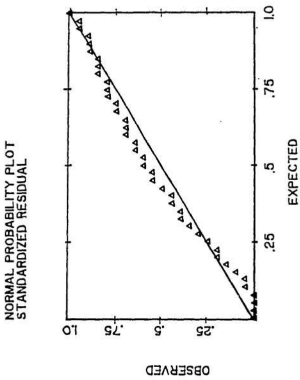

Figure 49 Normal probability plot of the standardized residual for poor weather condition

results of the significance tests that form part of the regression analysis will not be valid.

A lack of Normality can also distort the magnitude of the residuals which will lead to poorly estimated model coefficients.[189] This distortion of the residuals has occurred as can be seen from an examination of Figures 50 and 51.

These figures contain casewise plots of the standardized residuals that have an absolute value greater than three. For both fair and poor weather conditions all the residuals that meet this condition are positive. This is a direct result of the long positive tail of the skewed distributions of the standardized residuals contained in Figures 46 and 47.

It will be recalled that in Chapter Six, Analysis of headway data, Section 6.3.3.3, Assumption that errors are Normally distributed, it was concluded that the deviation from Normality that was evident in Figure 37, Distribution of residuals after first ANOVA procedure, was not large enough to significantly affect the inferences being drawn regarding which of the factors being studied significantly affected the response variable of headway.

However, the apparent dilemma that was discussed in Section 7.5.5, Concluding discussion on measures of fit, where the variability in the responses due to the regression of headway on gradient and the value of the coefficient of determination were small while there was evidence, as a result

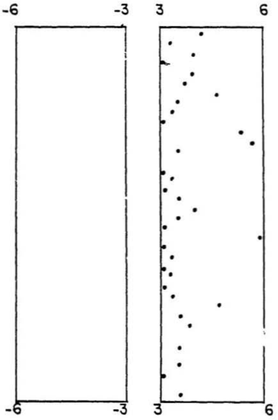

Figure 50 Casewise plot of the standardized residuals that have absolute value greater than three for fair weather condition

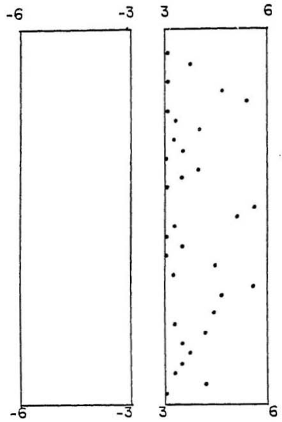

Figure 51 Casewise plot of the standardized residuals that have absolute value greater than three for poor weather condition

of the analysis of variance sub-procedure in the regression procedure, that a highly significant linear relationship did in fact exist between headway and gradient, has resulted in a more careful examination of whether the assumptions upon which regression is based are valid. This reexamination has led to the conclusion that the requirement of Normality of the distribution of the residuals is not met.

Accordingly, to bring the database more in line with the required assumption of Normality, the data will have to be transformed in some manner so that its distribution more closely follows the Normal distribution.

CHAPTER EIGHT

8.0 TRANSFORMATION OF THE DATA

8.1 Introduction

The assumptions upon which the linear regression model is based have been discussed in the preceding Chapter. If it is not possible to satisfy these requirements in the original scale of measurement of the response, as has been indicated, it may be that there is a transformation of the response that will yield the required satisfaction of the assumptions.[190]

As Davies notes, it is a fact of experimental design that, " data are not always recorded in the form most suitable for statistical analysis".[191] Continuing in a similar vein in another of his texts, Statistical Methods in Research and Production, he states that, "occasionally it will be found that a distribution departs so far from Normality that it would not be safe to apply the common statistical tests, and it would be a great advantage if, by a simple transformation of the variable, an approximately Normal distribution could be obtained."[192]

This Chapter details the transformation of the collected data so that its frequency distribution more closely follows the Normal distribution.

8.2 Transformation of the data

The frequency distribution of the response in this experiment, vehicle discharge headways, is contained in Figure 52, Frequency distribution of the response variable. This figure indicates that the distribution of the recorded data is positively skewed. This phenomenon is not unexpected. "Skewness frequently occurs when there is some natural limitation or variation which foreshortens the distribution curve in one direction."[193] There is obviously a physical limitation involved when dealing with vehicle headways under normal operating conditions, in that beyond a certain limit drivers in traffic will not follow the preceding car any closer than what they consider to be a safe following distance. This characteristic sets the limit on the peaked, foreshortened side of the skewed distribution. The long tail of the distribution can be explained by the presence in any stream of traffic of a number of drivers who feel more comfortable with a larger than usual following distance or headway.

As mentioned, it is obvious from visual inspection of Figure 52 that the distribution is positively skewed. This is confirmed by the value of the coefficient of skewness at 1.387. The coefficient of skewness is the standardized third moment of the parent distribution. The third moment denotes the mean value of the cubes of deviations from the mean. For symmetrical distributions, and in particular for the Normal

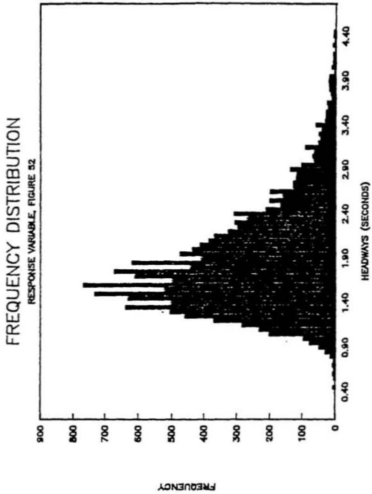

Figure 52 Frequency distribution of the response variable

distribution, positive and negative cubes cancel and the coefficient of skewness is zero. When the long tail of the distribution is in the direction of positive values the positive cubes outweigh the negative cubes, the coefficient is positive and the distribution is said to be positively skewed.

In addition to being skewed, the frequency distribution also exhibits a significant degree of kurtosis. The coefficient of kurtosis is given by the standardized fourth moment of the parent distribution where the fourth moment is the mean value of the fourth powers of deviations from the mean. For the Normal distribution, the coefficient of kurtosis is zero. When the coefficient is less than zero the distribution has shorter tails and squarer shoulders than the Normal distribution. When the coefficient of kurtosis is greater than zero the distribution has long tails and is more sharply peaked than the Normal distribution and is said to be leptokurtic. The coefficient of kurtosis for the frequency distribution of recorded headways is 4.245 and it is concluded that the distribution displays marked leptokurtosis.[194]

In an attempt to transform the recorded headway data to bring its distribution more in line with the requirement of Normality, four separate transformations were performed on the recorded database using the SPSS "compute" procedure. These transformations were:

1.inverse transformation

2. squared transformation

3. square root transformation, and

4. logarithmic transformation.

The frequency distributions for the transformed databases are contained in Figures 53 to 56.

For inspection and comparison purposes Table 37 contains the values of the coefficients of skewness and kurtosis for the four transformations.

From Table 37 it can be seen that the inverse and square transformations result in distributions that have higher coefficients of skewness and kurtosis than the observed distribution. Of the two remaining transformations which have values of these coefficients less than the observed, the square root and logarithmic, the logarithmic transformation produces a frequency distribution containing the lowest values for the coefficients of skewness and kurtosis.

Plots of the cumulative frequencies for the observed distribution and for the four transformed distributions are contained in Figures 57 to 61. These plots are on probability scale paper. A plot of the frequencies associated with the Normal distribution on such paper will result in a straight line. Inspection of Figure 57, Cumulative frequency of the observed data, reaffirms the conclusion that the distribution of that data is not Normal. Similarly, the probability plots for the distributions of the data after the inverse and square transformations, Figures 58 and 59 respectively, indicate that

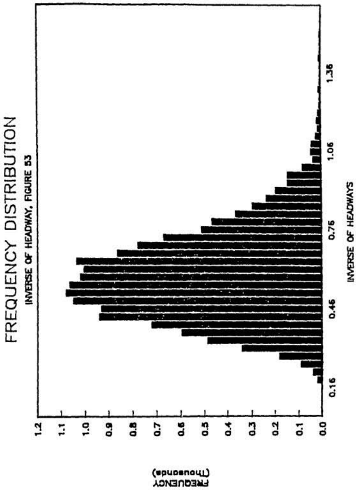

Figure 53 Frequency distribution of the inverse transformed datab

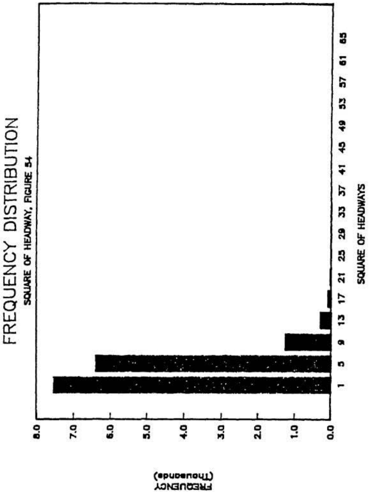

Figure 54 Frequency distribution of the squared transformed database

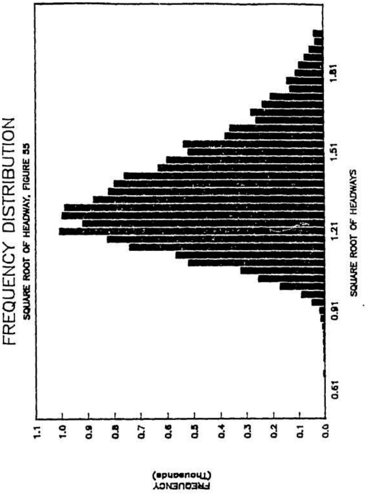

Figure 55 Frequency distribution of the square root transformed database

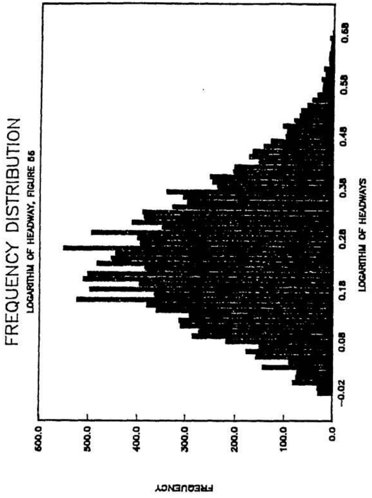

Figure 56 Frequency distribution of the logarithm transformed database

Table 37 Comparison of measures of skewness of frequency distributions for transformed databases

transformation	skewness	kurtosis
observed	1.387	4.245
inverse	1.406	9.179
squared	4.070	48.66
square root	0.741	1.199
logarithmic	0.187	0.451

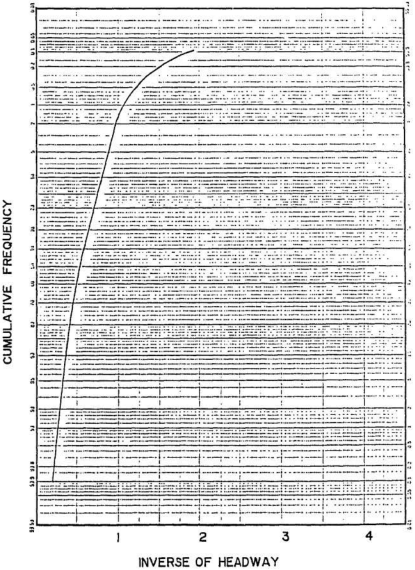

Figure 58 Plot of cumulative frequencies for the inverse transformed distribution

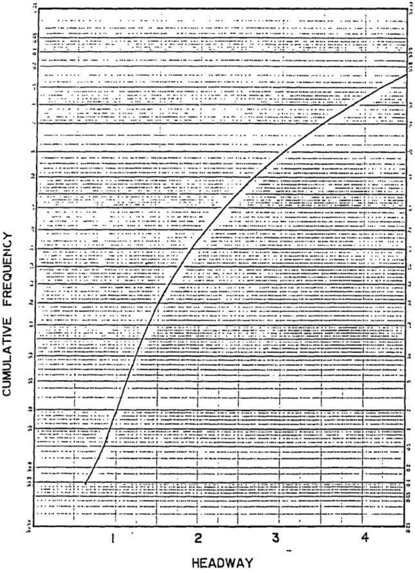

Figure 57 Plot of cumulative frequencies for the observed distribution

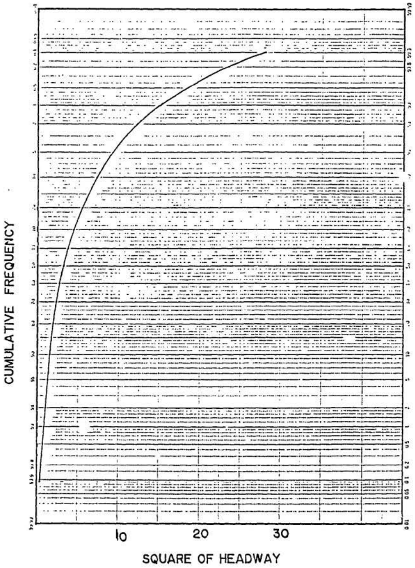

Figure 59 Plot of cumulative frequencies for the squared transformed distribution

those distributions are also not Normal. The probability plot of the distribution of the data after the square root transformation, Figure 60, is slightly more linear than the three previously discussed plots, but the most linear plot is that of the distribution of the data after the logarithmic transformation, contained in Figure 61.

Therefore, the logarithmic transformation of the observed data was used to bring the distribution in line with the requirement of Normality.

The analysis of variance procedure and the regression procedure were then performed on the transformed database. The results of this exercise are discussed in Chapter Nine.

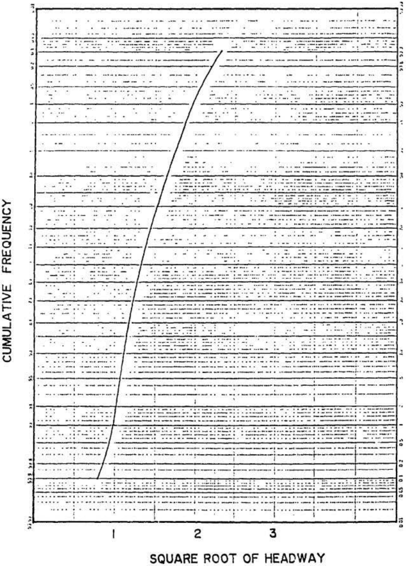

Figure 60 Plot of cumulative frequencies for the square root transformed distribution

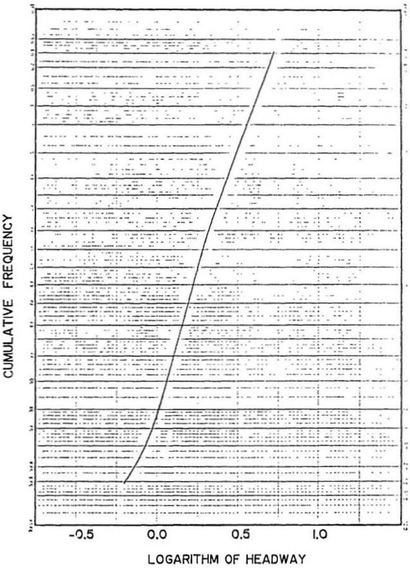

Figure 61 Plot of cumulative frequencies for the logarithm transformed distribution

CHAPTER NINE

9.0 ANALYSIS OF THE TRANSFORMED DATABASE

9.1 Introduction

The database that resulted from the transformation of the original data as discussed in the preceding Chapter was analyzed in a fashion similar to the analysis that was conducted on the original database.

In this Chapter, the Analysis of Variance technique is used to test the various null hypotheses that were originally postulated. The assumptions that were made regarding the mathematical model are retested using the transformed database.

The follow-up procedures for analysis of the transformed database, including graphical and regression techniques, are discussed. The results of the analysis of the transformed database and follow-up procedures are also discussed.

9.2 Analysis of the transformed database

As in the analysis of the original database, the SPSS/X software package was used to perform the analysis of variance procedure on the transformed database. The output from this procedure is included as Appendix L, Output from ANOVA procedure of SPSS/X software on transformed database. A summary of the results contained in this output is included in Table 38, Summary of output from ANOVA procedure on transformed database.

The results contained in Table 38 are similar to those obtained after the initial analysis of variance was performed. Again, the main effects of approach gradient, weather conditions and queue position are all significant at the 1% level. However, because there is a significant interaction between the factors of approach gradient and weather conditions, the main effects cease to have much meaning by themselves. As before, the effect of approach gradient on vehicle discharge headway must be examined at each level of the weather condition factor.

9.3 Verification of the factorial experiment model assumptions

The assumptions upon which the factorial experiment's mathematical model is based have to be verified before the inferences that have been drawn can be accepted. These assumptions are described in Section 6.3.3, and are repeated here for convenience:

1. additivity
2. independent errors
3. homogeneous error variances, and
4. Normally distributed errors.

The first assumption, that of additivity, says that the value of the response variable is equal to a quantity

Table 38 Summary of output from ANOVA procedure on transformed database

source of variation	d.f.	calc. F	tabulated F at 1%	remarks
gradient	4	12.327	3.32	significant
weather	1	9.534	6.63	significant
position	11	4.139	2.25	significant
gradient/ weather	4	6.956	3.32	significant
gradient/ position	44	1.466	1.57	not significant
weather/ position	11	2.036	2.25	not significant
gradient/ weather/ position	44	0.741	1.57	not significant

depending on the experimental conditions and the experimental unit plus a quantity depending on the treatment used. This is usually considered a reasonable assumption to make.[195]

The second assumption, that of independent errors, says that there is no correlation of error terms, that the value of any error term is not influenced by the value of any other error term. This assumption was checked by means of a visual inspection conducted on an excerpt of error terms from the residual database. The results, contained in Appendix M, Excerpt from database of residuals resulting from ANOVA procedure on transformed database, indicate that the residual signs are randomly ordered and that there is no correlation between error terms.

The third assumption, of homogeneous error variances, says that the population variance for each group of observations is the same. The assumption of error variance homogeneity was verified by means of Cochran's Test. The results of this test, contained in Appendix N, Cochran's Test for variance homogeneity after data transformation, indicate that the error variances are homogeneous. Therefore, the third assumption made about the mathematical model is valid.

The fourth, and final, assumption is that the error terms are Normally distributed. A frequency distribution plot for the error terms is contained in Figure 62, Distribution of residuals after second ANOVA procedure. It can be seen from this figure that the distribution is sufficiently Normal in

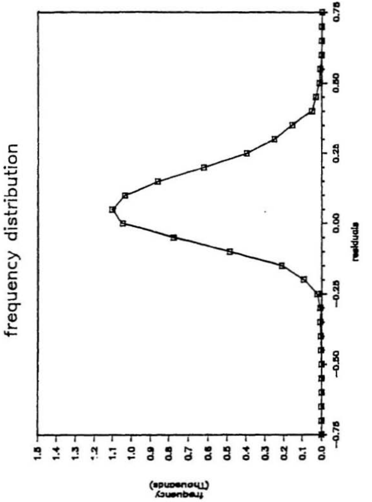

Figure 62 Distribution of residuals after second ANOVA procedure

shape to consider the fourth assumption to be valid, especially in light of the robustness of the analysis of variance technique to slight departures from Normality.[196]

Therefore, it is concluded that the assumptions hold, that the mathematical model used to perform the analysis of variance technique is valid and that the inferences that have been drawn regarding the results of the analysis of the experimental data are statistically valid.

It is now in order to determine what functional relationship exists, if any, between the factors that have been determined to significantly affect the response variable. As after the initial analysis of variance on the original database, these factors are approach gradient in interaction with weather conditions. The functional relationship will be determined through the regression of headway on gradient at each level of the qualitative weather factor.

9.4 Regression analysis of transformed database

As noted in Section 7.3.1, it is often useful as a preliminary step to plot the predictor variables against the response variable to see if the form of the regression model suggests itself.

Figures 63 and 64 contain plots of approach gradient versus the means of the logarithms of headway for fair and poor weather conditions respectively. The trends in these

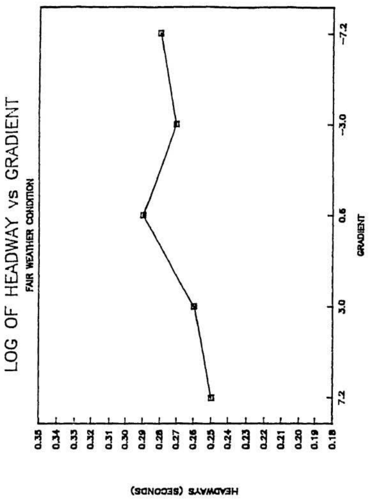

Figure 63 Plot of approach gradient versus mean of the logarithm of headway for fair weather condition

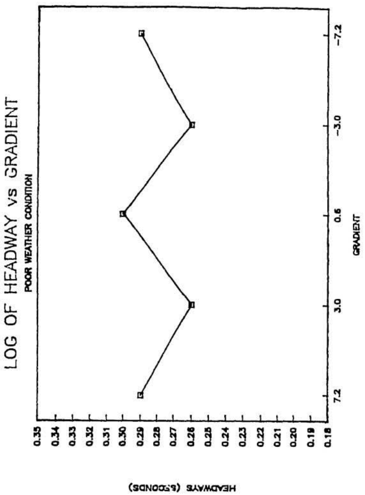

Figure 64 Plot of approach gradient versus mean of the logarithm of headway for poor weather condition

figures are comparable to the trends in Figures 38 and 39. For the fair weather condition, with the exception of approach 71 West, the data points again lie roughly in a straight line having negative slope. As before, for the poor weather condition, the data points exhibit less of a linear trend than is shown under fair weather conditions but there is again a slight negative slope to the data.

Smoothing of the data using the median smoothing technique discussed in Section 7.3.2 results in the plots contained in Figures 65 and 66. The results after smoothing indicate a linear relationship between approach gradient and the logarithm of headway. The data used to produce these figures is contained in Tables 39 and 40.

As discussed previously, the linear model has the form

$$Y = A + BX + E$$

where now, as a result of the transformation, Y = logarithm of headway. All other variables retain the descriptions assigned in Section 7.3.3.

The regression procedure of the SPSS/X software was used to perform the regression of the transformed headway variable on approach gradient under both weather conditions. The output from this procedure is included in Appendix O, Output from Regression procedure of SPSS/X software on transformed database. A summary of the results contained in this output is included in Table 41, Summary of output of regression of transformed database.

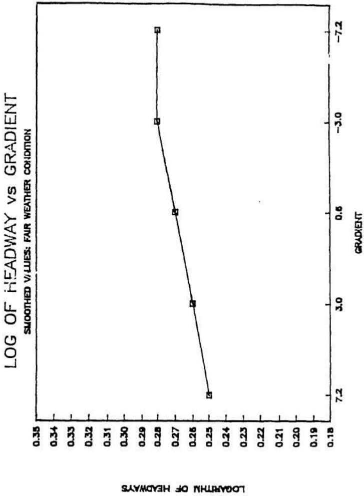

Figure 65 Plot of approach gradient versus mean of the logarithm of headway after smoothing technique - fair weather condition

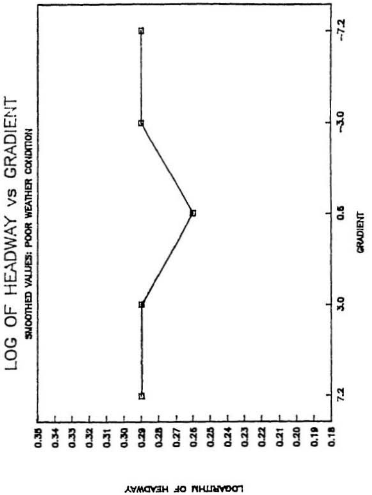

Figure 66 Plot of approach gradient versus mean of the logarithm of headway after smoothing technique - poor weather condition

Table 39 Mean headways before and after data smoothing for fair weather condition

fair approach	gradient	mean headway	smoothed headway
16 East	+7.2%	0.25	0.25
7 South	+3.0%	0.26	0.26
71 West	+0.6%	0.29	0.27
7 North	-3.0%	0.27	0.28
16 West	-7.2%	0.28	0.28

Table 40 Mean headways before and after data smoothing for poor weather condition

poor approach	gradient	mean headway	smoothed headway
16 East	+7.2%	0.29	0.29
7 South	+3.0%	0.26	0.29
71 West	+0.6%	0.30	0.26
7 North	-3.0%	0.26	0.29
16 West	-7.2%	0.29	0.29

9.5 Analysis of measures of fit

As was done with the regression output from the initial procedure, prior to attempting to interpret the prediction equation, the measures of the adequacy of fit discussed in Sections 7.5.1 through 7.5.4 have to be examined.[197]

To examine the variability of the data the Adjusted Total Sum of Squares is partitioned into the Sum of Squares due to Regression (SSR) and the Sum of Squares due Error (SSE). The values of these parameters for both weather conditions are contained in Table 41. In both cases the value of the SSE is much larger than the value of the SSR, indicating that the calculated regression line does not yield a statistically "good" fit to the observed data.

The partitioning of the total variation also enables the testing of the hypothesis that there is no linear relationship between the predictor variable and the response against the alternative hypothesis that such a relationship does exist.[198] The calculated F-test statistics for both weather conditions are contained in Table 41. As after the first regression there is a strong indication that a linear relationship exists between the predictor and response variables, particularly under fair weather conditions.

A third measure of fit involves examining the standard error of the estimate which provides a means of checking how accurately the proposed prediction equation can be expected to perform. Generally, for a specific value of the in-

Table 41 Summary of output of regression of transformed database

parameter	fair	poor
R-square	0.0036	0.0007
standard error	0.13381	0.13284
F-test statistic	28.2815	5.46829
constant	1.86688	1.89383
slope of regression line	-0.1577	-0.0732
SSE, sum of squares due to error	138.632	138.884
SSR, sum of squares due to regression	0.50636	0.0965

dependent variable, the true response can usually be expected to fall within three standard errors of the predicted response. The standard errors calculated as part of the regression procedure are contained in Table 41. For both weather conditions the standard error of the estimate is approximately 0.13. Therefore, there is a range of 0.78 units around the predicted values where the true responses are likely to be. This indicates that there is reason to doubt the ability of the model as specified to accurately predict headways.[199]

As noted previously, the coefficient of determination is another useful measure of fit when examining a regression prediction equation. This coefficient provid's a measure of the strength of a relationship between two variables. The values of the coefficient, R-square, for the regressions performed under both fair and poor weather conditions are also contained in Table 41. The small values of the coefficient under both weather conditions indicate that very little of the variability of the responses can be attributed to the regression of the logarithm of headway on gradient. As before, such small values of the coefficient of determination in equations that are to be used to make predictions are causes for concern. "A large value of R-square does not necessarily guarantee accurate prediction [...] but it should be required before undue claims are made about the fitted model."[200]

From the preceding discussions it is apparent that the paradox that existed after the initial regression procedure still exists after the regression on the transformed database. Certain measures of fit indicate that very little of the variability of the responses is accounted for by the regression while the F-statistics indicate at a highly significant level that a linear relationship does exist between the response and predictor variables.

Before discussing these results the validity of the assumptions upon which the regression procedure is based must again be verified, this time in the context of the second regression. This will ensure that the inferences and conclusions that are drawn regarding the results of this second regression are statistically sound.

9.6 Re-verification of the assumptions of regression

The assumptions that ensure that the estimated parameters of the regression equation are the maximum likelihood estimates were discussed in a previous section but are repeated here for convenience:

1. the predictor variables are nonstochastic and are measured without error,
2. the model is correctly specified,
3. model error terms have zero means, are uncorrelated and have constant variance, and
4. model error terms follow a Normal probability

distribution.[201]

The first assumption, that predictor variables are not random and are under the control of the data analyst, is considered in Section 7.7.1. In that section it was noted that considerable care was taken when selecting intersection approaches as candidates for data collection as discussed in Chapter Three, Selection of study intersections. The approaches were selected in such a manner that all but the factors of interest were neutralized or negated in some way. Therefore, the assumption that the predictor variables are nonstochastic and are under the analyst's control is deemed to be valid.

The second assumption, that the model is correctly specified, is more difficult to verify. However, there are graphical techniques that employ an analysis of residuals to detect model misspecification. One useful plot is that of residuals versus the predictor variable. Standardized scatterplots of the residuals versus the predictor variable, gradient, are contained in Figures 67 and 68 for fair and poor weather conditions respectively. Neither of these plots contains a discernable trend, only a random scatter of points about the line; residual = 0. This indicates correct model specification.[202]

The third assumption of regression states that the model error terms must have zero means, be uncorrelated and have constant variances.

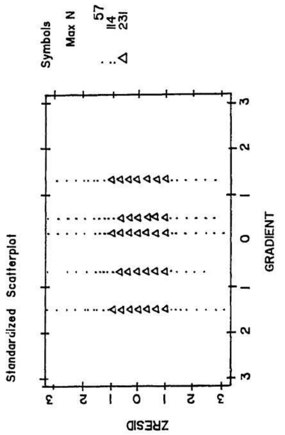

Figure 67 Standardized scatterplot of residuals versus predictor variable for fair weather condition

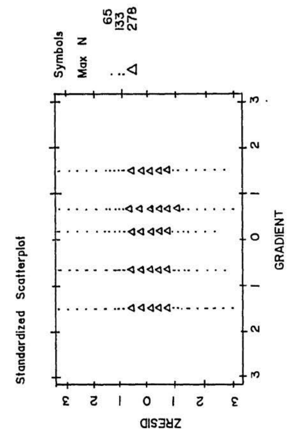

Figure 68 Standardized scatterplot of residuals versus predictor variable for poor weather condition

As discussed in Section 7.7.3, "For regression models containing intercept terms [the assumption that the error terms have zero means] is not at all restrictive...."[203] This is confirmed by examination of Tables 42 and 43, Residuals statistics resulting from regression of logarithm of headway on gradient under fair and poor weather conditions respectively. These tables show that the mean of the residuals is zero in both cases.

The second part of the third assumption, that model error terms be uncorrelated, can generally be accepted if the technique of randomization is employed in the experimental design and the data collection.[204] A visual inspection was conducted on a random consecutive sample drawn from the residual database. The results of this analysis are contained in Appendix P, Examination of residuals for autocorrelation after second regression. The results indicate that the error terms are not correlated. Therefore, the assumption is valid.

The final part of the third assumption states that the model error terms have constant variance. This assumption will automatically be true if the errors are independent as has just been shown.[205] This can be confirmed by examining a plot of residuals versus predicted values. Two such plots are contained in Figures 69 and 70 for fair and poor weather conditions respectively. For reasons noted in Section 7.7.5, the absence of any trend in these plots indicate that the variances are not heteroscedastic and that the assumption of

Table 42 Residual statistics resulting from regression of logarithm of headway on gradient under fair weather condition

Statistic	Mean
predicted value	0.25
standardized predicted value	0.00
residual	0.00
standardized residual	0.00
studentized residual	0.00

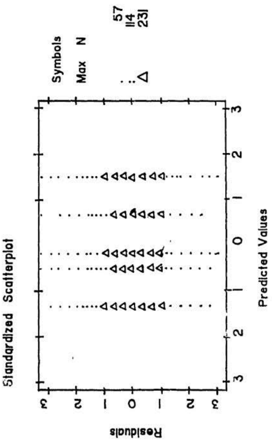

Figure 69 Plot of residuals versus predicted values for fair weather conditions

Table 43 Residual statistics resulting from regression of logarithm of headway on gradient under poor weather condition

Statistic	Mean
predicted value	0.26
standardized predicted value	0.00
residual	0.00
standardized residual	0.00
studentized residual	0.00

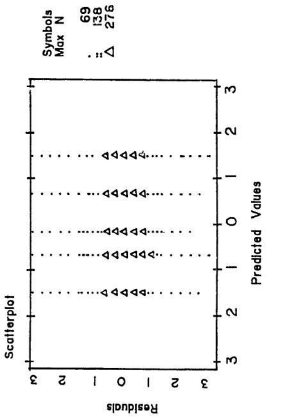

Figure 70 Plot of residuals versus predicted values for poor weather conditions

constant variance is valid.[206]

The fourth assumption, that the model error terms follow a Normal probability distribution, was found to be invalid after the first regressions of headway on gradient under poor and fair weather conditions. This conclusion resulted in the transformation of the data and the second regression procedure. The assumption of Normality is the basis for the tests of hypothesis that form part of the regression analysis.[207] The assumption that the model error terms are Normally distributed can be checked by examining histogram plots of the residuals. Figures 71 and 72 contain histograms of the standardized residuals for fair and poor weather conditions respectively. Examination of Figures 71 and 72 indicates that the distribution of residuals closely approximates the Normal distribution, much more so than the distribution of residuals resulting from the initial regression as shown in Figures 46 and 47. Additionally, the Normal probability plots of the standardized residual contained in Figures 73 and 74 are more linear than the plots resulting from the initial regression which are contained in Figures 48 and 49. Therefore, it is concluded that the final assumption of regression is valid.

The foregoing sections have verified the assumptions upon which least-squares estimation of regression parameters is based. The results of the regression analysis can now be analyzed and discussed with the knowledge that the estimates

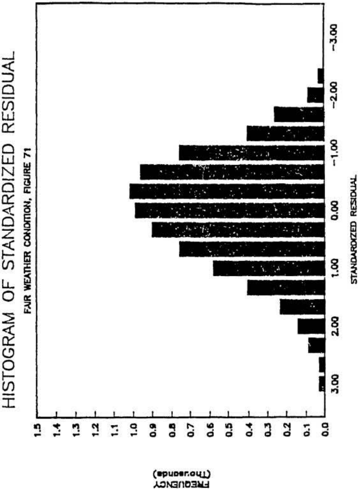

Figure 71 Histogram of the standardized residuals for fair weather condition

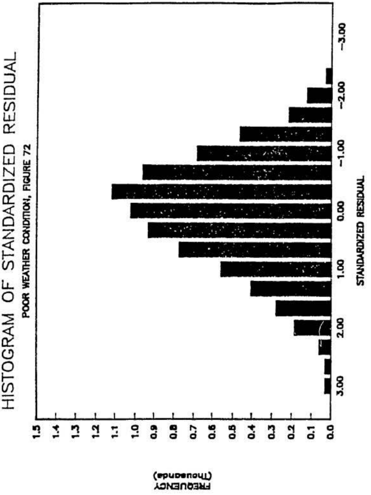

Figure 72 Histogram of the standardized residuals for poor weather condition

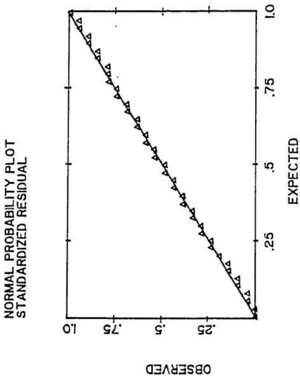

Figure 73 Normal probability plot of the standardized residual for fair weather condition

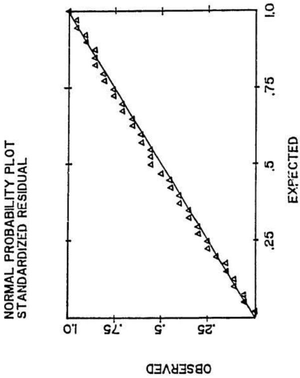

Figure 74 Normal probability plot of the standardized residual for poor weather condition

are the "best" estimates possible.

9.7 Discussion of regression results

The results of the regression procedure on the transformed data appear to be contradictory. As noted, despite the transformation of the data, certain measures of fit continue to indicate that the estimates of the regression parameters result in prediction equations that account for very little of the variability in the responses.

On the other hand, the F-statistics that have been calculated as part of the regression procedure still indicate that a strong linear relationship exists between the response variable of logarithm of headway and the predictor variable of approach gradient.

It was initially thought that this apparent contradiction might indicate a problem with the model specification. It has been noted that correct model specification in a regression analysis involves two important aspects. All relevant variables must be contained in the database and the proper functional form of each predictor must be defined in the prediction equation.[208]

With regards to the second aspect of model specification, it appears that the linear form for the relationship is the correct functional form in light of the significant indication, through the F-test, that a linear relationship does exist between these variables. The problem with model misspecification was thought to lie more with the fact that all relevant variables might not be contained in the prediction equation.

If this was the case, then the residuals, "are measuring the variability associated with both the random error component and the predictor variables erroneously left out of the specification of the model."[209]

Because of the contradictory results described above, it was decided to re-check the entire analysis in an effort to determine if there were problems with either the data or the analysis that might be causing the apparent contradiction.

The results of this check are described in the following chapter, Chapter Ten, Checking Previous Analyses.

CHAPTER TEN

10.0 CHECKING PREVIOUS ANALYSES

10.1 Introduction

The analyses described in preceding chapters of this thesis have indicated what appears to be a paradox of sorts; the regression procedures performed on both the original and transformed databases have produced equations with very low values of the coefficient of determination, indicating no linear relationship between the variables of interest, discharge headway and approach gradient, at the same time that the F-tests performed as part of the regression procedures have indicated that a significant linear relationship does exist between those variables.

Because of these contradictory results, it has been decided to re-check the previous analyses in an effort to determine if there were problems with either the data or the analyses that might be causing this apparent contradiction.

It was decided to perform the checking analysis using a micro-computer software package, SPSS-PC, similar to the mainframe statistical software, SPSS/X, that had been used to perform the original analyses. Data transfer between the two software packages was readily performed because of the similarity in form and function of the two packages. The use of micro-computer software made analysis a little easier chiefly by allowing ready access to computing capabilities.

10.2 Analysis of variance

The ANOVA procedure using the micro-computer version of SPSS/PC yielded exactly the same results as the SPSS-X mainframe version of the statistical software that had been used during the initial analyses. These results are contained in Tables 44 and 45, for the SPSS/PC and SPSS-X software packages respectively.

As a result of additional research, however, the interpretation of those results has changed somewhat.

In an analysis of variance procedure, a number of null hypotheses are postulated. In very general terms, the null hypotheses state that there is no statistical difference between the means of the various groups being compared. The alternative hypotheses state that all groups are, in fact, not the same. The alternative hypotheses do not say which groups differ from one another. They just say that at least one of the groups being compared differs from the others.[210]

As can be seen from Table 46, which is a copy of Table 28 repeated for convenience, it has been determined that the main effects of gradient, weather and position are statistically significant at the 1% level. In addition, the two-way interaction of gradient and weather has also been determined to be statistically significant at the 1% level. Because of this significant interaction, the effect of

Table 44 Results of ANOVA procedure in SPSS/PC

* * * A N A L Y S I S   O F   V A R I A N C E * * *

	HEADWAY	DISCHARGE HEADWAY
BY	GRADIENT	APPROACH GRADIENT
	POSITION	POSITION IN THE QUEUE
	WEATHER	WEATHER CONDITIONS

Source	Sum of Squares	DF	Mean Square	F	Signif of F
Main Effects	39.924	16	2.495	6.767	.000
GRADIENT	20.947	4	5.237	14.202	.000
POSITION	15.968	11	1.452	3.937	.000
WEATHER	3.010	1	3.010	8.164	.004
2-way Interactions	38.001	59	.644	1.747	.000
GRADIENT POSIT.	22.676	44	.515	1.398	.042
GRADIENT WEATHER	8.400	4	2.100	5.695	.000
POSITION WEATHER	6.925	11	.630	1.707	.065
3-way Interactions	13.807	44	.314	.851	.746
GRADIENT POSIT. WEATHER	13.807	44	.314	.851	.746
Explained	91.733	119	.771	2.091	.000
Residual	2610.674	7080	.369		
Total	2702.406	7199	.375		

7200 Cases were processed.
0 Cases (.0 PCT) were missing.

Table 45 Results of ANOVA procedure in SPSS-X

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Main Effects	39.924	16	2.495	6.767	0.000
Gradient	20.947	4	5.237	14.202	0.000
Weather	3.010	1	3.010	8.164	0.004
Position	15.968	11	1.452	3.937	0.000
2-way Interactions	38.001	59	0.644	1.747	0.000
Gradient/Weather	8.400	4	2.100	5.695	0.000
Gradient/Position	22.676	44	0.515	1.398	0.042
Weather/Position	6.925	11	0.630	1.707	0.065
3-way Interactions	13.807	44	0.314	0.851	0.746
Gradient/Weather/ Position	13.807	44	0.314	0.851	0.746
Explained	91.733	119	0.771	2.091	0.000
Residual	2610.674	7080	0.369		
Total	2702.406	7199	0.375		

Table 46 Analysis of ANOVA Results

source of variation	d.f.	calc F	tabulated F at 1%	remarks
gradient	4	14.202	3.32	significant
weather	1	8.164	6.63	significant
position	11	3.937	2.25	significant
gradient/ weather	4	5.695	3.32	significant
gradient/ position	44	1.398	1.57	not significant
weather/ position	11	1.737	2.25	not significant
gradient/ weather/ position	44	0.851	1.57	not significant

gradient on discharge headways has to be examined separately at each level of the weather factor.

The question that was not asked during the original analysis is whether the differences that were observed in the means, while statistically significant, are really practically significant. A difference may meet the requirements for statistical significance but may not be large enough to be of any concern in real terms. In other words, "even though two groups are statistically found to be different, their difference is not necessarily of practical importance."[211]

Whether a difference in the means of the two groups being compared is found to be statistically significant depends on two factors:

1. the variability in the two groups, and
2. the sample size.[212]

"A difference can be statistically significant with a sample size of 100, while the same difference would not be significant with a sample size of 50. The difference between the two sample means is the same ... but its statistical interpretation differs. For large sample sizes, small differences between groups may be statistically significant, while for small sample sizes, even large differences may not be."[213]

The sample size in the experiment at hand was very large. A total of 7200 discharge headways were recorded and coded for analysis.

The differences in discharge headways that were noted under the two weather conditions were very small, generally in the one-hundredths of a second range.

As can be seen from Table 47 which follows, the overall sample standard error of the mean is 0.0072s, seven one-thousands of a second. Therefore, the 95% confidence interval for the overall sample mean covers a range of less than three one-hundredths of a second, from 1.8705s to 1.8988s.

When the discharge headway data is examined separately at the two levels of the weather factor, because of the previously discussed interaction effect, the standard error of the mean for both weather conditions is 0.010s, or, one-hundredth of a second. The 95% confidence interval for each weather condition covers a range of only four one-hundredths of a second, 0.04s. The results of the analysis at each level of the weather factor are included in Tables 48 and 49, which follow.

The very large sample size has produced a test that is very sensitive, meaning that the test is able to detect very small differences in the treatment means and attach statistical significance to them. Power of the test calculations for the three main effects indicate powers that are all in the high 90% range.

However, the question that now has to be considered is whether or not the differences that are being detected are of practical importance.

Table 47 Oneway ANOVA - Headway by gradient; both weather conditions

Variable	HEADWAY	DISCHARGE HEADWAY
By Variable	GRADIENT	APPROACH GRADIENT

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	4	20.9466	5.2367	14.0512	.0000
Within Groups	7195	2681.4598	.3727		
Total	7199	2702.4065			

Group	Count	Mean	Stan. Dev.	Standard Error	95 Pct Conf Int for Mean		
Grp 1	1440	1.8609	.5787	.0152	1.8310	To	1.8908
Grp 2	1440	1.8108	.5888	.0155	1.7804	To	1.8413
Grp 3	1440	1.9565	.6585	.0174	1.9224	To	1.9905
Grp 4	1440	1.8585	.5403	.0142	1.8306	To	1.8864
Grp 5	1440	1.9365	.6755	.0178	1.9016	To	1.9715
Total	7200	1.8846	.6127	.0072	1.8705	To	1.8988

Table 48 Oneway ANOVA - Headway by gradient; fair weather condition

Variable HEADWAY DISCHARGE HEADWAY
By Variable GRADIENT APPROACH GRADIENT

Analysis of Variance

Source	**D.F.**	**Sum of Squares**	**Mean Squares**	**F Ratio**	**F Prob.**
Between Groups	4	12.5614	3.1404	8.6569	.0000
Within Groups	3595	1304.11	.3628		
Total	3599	1316.6749			

Group	**Count**	**Mean**	**Stan. Dev.**	**Stan. Error**	**95 Pct Conf Int for Mean**		
Grp 1	720	1.78	.5606	.0209	1.7394	To	1.8214
Grp 2	720	1.81	.6055	.0226	1.7685	To	1.8571
Grp 3	720	1.93	.6359	.0237	1.8909	To	1.9839
Grp 4	720	1.87	.5325	.0198	1.8403	To	1.9182
Grp 5	720	1.91	.6670	.0249	1.8623	To	1.9599
Total	3600	1.86	.6049	.0101	1.8444	To	1.8840

Table 49 Oneway ANOVA - Headway by gradient; poor weather condition

Variable	HEADWAY	DISCHARGE HEADWAY
By Variable	GRADIENT	APPROACH GRADIENT

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	4	16.7855	4.1964	11.0444	.0000
Within Groups	3595	1365.9359	.3800		
Total	3599	1382.7214			

Group	Count	Mean	Stan. Dev.	Stan. Error	95 Pct Conf Int for Mean		
Grp 1	720	1.9414	.5855	.0218	1.8985	To	1.9842
Grp 2	720	1.8089	.5721	.0213	1.7670	To	1.8507
Grp 3	720	1.9755	.6803	.0254	1.9257	To	2.0253
Grp 4	720	1.8377	.5475	.0204	1.7977	To	1.8778
Grp 5	720	1.9620	.6834	.0255	1.9120	To	2.0120
Total	3600	1.9051	.6198	.0103	1.8848	To	1.9253

10.3 Practicality of the observed differences in the treatment means

The main concern of traffic operations personnel is the safe and efficient movement of people and goods. This sentence summarizes the ultimate raison d'etre for the branch of civil engineering that deals with traffic engineering.

As noted previously, in the urban environment, the signalized intersection constitutes the key operational constraint to the efficient movement of goods and people. One of the parameters that traffic operations people utilize to measure the efficiency of a traffic signal installation is the service volume that passes through that signal. From a practical point of view, an increase of 10% in the service volume of an approach to a signalized intersection would be considered an important improvement.

Given that the mean headway from the database of 7200 headways is 1.88 seconds, an increase in discharge headways of at least 10%, or 0.19 seconds, would have to be achieved on an approach to a signalized intersection to realize an increase of 10% in the service volume on that approach.

Obviously, an increase of hundredths of a second is of no practical importance to either motorists or operations personnel.

Therefore, it is concluded that, while the differences in the discharge headways that have been observed on the various approach gradients are statistically different, those differences are of no practical importance to traffic operations people. The differences are statistically significant only because of the very large sample size. In effect, it might crudely be said that the experiment that has been designed is too sensitive to yield results that are of practical importance to operations personnel.

10.4 Discussion of the relationship between discharge headways, weather conditions and approach gradients

As noted, because of the interaction between weather and gradient, the effects of approach gradient on discharge headways were investigated at each level of the weather factor.

The mean headways for the various approach gradients under the two weather conditions are shown in Table 50.

It can be seen from Table 50 that, generally speaking, the mean discharge headway values under fair weather conditions are less than or equal to the mean headway values under poor weather conditions. The exception is the approach 7 North, having gradient -3.0%.

Except for approach 7 North, the observed relationship is in line with the intuitive assumption that poor weather conditions adversely affect discharge headways. This conclusion makes practical sense. It would be logical to expect that some motorists might adjust their driving habits

Table 50 Mean headways by approach gradient by weather condition

		weather conditions		
approach	gradient	fair	poor	mean
16 East	+7.2%	1.78	1.94	1.86
7 South	+3.0%	1.81	1.81	1.81
71 West	+0.6%	1.94	1.98	1.96
7 North	-3.0%	1.88	1.84	1.86
16 West	-7.2%	1.91	1.96	1.94

under adverse weather conditions to allow for such factors as reduced visibility and reduced friction of tires on wet pavement.

Examination of the results of a T-test comparing discharge headways under fair weather conditions with discharge headways under poor weather conditions leads to the conclusion that there is, in fact, a statistically significant difference between discharge headways under both weather conditions. These results are given in Table 51.

But, again, the question that remains to be addressed is whether or not this difference is of any practical importance.

From Table 51 it can be seen that the difference between the mean discharge headways for the two weather conditions is 0.04s. This is not close to the 10% difference that has been suggested as a benchmark for practical importance.

In a similar manner, the discharge headways for each of the approach gradient conditions can be examined under each of the weather conditions. Table 50 contains information on the mean discharge headway values for the various intersection approaches upon which data was collected.

When the data contained in Table 50 are examined, it can be seen that there is no obvious pattern or relationship apparent between discharge headway and approach gradient, although under fair weather conditions it can be seen that, with the exception of the approach having +0.6% gradient, discharge headways seem to increase slightly as approach

Table 51 Results of t-test comparing headways under fair and poor weather conditions

Independent samples of WEATHER WEATHER CONDITIONS

Group 1: WEATHER EQ 1 Group 2: WEATHER EQ 2

t-test for: HEADWAY DISCHARGE HEADWAY

	Number of Cases	Mean	Standard Deviation	Standard Error
Group 1	3600	1.8642	.605	.010
Group 2	3600	1.9051	.620	.010

		Pooled Var. Est.			Separate Var. Est.		
F Value	2-Tail Prob.	t Value	DF	2-Tail Prob.	t Value	DF	2-Tail Prob.
1.05	.142	-2.83	7198	.005	-2.83	7193	.005

gradient goes from positive to negative grade.

The increase in discharge headways as approach gradients change from positive (uphill) gradients to negative (downhill) gradients might possibly be explained as the reaction of drivers as they realize that they will need additional stopping distance on downgrades because gravity is working against deceleration, as opposed to upgrades where gravity aids deceleration.

However, if that line of reasoning is extended, one would expect that the phenomenon of increased discharge headways on downgrades might be more pronounced under poor weather conditions as both gravity and reduced friction on wet pavement work against deceleration.

However, it appears that under poor weather conditions, there is greater variability in driving habits, and thus no linear relationship is apparent from the data contained in Table 50 for the poor weather condition.

The question that must again be asked is whether the differences in discharge headways that are being discussed are of practical importance?

If the confidence levels for the overall means are compared there is a difference of only 0.08s, approximately 4%, between the lower limit of the 95% confidence interval for the fair weather condition and the upper limit of the 95% confidence interval for the poor weather condition.

This difference is not close to the 10% difference that has been suggested as being important for practical significance.

To reiterate the conclusion noted previously, the differences in discharge headways that have been noted are statistically significant chiefly because of the very large sample size that was employed in the experiment. These differences are not large enough to be of any importance in a practical sense.

10.5 Developing a relationship between approach gradient and discharge headway

Nevertheless, despite the lack of a strong indication of linear relationship as indicated by the preceding examination of the data, the data was analyzed using a regression procedure in an attempt to quantify, if possible, the relationship between approach gradient and discharge headway.

When the REGRESSION procedure was run on the microcomputer version of SPSS/PC, the results that were obtained were not the same as the results that had been produced by the SPSS-X mainframe version of the statistical software during the initial analyses.

This result was surprising for two reasons:

1. the same database was used in both analyses, and
2. the results of the ANOVA procedures that had been run under both operating systems had been identical.

The results of the REGRESSION procedures under the SPSS/PC and SPSS-X systems are contained in Appendices Q and R, respectively.

Careful examination of the output from the REGRESSION procedure of SPSS-X revealed an anomaly in the output that had previously gone unnoticed. It can be seen from Appendix R that the Analysis of Variance portion of the REGRESSION analysis for the fair weather condition has 7745 degrees of freedom. However, under one weather condition there should be only 3600 cases, one-half of the total of 7200 cases. Similarly, under the poor weather condition, there are an unexplained 7871 degrees of freedom when there should be 3599.

Examination of the output from the SPSS/PC REGRESSION procedure, however, shows that there are 3599 degrees of freedom for each weather condition, as would be expected for a database containing 3600 cases.

This problem with the data used in the original regression analyses had gone undetected during the initial analyses.

Nevertheless, despite this error in the database that was used during the original regression procedures, the results that were achieved with the corrected database were substantially the same as those that had been achieved in the original procedures.

10.5.1 Fair weather condition

Under the fair weather condition, when the REGRESSION procedure was run, there was still a very low value of the coefficient of determination, $R^2 = 0.00539$, and the F-test statistic was still highly significant. The apparent paradox noted earlier in this chapter still appears to exist.

The low value of the coefficient of determination indicates that there is no linear relationship between the variables of interest, while the significant F-test statistic indicates that a linear relationship does exist.

The F-test procedure in regression analysis is used, in this case, to test the null hypothesis that there is no linear relationship between discharge headways and approach gradient. However, the F-test statistic produced as a result of the regression procedure in SPSS/PC for the fair weather condition, as shown in Appendix Q, indicates that this null hypothesis should be rejected, as there is a statistically significant result indicating that a linear relationship between headway and gradient does, in fact, exist.

However, as previously noted, there are two factors that contribute to any significant result:

1. the variability in the two groups, and
2. the sample size.

The statistically significant result that was obtained from the F-test procedure performed within the REGRESSION procedure is the result of the very large sample size that was used in the experiment.

Although the F-test statistic generated by the SPSS/PC software indicates that there is a linear relationship between the variables, a result produced by the large sample size, the low coefficient of determination that has been calculated, $R^2 = 0.00539$, indicates that very little of the variability in the data has been accounted for by the relationship generated by the regression procedure. In other words, the low value of R^2 indicates that there is no linear relationship between the variables.

In this instance, because the F-test is influenced by the large sample size, the R^2 indicator must be given more weight than the results of the F-test as an indicator of the strength of the relationship between the variables of interest.

In fact, it should be noted that the large sample size is the main reason for the apparent paradox noted in the original analyses when it was observed that the regression procedure produced equations with very low values of the coefficient of determination at the same time that the F-test procedure that is produced as part of the REGRESSION procedure in SPSS/X indicated a significant linear relationship existed between approach gradient and discharge headways.

10.5.2 Poor weather condition

Under the poor weather condition, there is an interesting difference in the results of the analysis produced by the SPSS/PC software using the corrected database, and those that had been achieved when the SPSS-X software had been used on the incorrect database.

For the poor weather condition, the coefficient of determination is still very low, $R^2 = 0.00016$, but the results of the analysis performed on the revised database produce an F-test statistic that is highly significant. This means that the null hypothesis of no linear relationship between approach gradient and discharge headways can not be rejected, and must be accepted. In other words, both parameters indicate the same conclusion, that there is no linear relationship between approach gradient and discharge headways for the poor weather condition. The paradox referred to in the original analysis does not exist for the poor weather conditions when the corrected database is analyzed.

Therefore, it is now concluded that there is no linear relationship between discharge headways and approach gradient under either weather condition.

Under the fair weather condition, the very low value of the coefficient of determination says that there is no linear relationship between the two variables. Although the F-test statistic indicates that there is a significant linear relationship, it has been concluded that this indication is the result of the very large sample size and the resulting highly sensitive test. Therefore, it is concluded that the coefficient of determination is the more credible indicator.

Under the poor weather condition, both parameters, the coefficient of determination and the F-test statistic, indicate that there is no significant linear relationship between approach gradient and discharge headways.

10.6 Investigation of other relationships

If there is no linear relationship between the variables of approach gradient and discharge headway, it is possible that there may be a non-linear relationship between them.

A number of transformations were tried in an effort to determine if a non-linear relationship was applicable. As can be seen from Table 52, in all cases, the coefficients of determination were very low.

It may still be possible to devise a non-linear relationship between discharge headways and approach gradient, but that relationship would likely only apply to the five locations studied in this experiment, it would be of no practical importance, and it probably not be the result of an actual cause and effect relationship.

Table 52 Coefficients of determination for transformations

DEPENDENT VARIABLE	INDEPENDENT VARIABLE	R^2 COEFFICIENT
Headway	Gradient	0.00026
Headway	$Gradient^2$	0.00233
Headway	1/Gradient	0.00231
Headway	-1/Gradient	0.00231
log(Headway)	Gradient	0.00001
log(Headway)	$Gradient^2$	0.00225
log(Headway)	1/Gradient	0.00191
log(Headway)	-1/Gradient	0.00191
sq.rt(Headway)	Gradient	0.00007
sq.rt(Headway)	$Gradient^2$	0.00240
sq.rt(Headway)	1/Gradient	0.00211
sq.rt(Headway)	-1/Gradient	0.00211
$Headway^2$	Gradient	0.00041
$Headway^2$	$Gradient^2$	0.00175
$Headway^2$	1/Gradient	0.00255
$Headway^2$	-1/Gradient	0.00255
1/Headway	Gradient	0.00006
1/Headway	$Gradient^2$	0.00128
1/Headway	1/Gradient	0.00159
1/Headway	-1/Gradient	0.00159
-1/Headway	Gradient	0.00006
-1/Headway	$Gradient^2$	0.00128
-1/Headway	1/Gradient	0.00159

10.7 Conclusions regarding the relationship of discharge headway and approach gradient

It is concluded that, although it has been established that the differences in discharge headways on different approach gradients are statistically significant, the significance of those differences is, for the most part, a result of the large sample size, and, more importantly, is of no practical importance.

It is further concluded that there is no practical quantifiable relationship between approach gradient and discharge headways on the approaches to signalized intersections in the City of St. John's.

Although it has been shown that there is no quantifiable, practical relationship between discharge headways on an approach to a signalized intersection and the gradient of that approach, other time-space relationships exist that are of interest to operations personnel. One such relationship, the relationship between elapsed time from the start of the green phase and vehicle position in the queue, is discussed in the following chapter.

CHAPTER ELEVEN

11.0 RELATIONSHIP BETWEEN ELAPSED TIME AND QUEUE POSITION

11.1 Introduction

The time that elapses from the start of the green phase of a cycle at a signalized intersection until a vehicle clears the intersection is obviously a quantity of interest to traffic operations personnel. This quantity is closely related to discharge headways. As was noted earlier, the time that elapses from the start of the green phase until any vehicle in the queue clears the intersection is simply the sum of the discharge headways for all vehicles preceding the vehicle of interest.

It would be very useful for traffic operations personnel in the City of St. John's to be able to predict the time required for a specific number of vehicles to clear a signalized intersection. In fact, arguably, it may be of more practical importance for operations personnel to be able to accurately predict the elapsed time required for a specific number of vehicles to clear an intersection than it would be for them to be able to predict the discharge headway of a specific vehicle.

Consider for instance the following simplistic example of the design for the timing scheme for a signalized intersection.

Traffic count data indicate that an average of 450 vehicles per hour pass through one approach to a signalized intersection. If it is assumed that the traffic signal cycle length is fixed at 80s because of synchronization constraints, then there are 45 cycles per hour (3600s/hour divided by 80s/cycle). The average arrival rate per cycle is, therefore, 10 vehicles per cycle (450 veh/hr divided by 45 cycles/hr). If traffic operations personnel can accurately predict how much time is required for these ten vehicles to clear the intersection, (that is, how much time elapses before ten vehicles clear) then that elapsed time can be incorporated into an efficient traffic signal timing scheme.

Therefore, it would be worthwhile investigating the relationships, if any, between elapsed time and the three original variables of interest, approach gradient, weather conditions, and position in the queue.

11.2 Analysis of variance

As before, the initial step in the analysis involves an analysis of variance procedure to determine which of the variables of interest has a significant effect on the response variable, which is now the elapsed time from the start of green.

The results of this analysis of variance are contained in Table 53, Results of ANOVA Procedure in SPSS/PC for Elapsed Time Data.

Table 53 Results of ANOVA procedure in SPSS/PC on elapsed time data

* * * A N A L Y S I S   O F   V A R I A N C E * * *

ELAPSED ELAPSED TIME FROM START OF GREEN PHASE
BY GRADIENT APPROACH GRADIENT IN PERCENT
POSITION VEHICLE POSITION IN THE QUEUE
WEATHER WEATHER CONDITIONS

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig. of F
Main Effects	299868.9	16	18741.809	8990.222	.000
GRADIENT	538.036	4	134.509	64.522	.000
POSITION	299286.2	11	27207.839	13051.275	.000
WEATHER	44.686	1	44.686	21.435	.000
2-way Interactions	713.975	59	12.101	5.805	.000
GRADIENT POSITION	271.529	44	6.171	2.960	.000
GRADIENT WEATHER	404.628	4	101.157	48.524	.000
POSITION WEATHER	37.819	11	3.438	1.649	.079
3-way Interactions	120.910	44	2.748	1.318	.078
GRADIENT POSITION WEATHER	120.910	44	2.748	1.318	.078
Explained	300703.8	119	2526.923	1212.135	.000
Residual	14759.592	7080	2.085		
Total	315463.4	7199	43.820		

7200 Cases were processed.
0 Cases (.0 PCT) were missing.

It can be seen from Table 53 that each of the three main effects is significant. However, two of the two-way interaction effects are also significant. The interaction of approach gradient and vehicle position in the queue is significant, as is the interaction of weather conditions and approach gradient.

11.2.1 Interaction of approach gradient and vehicle position

The summary of elapsed time data for each of the five approach gradients upon which data was collected is contained in Table 54, Summary of Elapsed Time Data by Gradient. Intuitively, it might be expected that elapsed time would increase as approach gradient increased, as a result of accelerating uphill. However, it can be seen from examination of the data for Position 12 in Table 54 that this expected result does not materialize. In fact, there is no apparent trend in the elapsed time data for the various approach gradients.

From an examination of Table 53, it is apparent that little of the explained variation is accounted for by the two-way interaction of gradient and position. Only 0.09% of the explained variation is actually accounted for by this interaction. The interaction of gradient and position is statistically significant but, as noted in the previous chapter, the statistical significance is chiefly a result of the very large sample size.

Table 54 Summary of elapsed time data by gradient

	-7.2%	**-3.0%**	**+0.6%**	**+3.0%**	**+7.2%**
POSITION 1	1.83	1.96	2.05	1.88	2.05
POSITION 2	3.85	3.93	4.13	3.83	3.94
POSITION 3	5.79	5.78	6.12	5.64	5.82
POSITION 4	7.72	7.71	7.96	7.38	7.78
POSITION 5	9.64	9.58	9.81	9.23	9.55
POSITION 6	11.55	11.42	11.64	11.07	11.38
POSITION 7	13.43	13.18	13.53	12.89	13.10
POSITION 8	15.43	14.94	15.50	14.71	14.90
POSITION 9	17.36	16.75	17.47	16.49	16.76
POSITION 10	19.24	18.64	19.38	18.23	18.59
POSITION 11	21.26	20.52	21.48	19.99	20.50
POSITION 12	23.23	22.30	23.47	21.73	22.33

When the magnitude of the amount of variation in the data that is explained by this interaction (0.09%) is compared to the amount of variation explained by the main effect of position (99.5%), it can be seen that this two-way interaction is not practically important.

Therefore, because the two-way interaction of gradient and position explains so little of the variation in the data, as indicated in Table 53, because there is no logical trend in the interaction of the elapsed time data with vehicle position as indicated in Table 54, and because the two-way interaction of gradient and position is significant chiefly because of the large number of residual degrees of freedom as a result of the large sample size, as indicated in Table 53, it is concluded that the two-way interaction of gradient and position is not of practical importance.

11.2.2 Interaction of approach gradient and weather conditions

The significant interaction between approach gradient and weather conditions means that the effect of approach gradient on elapsed time from start of green depends on the level of the weather conditions variable, fair or poor.

The summary of elapsed time data for each approach gradient at each level of the weather variable is contained in Tables 55 and 56 for queue positions 1 - 6 and 7 - 12, respectively.

From Tables 55 and 56, it can be seen that for the first

Table 55 Elapsed time data by position by weather by gradient

POS.	GRADE	FAIR	POOR	DIFF.	PERCENT
1	-7.2	1.81	1.87	0.06	1.6%
	-3.0	2.06	1.87	-0.19	-5.0%
	0.6	2.06	2.06	0.00	-0.1%
	3.0	1.87	1.90	0.03	0.8%
	7.2	2.03	2.07	0.04	0.9%
2	-7.2	3.75	3.96	0.22	2.8%
	-3.0	4.13	3.74	-0.39	-4.9%
	0.6	4.09	4.18	0.09	1.1%
	3.0	3.81	3.86	0.06	0.7%
	7.2	3.86	4.03	0.16	2.1%
3	-7.2	5.66	5.92	0.26	2.3%
	-3.0	5.98	5.59	-0.39	-3.4%
	0.6	6.12	6.13	0.01	0.1%
	3.0	5.64	5.65	0.02	0.2%
	7.2	5.69	5.96	0.27	2.3%
4	-7.2	7.61	7.85	0.24	1.5%
	-3.0	7.93	7.50	-0.43	-2.8%
	0.6	7.95	7.98	0.03	0.2%
	3.0	7.34	7.43	0.09	0.6%
	7.2	7.55	8.02	0.47	3.0%
5	-7.2	9.55	9.75	0.20	1.0%
	-3.0	9.86	9.31	-0.55	-2.9%
	0.6	9.89	9.73	-0.16	-0.8%
	3.0	9.32	9.16	-0.16	-0.9%
	7.2	9.20	9.90	0.70	3.6%
6	-7.2	11.38	11.74	0.36	1.6%
	-3.0	11.68	11.16	-0.51	-2.2%
	0.6	11.70	11.59	-0.11	-0.5%
	3.0	11.09	11.07	-0.02	-0.1%
	7.2	10.90	11.86	0.96	4.2%

four queue positions, as would be expected intuitively, elapsed time values are greater under poor weather conditions than under fair weather with the exception of the approach having -3.0% gradient. This exception was also noted previously in the discussion of the relationship of weather on discharge headways.

For queue positions 5 through 9, elapsed time values are greater under poor weather conditions at the approaches having gradients of -3.0%, +0.6% and +3.0%. And for queue positions 10 through 12, elapsed time values are greater under poor weather conditions at the approaches having -3.0% and +3.0%.

From this analysis it is obvious that there is an interaction effect between weather and gradient. The question remains, however, as to how important that interaction is from a practical point of view.

Examining the last column of Tables 55 and 56 shows that the percentage of change in elapsed times under poor and fair weather conditions is not very large. In all instances it is less than the practical difference of ten per cent that has been selected as the benchmark figure.

Therefore, it is concluded that, although the interaction effect of approach gradient and weather condition on elapsed time is statistically significant, it is not practically important.

From an examination of Table 53, it can again be seen that very little of the explained variation is actually

Table 56 Elapsed time data by position by weather by gradient

POS.	GRADE	FAIR	POOR	DIFF.	PERCENT
7	-7.2	13.22	13.65	0.43	1.6%
	-3.0	13.43	12.94	-0.50	-1.9%
	0.6	13.62	13.46	-0.17	-0.6%
	3.0	12.98	12.82	-0.16	-0.6%
	7.2	12.57	13.65	1.07	4.1%
8	-7.2	15.18	15.69	0.50	1.6%
	-3.0	15.14	14.75	-0.39	-1.3%
	0.6	15.62	15.40	-0.22	-0.7%
	3.0	14.86	14.57	-0.29	-1.0%
	7.2	14.31	15.50	1.19	4.0%
9	-7.2	17.08	17.66	0.58	1.7%
	-3.0	17.02	16.48	-0.54	-1.6%
	0.6	17.48	17.46	-0.03	-0.1%
	3.0	16.65	16.34	-0.30	-0.9%
	7.2	16.06	17.47	1.41	4.2%
10	-7.2	18.92	19.58	0.66	1.7%
	-3.0	18.91	18.38	-0.53	-1.4%
	0.6	19.34	19.44	0.11	0.3%
	3.0	18.34	18.13	-0.21	-0.6%
	7.2	17.88	19.31	1.43	3.8%
11	-7.2	21.06	21.47	0.41	1.0%
	-3.0	20.81	20.24	-0.58	-1.4%
	0.6	21.39	21.57	0.18	0.4%
	3.0	20.03	19.96	-0.07	-0.2%
	7.2	19.67	21.34	1.67	4.1%
12	-7.2	22.93	23.54	0.61	1.3%
	-3.0	22.55	22.05	-0.50	-1.1%
	0.6	23.25	23.71	0.46	1.0%
	3.0	21.75	21.71	-0.05	-0.1%
	7.2	21.36	23.30	1.93	4.3%

explained by the two way interaction of approach gradient and weather condition. Only one-tenth of one per cent (0.001%) of the explained variation is accounted for by this interaction.

As noted previously, 99.5% of the explained variation is explained by the main effect of position on elapsed time. In comparison, the contribution of the two-way interaction of approach gradient and weather condition is not practically important.

Therefore, because the two-way interaction of gradient and weather explains very little of the variation in the data, as indicated in Table 53, because the observed differences in elapsed times under the two weather conditions are not large in a practical sense, as indicated in Tables 55 and 56, and because this two-way interaction is statistically significant chiefly because of the large number of residual degrees of freedom as a result of the large sample size as indicated in Table 53, it is concluded that the two-way interaction of gradient and weather is of no practical importance and can be ignored.

The variable that accounts for, by far, the greatest amount of the explained variation in the elapsed time data is queue position. This makes sense, of course, as more time is required for vehicles later in the queue to clear than for vehicles early in the queue.

Examination of Table 53 indicates that 99.5% of the explained variation in the data is explained by the effect of queue position. More importantly, 94.9% of the total variation in the elapsed time data is explained by this variable.

Therefore, it is logical to investigate more fully the relationship between time from the start of green and queue position. However, before proceeding with attempts to determine this relationship, it is first necessary to check the assumptions upon which the analysis of variance technique is based to ensure that any inferences that have been drawn are valid.

11.3 Verification of assumptions

These assumptions were described previously, and are repeated here for convenience:

1. additivity
2. independent errors
3. Normally distributed errors, and
4. homogeneous error variances.

The first assumption, that of additivity, says that the value of the response variable is equal to a quantity depending on the experimental conditions and the experimental unit plus a quantity depending on the treatment used. This is usually considered a reasonable assumption to make.[214]

The second assumption, that of independent errors, says that there is no correlation of error terms, that the value of any error term is not influenced by the value of any other error term. This assumption was checked by means of a visual inspection conducted on an excerpt of error terms from the residual database. The results, contained in Appendix S, Excerpt from database of residuals resulting from ANOVA procedure on elapsed time database, indicate that the residual signs are randomly ordered and that there is no correlation between error terms.

The third assumption is that the error terms are Normally distributed. A frequency distribution plot for the error terms is contained in Figure 75, Distribution of residuals after ANOVA procedure on elapsed time database. It can be seen from Figure 75 that the distribution is sufficiently Normal in shape to consider the third assumption to be valid, especially in light of the robustness of the analysis of variance technique to slight departures from Normality.[215]

The fourth, and final assumption, of homogeneous error variances, says that the population variance for each group of observations is the same. The assumption of error variance homogeneity was checked by means of Cochran's Test. The results of this test, contained in Appendix T, Cochran's Test of elapsed time data for variance homogeneity, indicate that the error variances are not homogeneous. Therefore, the fourth assumption upon which the Analysis of variance technique is based is not valid.

As can be seen from the data contained in Appendix T,

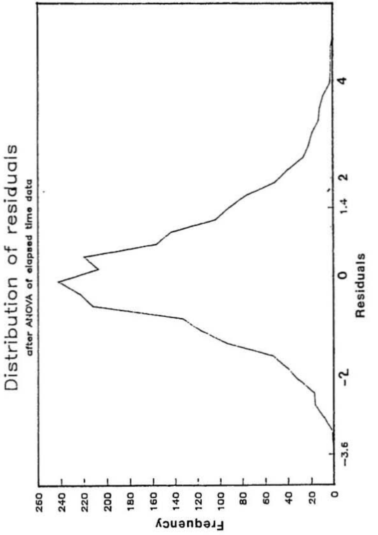

Figure 75 Distribution of residuals after second ANOVA procedure

for the variable of queue position, the variance increases with increasing values of queue position. This observation should not be entirely unexpected. It is logical to expect that there would be greater variability in elapsed times for positions later in the queue.

However, because this fourth assumption is not valid, the elapsed time data will have to be transformed in an effort to bring the data into line with the required assumptions.

11.4 Transformation of the elapsed time data

As noted above, the elapsed time data has to be transformed and the analysis of variance procedure repeated for the transformed database. Generally, when the variance increases linearly with the values of the independent variable, as evident in Appendix T, and all values of the dependent variable are positive, a square root transformation will result in an acceptable database.

Accordingly, the elapsed time database was transformed using the COMPUTE procedure of the SPSS/PC software.

11.5 Analysis of the transformed elapsed time database

The SPSS/PC software was again used to perform the analysis of variance procedure on the transformed database. The output from this procedure is contained in Appendix U, Output from ANOVA procedure of SPSS/PC software on transformed elapsed time database. A summary of the results contained in this output is included Table 57, Summary of output from ANOVA procedure on transformed elapsed time database.

The results contained in Table 57 are similar to those obtained after the initial analysis of variance procedure was performed on the elapsed time database. Again the main effects of approach gradient, weather conditions and queue position are all significant at the 1% level, and two of the two-way interaction effects are also significant. The interaction of approach gradient and vehicle position in the queue is significant, as is the interaction of weather conditions and approach gradient.

However, as with the original elapsed time database, although all main effects and two interactions are statistically significant, the variable that accounts for the greatest amount of the explained variation is queue position. Examination of Table 57 indicates that 99.7% of the explained variation in the data is explained by the effect of queue position. More importantly, 95.9% of the total variation in the transformed elapsed time data is explained by this variable.

Therefore, as with the original elapsed time database, it is logical to investigate the relationship between the square root of elapsed time from the start of green and position in the queue.

However, before proceeding with attempts to determine the relationship between the square root of elapsed time and

Table 57 Summary of output from ANOVA procedure on transformed elapsed time database

source of variation	d.f.	calc. F	remarks
gradient	4	54.182	significant
weather	1	15.843	significant
position	11	16009.4	significant
gradient/ weather	4	45.15	significant
gradient/ position	44	1.765	significant
weather/ position	11	0.950	not significant
gradient/ weather/ position	44	0.647	not significant

queue position, it is again necessary to check the assumptions upon which the analysis of variance technique is based to ensure that any inferences that have been drawn are valid.

11.6 Re-verification of assumptions

As previously noted, the first assumption, that of additivity, says that the value of the response variable is equal to a quantity depending on the experimental conditions and the experimental unit plus a quantity depending on the treatment used. Again, as noted earlier, this is usually considered a reasonable assumption to make.[216]

The second assumption, that of independent errors, says that there is no correlation of error terms, that the value of any error term is not influenced by the value of any other error term. This assumption was checked by means of a visual inspection conducted on an excerpt of error terms from the residual database. The results, contained in Appendix V, Excerpt from database of residuals resulting from ANOVA procedure on transformed elapsed time database, indicate that the residual signs are randomly ordered and that there is no correlation between error terms.

The third assumption is that the error terms are Normally distributed. A frequency distribution plot for the error terms is contained in Figure 76, Distribution of residuals after ANOVA procedure on transformed elapsed time database. It can be seen from this figure that the distribution is

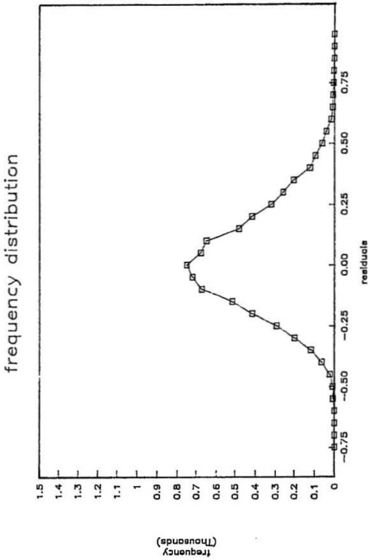

Figure 76 Distribution of residuals after ANOVA procedure on transformed elapsed time database

sufficiently Normal in shape to consider the third assumption to be valid, especially in light of the robustness of the analysis of variance technique to slight departures from Normality.[217]

The fourth, and final assumption, of homogeneous error variances, says that the population variance for each group of observations is the same. The assumption of error variance homogeneity was checked by means of Cochran's Test. The results of this test, contained in Appendix W, Cochran's Test of transformed elapsed time data for variance homogeneity, indicate that the error variances are homogeneous. The fourth assumption upon which the Analysis of Variance technique is based is valid.

Therefore, the conclusion can be drawn that all the assumptions upon which the ANOVA procedure is based have been satisfied.

11.7 Relationship of square root of elapsed time and queue position

As a first step in investigating the relationship of the square root of elapsed time and queue position, the data was plotted in a scattergraph. The resulting plot is shown in Figure 77, Plot of square root of elapsed time versus queue position.

There is an obvious linear trend in the plot contained in Figure 77. As would be expected, as position in the queue

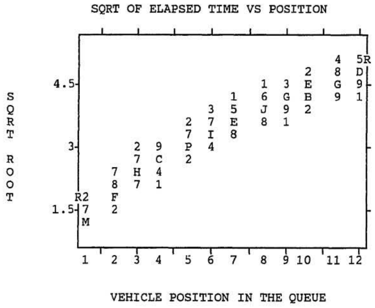

Figure 77 Plot of square root of elapsed time versus queue position

increases, so does the square root of elapsed time.

Table 58 contains the correlation coefficients for the various combinations of the three independent variables, approach gradient, queue position and weather conditions, and the dependent variable, square root of elapsed time.

The correlation coefficient for the square root of elapsed time and queue position is the largest by far. The value of the correlation coefficient is 0.9669. A value of a correlation coefficient of +1.000 indicates a perfect positive linear relationship, so it is apparent that the relationship between square root of elapsed time and queue position is strongly linear and positive.

It now remains to quantify that relationship and to develop a prediction equation that will enable elapsed time values to be accurately predicted from values of queue position.

11.8 Regression of the square root of elapsed time on queue position

The output from the regression of the square root of elapsed time on queue position is contained in Appendix X, Output from REGRESSION procedure in SPSS/PC of square root of elapsed time on queue position. A summary of the results is included in Table 59, Summary of output of regression of square root of elapsed time on queue position.

As noted previously, the least squares estimation

Table 58 Correlation coefficients

Correlations:	SQRTELAP	GRADIENT	POSITION	WEATHER
SQRTELAP	1.0000	-.0122	.9669	.0093
GRADIENT	-.0122	1.0000	-.0000	.0000
POSITION	.9669	-.0000	1.0000	.0000
WEATHER	.0093	.0000	.0000	1.0000

SQRTELAP is the square root of elapsed time
GRADIENT is the approach gradient
POSITION is the queue position
WEATHER is the weather condition

Table 59 Summary of output of regression of square root of elapsed time on queue position

parameter	value
R-square	0.93489
standard error	0.26468
F-test statistic	103364.23847
constant	1.46608
slope of regression line	0.29051
SSE, sum of squares due to error	504.26011
SSR, sum of squares due to regression	7241.24240

technique will always produce a prediction equation regardless of whether the specified model is correct. Because of this fact, measures of adequacy of the fit should be examined prior to any attempt to interpret the prediction equation.

11.8.1 Partitioning of the variability

One measure of the variability in data is a quantity called the Adjusted Total Sum of Squares, TSS(adj). This quantity is the sum of the squares of the differences between each observation in a data set and the mean of all observations.

The Adjusted Total Sum of Squares can be broken down or partitioned as follows:

$$TSS(adj) = SSR + SSE$$

where SSR = Sum of Squares due to Regression of Y on X

SSE = Sum of Squares due to Error

The Residual Sum of Squares (SSE) measures the variability in the responses that cannot be attributed to the responses all falling on the fitted regression line. If the regression line gives a "good" fit, the value of SSE would be very small compared to the value of SSR. A large residual variation, SSE, may mean that the residuals are large and the fit of the prediction equation to the observed data is poor. In similar fashion, a small value for SSR may mean the predictor variable is of little use in predicting the response.[218]

The Sum of Squares due to Regression and the Sum of Squares due to Error are contained in Table 59, Summary of output of regression of square root of elapsed time on queue position.

It can be seen from Table 59 that the value of SSE is smaller than the value of SSR. The magnitude of the difference between the SSE and the SSR is such that it can be concluded that the calculated regression line does yield a statistically "good" fit to the observed data.

11.8.2 Analysis of variance

The partitioning of the total variation also enables the testing of the following hypothesis:

Ho: B equals Ø   Ha: B does not equal Ø

This amounts to testing the null hypothesis of no linear relationship between the predictor variable and the response against the alternative that such a relationship does exist. This test may be referred to as testing the significance of the regression relationship.[219]

The calculated F-statistic is contained in Table 59, Summary of output of regression of square root of elapsed time on queue position. The calculated F-statistic indicates that there is a highly significant acceptance level for the alternative hypothesis. In other words, there is strong indication that a linear relationship exists between the predictor variable of square root of elapsed time and the response variable of queue position.

The level of significance is 0.00%. This level of significance seems to indicate that without a doubt a statistically significant linear relationship exists.

11.8.3 Coefficient of determination

The coefficient of determination, R-Square, is a measure of the association between two variables. It is helpful when attempting to determine or quantify in some form the strength of a relationship between two variables.

Although it is actually the square of Pearson's r, a computational simplification makes it possible to define R-Square as

$$\text{R-Square} = SSR/(SSR + SSE)$$

In this form, R-Square can be seen to be the proportion of the adjusted variation in the responses that is attributed to the estimated regression line. If the residuals are small, then R-Square approaches a value of 1.0. If the residuals are large, then R-Square approaches a value of 0.[220]

The value of R-Square for the regression procedure that was performed is also contained in Table 59, Summary of output of regression of square root of elapsed time on queue position

The coefficient of determination indicates that 93.5% of the variability of the responses can be attributed to the regression of the square root of elapsed time on queue position.

"...the coefficient of determination [is] one of the most important measures of the adequacy of prediction equations...before confidence can be placed in predictions from a fitted model, R-Square must be considered sufficiently large by the data analyst. A large value of R-Square does not necessarily guarantee accurate prediction [...] but it should be required before undue claims are made about the fitted model.[221]

Obviously, the value of R-Square that has been calculated in this experiment indicates that the prediction equation that has been produced by the regression of the square root of elapsed time on queue position is able to produce an accurate prediction of the square root of elapsed time. Only 6.5% of the variability in the data is left unexplained.

11.8.4 Concluding discussion on measures of fit

It is apparent from the preceding sections that the prediction equation that has been generated during the regression analysis is capable of accurately predicting the square root of elapsed times, and, hence, elpased times from the start of green phase. The variability in the responses that cannot be attributed to the responses all falling on the regression line (SSE) is small, and the coefficient of determination, R-Square, is large, reinforcing the fact that most of the variability of the responses can be accounted for by the regression of the square root of elapsed time on queue position.

In additon, the analysis of variance sub-procedure in the regression procedure indicates, at a highly significant level, that a linear relationship exists between square root of elapsed time and queue position.

All measures of fit indicate that the regression equation that has been generated is capable of accurately predicting values of the square root of elapsed time from the start of green phase.

11.9 Prediction equation

From Appendix X, Output from REGRESSION procedure in SPSS/PC of square root of elapsed time on queue position, it can be seen that the regression coefficients for intercept and slope have been calculated as 1.46608 and 0.29051 respectively. The standard errors (SE B) indicate the variability that is associated with each of the regression coefficients.

The equation to predict the square root of the elapsed time that will expire before a particular vehicle clears a signalized intersection in the City of St. John's is given by:

$$SQ.RT.TIME = 1.46608 + (0.29051 * POSITION)$$

where, SQ.RT.TIME is the square root of predicted time, in $\text{seconds}^{1/2}$, that elapses between the start of the green phase for an approach and the time when the vehicle in the queue position of interest clears the intersection, and

POSITION is the number of the queue position for the vehicle of interest.

Of course, in the real world, the square root of the time that elapses between the start of a green phase for an approach and the time when a vehicle in the queue position of interest clears the intersection is of little interest. The actual quantity of interest is the real time that elapses.

Therefore, it is necessary to manipulate the prediction equation noted above into the following form:

$$\text{TIME} = (1.46608 + (0.29051 * \text{POSITION}))^2$$

where, TIME is the predicted time, in seconds, that elapses between the start of the green phase for an approach and the time when the vehicle in the queue position of interest clears the intersection, and

POSITION is the number of the queue position for the vehicle of interest.

Table 60, Predicted elapsed times, contains the predicted values of elapsed time for each of the queue positions. Table 60 also contains the 95% confidence interval limits for each position. It can be seen, for each queue position, that the range of elapsed times contained in the 95% confidence interval is small. This is as would be expected given the relatively small values for the standard errors of the estimates of the regression coefficients.

The small confidence interval does not exceed the ten per cent value for change in elapsed time that has been selected as being of practical importance. This means that the confidence level limits are of no practical importance other than to show that the predicted values are accurate estimates.

The following calculation is offered as an example of how the prediction equation can be used to predict the time that will elapse before eight vehicles clear an intersection:

$$\text{TIME} = (1.46608 + (0.29051 * 8))^2 = 14.36 \text{ seconds.}$$

When the 95% confidence interval is calculated as 14.16s to 14.57s, it can be seen that the difference of 0.41s

Table 60 Predicted elapsed times

position	predicted elapsed time	lower interval	upper interval
1	3.09	3.03	3.14
2	4.19	4.12	4.26
3	5.46	5.38	5.55
4	6.91	6.80	7.01
5	8.52	8.39	8.65
6	10.30	10.15	10.45
7	12.25	12.07	12.43
8	14.36	14.16	14.57
9	16.65	16.42	16.89
10	19.11	18.84	19.38
11	21.73	21.43	22.03
12	24.52	24.19	24.86

represents less than 3% of the predicted elapsed time and is of no practical importance.

11.10 Conclusions

There is a strong linear, positive correlation between the time that elapses before a vehicle clears a signalized intersection and the position of that vehicle in the queue. The prediction equation generated by the regression of the square root of elapsed time on position in the queue is an accurate predictor of elapsed time from the start of green for the first twelve queue positions at signalized intersections in the City of St. John's.

CHAPTER TWELVE

12.0 SUMMARY AND CONCLUSIONS

12.1 Summary

The effect of approach gradient, weather conditions and vehicle position in the queue upon the headways of vehicles leaving signalized intersections in the City of St. John's was investigated through the application of statistical techniques to data that was collected at five selected approaches to signalized intersections. This investigation was performed using a factorial experimental design to determine which of the factors significantly affected the response variable, discharge headway. An attempt was then made using regression techniques to determine the relationship between those factors and vehicle headways.

During the regression analysis phase of the experiment it was concluded that one of the assumptions of regression, Normality of the distribution of the error terms, was not valid. Accordingly, the database was transformed to produce a more Normal distribution. The factorial experiment and regression analysis were then repeated on the transformed database.

Many of the factors that influence traffic operations at signalized intersections were considered during initial experimental design stages. The intersection approaches that were ultimately selected for data collection were chosen so that the effects of all factors except those of interest were controlled.

Data on vehicle headways was collected during the Spring of 1986. This data was entered into a flat ASCII file and loaded into Memorial University's mainframe system, where it was manipulated and analyzed using various procedures of the SPSS/X statistical software package.

The factorial experiment that was performed indicated a statistically significant interaction between weather conditions and approach gradient. However, subsequent attempts, through regression procedures, to formulate equations quantifying the relationship between approach gradient and vehicle headway at each level of the weather condition factor were not very successful.

Consequent examination of the data revealed an error in the database that had been used during those regression procedures. When the regression procedures were performed on the corrected database, the results were largely unchanged in that no practical relationship could be quantified between approach gradient and discharge headways.

However, a practical and statistically significant relationship was developed between the elapsed time from the start of the green phase and vehicle position in the queue.

12.2 Conclusions

The primary objective of the experiment was to analysis the effects that the factors of weather conditions, vehicle position in the queue and approach gradient might have on discharge headways at signalized intersections in the City of St. John's.

The results of the factorial experiment that was performed on the headway data indicated that the main effects of each of these three factors on the response variable of vehicle discharge headways was statistically significant at the 1% level. However, the results of the factorial experiment also indicated that there was significant interaction between the factors of weather conditions and approach gradient. Because of this interaction, the main effects by themselves ceased to have much meaning.

It was concluded, therefore, that the effect of approach gradient on vehicle discharge headways at any specific time depended on the weather conditions that existed on that approach at that time. Analysis of the data indicated that, generally, discharge headways were less under fair weather conditions than they were when weather conditions were classified as poor. However, because of the significant interaction between weather and gradient, and because weather conditions are considered qualitative, the effect of approach gradient on discharge headways was examined separately at each level of the weather condition factor.

However, a prediction equation was developed to describe the relationship between the dependent variable, elapsed time from the start of the green phase at a signalized intersection, which is related to discharge headway, and the independent variable, vehicle position in the queue.

It is concluded that this equation is a practical prediction equation with excellent predictive capabilities.

This equation is stated as:

$$\text{TIME} = (1.46608 + (0.29051 * \text{POSITION}))^2$$

where, TIME is the predicted time, in seconds, that elapses between the start of the green phase for an approach and the time when the vehicle in the queue position of interest clears the intersection, and

POSITION is the number of the queue position for the vehicle of interest.

This prediction equation accounts for 93.5% of the variability in the observed data.

However, it must be noted that this equation can only be appropriately applied to intersection approaches in the Columbus Drive/Prince Philip Drive corridor, as this was the

The secondary objective of the experiment, to quantify the relationship between approach gradient and discharge headways under fair and poor weather conditions, was not completed as successfully as was the primary objective. The regression procedure produced equations with very low values of the coefficients of determination, indicating that little of the variability in the responses was being accounted for by the regression equation. At the same time, the significance level of the F-test procedure that was performed as part of the regression procedure gave indications that a strong linear relationship existed between approach gradient and discharge headway. However, it was concluded that the significant result of the F-test procedure was a result of the large number of residual degrees of freedom resulting from the very large database.

It was also concluded that, although it has been established that the differences in discharge headways on different approach gradients are statistically significant, the significance of those differences is, for the most part, a result of the large sample size, and, more importantly, is of no practical importance.

It was further concluded that there is no practical quantifiable relationship between approach gradient and discharge headways on the approaches to signalized intersections in the City of St. John's.

location of the approaches upon which the initial data was collected.

Traffic flows in this high speed commuter corridor may have significantly different characteristics than flows in other areas of the City of St. John's, and the prediction equation that has been developed should be used with caution if it is applied in other areas of the City.

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Appendix A

Signalized intersection approach database

This Appendix contains a database consisting of the levels of the various factors listed in Table 3 for each of the two hundred and forty signalized intersection approaches in the City of St. John's

This Appendix contains a database consisting of the levels of the various factors listed in Table 3 for each of the two hundred and forty signalized intersection approaches in the City of St. John's

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	N	adeq.	N	min.	G	2	N	OCD	G	U	50	N	100	collector
1	S	adeq.	N	min.	G	2	N	OCD	G	U	50	N	100	collector
1	E	adeq.	Y	min.	G	2	N	OCD	G	U	50	N	100	arterial
1	W	adeq.	Y	min.	G	2	N	OCD	G	U	50	N	100	arterial
2	N	adeq.	Y	min.	G	2	N	OCD	G	U	50	N	100	local
2	E	adeq.	Y	min.	G	2	N	OCD	G	U	50	N	100	arterial
2	W	adeq.	Y	min.	G	2	N	OCD	G	U	50	N	100	arterial
3	N	adeq.	Y	min.	G	2	N	OCD	G	U	70	N	100	arterial
3	S	adeq.	Y	min.	G	2	N	OCD	G	U	70	N	100	arterial
3	E	adeq.	Y	min.	G	2	N	OCD	G	S	50	N	100	arterial
3	W	adeq.	Y	min.	G	2	N	OCD	G	S	50	N	100	arterial
4	N	adeq.	N	min.	G	2	N	SRA	G	U	50	N	100	local
4	E	adeq.	Y	min.	G	2	N	SRA	G	S	50	N	100	arterial
4	W	adeq.	Y	min.	G	2	N	SRA	G	S	50	N	100	arterial
5	N	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	arterial
5	S	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	arterial
5	W	adeq.	N	min.	G	2	N	SRA	G	U	70	N	100	collector
7	N	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	arterial
7	S	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	arterial
7	E	adeq.	N	min.	G	2	Y	SRA	G	S	50	N	100	arterial
7	W	adeq.	N	min.	G	2	Y	SRA	G	S	50	N	100	collector
8	N	adeq.	Y	min.	G	2	N	SRA	G	U	70	Y	100	arterial
8	S	adeq.	Y	min.	G	2	N	SRA	G	U	70	N	100	arterial
8	E	adeq.	N	min.	G	2	Y	SRA	G	S	50	N	100	collector
8	W	adeq.	N	min.	G	2	Y	SRA	G	S	50	N	100	local
9	N	adeq.	Y	min.	G	2	N	SRA	G	U	70	N	100	arterial
9	S	adeq.	Y	min.	G	2	N	SRA	G	U	70	N	100	arterial
9	E	adeq.	Y	min.	G	2	N	SRA	G	U	50	N	100	arterial
9	W	adeq.	Y	min.	G	2	N	SRA	G	U	50	N	100	local
10	N	adeq.	N	min.	G	2	N	OCD	G	U	50	N	100	local
10	E	adeq.	Y	min.	G	2	N	OCD	G	U	50	N	100	arterial
10	W	adeq.	Y	min.	G	2	N	OCD	G	U	50	N	100	arterial
12	N	adeq.	N	min.	G	2	N	OCD	G	U	50	Y	100	collector
12	E	adeq.	Y	min.	G	2	N	OCD	G	S	50	Y	100	arterial
12	W	adeq.	Y	min.	G	2	N	OCD	G	S	50	Y	100	arterial
13	S	adeq.	N	min.	G	2	N	OCD	G	U	50	Y	100	local
13	E	adeq.	Y	min.	G	2	N	OCD	G	U	50	Y	100	arterial
13	W	adeq.	Y	min.	G	2	N	OCD	G	U	50	Y	100	arterial
14	N	inadeq	N	min.	P	2	N	OCD	G	S	50	N	100	collector
14	S	adeq.	N	min.	P	2	Y	OCD	G	S	50	N	100	collector
14	E	adeq.	N	min.	G	2	N	OCD	G	U	50	Y	100	arterial

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
14	W	adeq.	Y	min.	G	2	N	OCD	G	U	50	N	100	arterial
15	N	adeq.	N	min.	G	2	N	OCD	G	S	50	N	100	collector
15	S	adeq.	N	min.	G	2	N	OCD	G	S	50	N	100	collector
15	E	adeq.	N	min.	G	2	Y	OCD	G	U	50	N	100	local
15	W	adeq.	N	min.	G	2	N	OCD	G	U	50	N	100	collector
16	N	adeq.	Y	min.	G	2	N	SRA	G	U	50	N	100	collector
16	S	adeq.	Y	min.	G	2	N	SRA	G	U	50	N	100	collector
16	E	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	arterial
16	W	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	arterial
17	N	adeq.	N	min.	G	2	N	SRA	G	U	50	N	100	local
17	E	adeq.	Y	min.	G	2	N	SRA	G	U	70	N	100	arterial
17	W	adeq.	Y	min.	G	2	N	SRA	G	U	70	N	100	arterial
18	N	adeq.	Y	min.	G	2	N	SRA	G	U	50	N	100	local
18	S	adeq.	N	min.	G	2	Y	SRA	G	U	50	N	100	collector
18	E	adeq.	Y	maj.	F	2	N	SRA	G	U	70	N	100	arterial
18	W	adeq.	Y	min.	G	2	N	SRA	G	U	70	N	100	arterial
19	N	adeq.	Y	min.	G	2	N	SRA	G	U	50	N	100	collector
19	S	adeq.	Y	min.	P	2	N	SRA	G	U	50	N	100	arterial
19	E	adeq.	Y	min.	G	2	N	SRA	G	U	70	N	100	arterial
19	W	adeq.	Y	min.	G	2	N	SRA	G	U	70	N	100	arterial
21	N	adeq.	N	min.	G	2	N	SRA	G	U	50	Y	100	local
21	E	adeq.	Y	min.	G	2	N	SRA	G	S	70	N	100	arterial
21	W	adeq.	Y	min.	G	2	N	SRA	G	S	70	Y	100	arterial
22	N	adeq.	Y	min.	P	2	N	SRA	G	U	50	N	100	arterial
22	S	adeq.	Y	min.	P	2	N	SRA	G	U	50	N	100	arterial
22	E	adeq.	Y	min.	G	2	N	SRA	G	U	70	N	100	arterial
22	W	adeq.	Y	min.	G	2	N	SRA	G	U	50	N	100	arterial
23	N	adeq.	Y	min.	G	2	N	OCD	G	U	50	N	80	arterial
23	S	adeq.	Y	min.	G	2	N	OCD	G	U	50	N	80	arterial
23	E	adeq.	Y	min.	G	2	N	OCD	G	U	50	N	80	arterial
23	W	adeq.	Y	min.	G	2	N	OCD	G	U	50	N	80	arterial
24	N	adeq.	Y	min.	G	2	N	SRA	G	U	50	N	80	arterial
24	S	adeq.	Y	min.	G	2	N	SRA	G	U	50	N	80	arterial
24	W	adeq.	N	min.	G	2	N	SRA	G	U	50	N	80	arterial
25	N	adeq.	Y	min.	G	2	N	SRA	G	U	50	N	90	arterial
25	S	adeq.	Y	min.	G	2	N	SRA	G	U	50	N	90	arterial
25	E	adeq.	N	min.	G	2	Y	SRA	G	U	50	N	90	collector
25	W	adeq.	N	min.	G	2	Y	SRA	G	U	50	N	90	collector
26	N	inadeq	N	min.	G	2	N	SRA	G	U	50	Y	60	collector
26	E	adeq.	Y	min.	G	2	N	SRA	G	U	50	N	60	arterial
26	W	adeq.	Y	min.	G	2	Y	SRA	G	U	50	Y	60	arterial
27	N	adeq.	Y	min.	G	2	N	SRA	G	U	50	N	80	arterial
27	S	adeq.	Y	min.	G	2	N	SRA	G	U	50	Y	80	arterial
27	E	adeq.	N	min.	G	2	N	SRA	G	U	50	N	80	arterial
27	W	adeq.	N	min.	G	2	N	SRA	G	U	50	N	80	arterial
28	N	inadeq	N	min.	G	2	Y	RC	G	U	50	N	80	collector
28	S	inadeq	N	min.	G	2	N	RC	G	U	50	N	80	collector
28	E	adeq.	N	min.	G	2	Y	RC	G	S	50	N	80	arterial
28	W	inadeq	N	maj.	G	2	N	RC	G	S	50	N	80	arterial
29	N	adeq.	N	min.	G	2	N	RC	G	U	50	N	80	arterial

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
29	S	adeq.	N	min.	G	2	N	RC	G	U	50	N	80	arterial
29	E	adeq.	N	min.	G	2	N	RC	G	S	50	N	80	collector
29	W	adeq.	N	min.	G	2	N	RC	G	S	50	N	80	collector
30	N	adeq.	N	min.	G	2	N	RC	G	U	50	N	80	arterial
30	S	adeq.	N	min.	G	2	N	RC	G	U	50	N	80	arterial
30	E	adeq.	N	min.	G	2	N	RC	G	U	50	N	80	collector
30	W	adeq.	N	min.	P	2	Y	RC	G	U	50	N	80	collector
31	N	adeq.	N	min.	G	2	Y	RC	G	U	50	N	80	arterial
31	S	adeq.	N	min.	G	2	Y	RC	G	U	50	N	80	arterial
31	E	adeq.	N	min.	G	2	Y	RC	G	U	50	N	80	collector
31	W	adeq.	Y	min.	G	2	N	RC	G	U	50	N	80	collector
32	N	adeq.	N	min.	G	2	Y	RC	G	U	50	N	50	arterial
32	S	adeq.	N	min.	G	2	Y	RC	G	U	50	N	50	arterial
32	E	adeq.	N	min.	G	2	N	RC	G	U	50	N	50	collector
32	W	adeq.	N	min.	G	2	N	RC	G	U	50	N	50	collector
33	N	adeq.	Y	min.	G	2	N	SRA	G	U	50	N	70	arterial
33	S	adeq.	Y	min.	G	2	N	SRA	G	U	50	Y	70	arterial
33	E	adeq.	N	min.	G	2	N	SRA	G	U	50	N	70	arterial
33	W	adeq.	N	min.	G	2	Y	SRA	G	U	50	N	70	arterial
34	N	adeq.	N	min.	P	2	N	SRA	G	S	50	N	100	arterial
34	S	adeq.	N	min.	G	2	N	SRA	G	S	50	N	100	arterial
34	E	adeq.	N	min.	G	2	N	SRA	G	U	50	N	100	arterial
34	W	adeq.	N	min.	G	2	N	SRA	G	U	50	N	100	arterial
35	N	adeq.	N	min.	G	2	Y	RC	G	U	50	N	60	collector
35	S	adeq.	N	min.	G	2	Y	RC	G	U	50	N	60	collector
35	E	adeq.	N	min.	G	2	N	RC	G	S	50	N	60	arterial
35	W	adeq.	N	min.	G	2	Y	RC	G	S	50	N	60	arterial
36	N	adeq.	N	min.	G	2	Y	RC	P	S	50	N	60	collector
36	S	adeq.	N	min.	G	2	Y	RC	P	S	50	N	60	collector
36	E	adeq.	N	min.	G	2	N	RC	P	S	50	N	60	arterial
36	W	adeq.	N	min.	G	2	Y	RC	P	S	50	N	60	arterial
37	N	adeq.	Y	min.	P	2	N	RC	G	U	50	N	70	collector
37	S	adeq.	N	min.	G	2	Y	RC	G	U	50	N	70	collector
37	E	adeq.	Y	min.	G	2	N	RC	G	U	50	N	70	arterial
37	W	adeq.	N	min.	G	2	N	RC	G	U	50	N	70	arterial
38	N	adeq.	N	min.	G	2	Y	RC	G	S	50	N	70	collector
38	S	adeq.	N	min.	G	2	Y	RC	G	S	50	N	70	collector
38	E	adeq.	N	min.	G	2	Y	RC	G	U	50	N	70	arterial
38	W	adeq.	N	min.	G	2	N	RC	G	U	50	Y	70	arterial
39	S	adeq.	N	min.	G	2	Y	RC	P	U	50	N	80	arterial
39	E	inadeq	N	min.	G	2	N	RC	P	U	50	N	80	collector
39	W	adeq.	Y	min.	G	2	N	RC	P	U	50	N	80	arterial
40	N	adeq.	N	min.	P	2	Y	RC	G	S	50	N	70	collector
40	S	adeq.	N	min.	P	2	Y	RC	G	S	50	N	70	collector
40	E	adeq.	N	min.	G	2	Y	RC	G	S	50	N	70	arterial
40	W	adeq.	N	min.	G	2	Y	RC	G	S	50	N	70	arterial
41	N	adeq.	N	min.	G	2	Y	CBD	G	U	50	N	80	arterial
41	E	adeq.	Y	min.	G	2	N	CBD	G	U	50	N	80	arterial
41	W	adeq.	Y	min.	G	2	N	CBD	G	U	50	Y	80	arterial
42	N	adeq.	N	min.	G	2	N	CBD	G	U	50	N	80	collector

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
42	S	adeq.	N	min.	G	2	N	CBD	G	U	50	N	80	collector
42	E	adeq.	Y	min.	G	2	N	CBD	G	U	50	Y	80	arterial
42	W	adeq.	Y	min.	G	2	Y	CBD	G	U	50	N	80	arterial
43	N	adeq.	N	min.	G	2	N	CBD	G	S	50	N	80	collector
43	S	adeq.	N	min.	G	2	N	CBD	G	S	50	N	80	collector
43	E	adeq.	Y	min.	G	2	N	CBD	G	U	50	Y	80	arterial
43	W	adeq.	Y	min.	G	2	N	CBD	G	U	50	Y	80	arterial
44	N	adeq.	N	min.	P	2	N	CBD	G	U	50	N	80	collector
44	E	adeq.	Y	min.	G	2	N	CBD	G	U	50	Y	80	arterial
44	W	adeq.	Y	min.	G	2	N	CBD	G	U	50	N	80	arterial
46	N	adeq.	N	min.	G	2	Y	CBD	G	U	50	N	80	collector
46	S	adeq.	N	min.	G	2	N	CBD	G	U	50	N	80	collector
46	E	adeq.	Y	min.	G	2	Y	CBD	G	U	50	N	80	arterial
46	W	adeq.	Y	min.	G	2	N	CBD	G	U	50	Y	80	arterial
47	S	adeq.	N	min.	G	2	N	CBD	G	U	50	Y	80	arterial
47	E	adeq.	Y	min.	G	2	Y	CBD	G	U	50	Y	80	arterial
47	W	adeq.	Y	min.	G	2	N	CBD	G	U	50	N	80	arterial
48	N	adeq.	N	min.	G	2	N	CBD	G	U	50	N	80	collector
48	E	adeq.	N	min.	G	2	N	CBD	G	U	50	Y	80	collector
48	W	adeq.	Y	min.	G	2	N	CBD	G	U	50	Y	80	arterial
49	N	adeq.	N	min.	G	2	Y	CBD	G	U	50	Y	80	local
49	E	adeq.	Y	min.	G	2	Y	CBD	G	U	50	Y	80	collector
49	W	adeq.	Y	min.	G	2	Y	CBD	G	U	50	Y	80	collector
50	N	adeq.	N	min.	G	2	Y	CBD	G	U	50	N	80	local
50	S	adeq.	N	min.	G	2	Y	CBD	G	S	50	N	80	local
50	E	adeq.	N	maj.	P	2	Y	CBD	G	U	50	Y	80	collector
50	W	adeq.	Y	maj.	P	2	Y	CBD	G	U	50	Y	80	collector
51	N	adeq.	N	min.	P	2	Y	CBD	G	S	50	N	80	local
51	E	adeq.	Y	min.	P	2	Y	CBD	G	U	50	Y	80	collector
51	W	adeq.	N	min.	P	2	Y	CBD	G	U	50	Y	80	collector
52	N	adeq.	N	min.	G	2	N	CBD	G	U	50	N	80	local
52	S	adeq.	N	min.	G	2	N	CBD	G	S	50	N	80	local
52	E	adeq.	Y	min.	P	2	Y	CBD	G	U	50	Y	80	collector
52	W	adeq.	Y	min.	P	2	Y	CBD	G	U	50	Y	80	collector
53	S	adeq.	N	maj.	G	2	Y	CBD	G	U	50	Y	80	local
53	E	adeq.	Y	min.	G	2	Y	CBD	G	U	50	Y	80	collector
53	W	adeq.	N	min.	P	2	Y	CBD	G	U	50	Y	80	collector
54	N	adeq.	Y	min.	P	2	N	CBD	G	S	50	N	60	arterial
54	S	adeq.	Y	min.	G	2	N	CBD	G	S	50	Y	60	arterial
54	E	adeq.	N	min.	G	2	N	CBD	G	U	50	N	60	collector
54	W	adeq.	N	min.	G	2	N	CBD	G	U	50	N	60	collector
55	N	inadeq	Y	min.	G	1	N	CBD	G	U	50	N	80	arterial
55	S	adeq.	N	min.	P	1	N	CBD	G	U	50	N	80	arterial
55	E	adeq.	Y	min.	G	2	N	CBD	G	S	50	N	80	collector
55	W	adeq.	N	min.	G	2	N	CBD	G	S	50	N	80	collector
56	N	adeq.	N	min.	G	2	N	SRA	G	U	50	N	60	collector
56	S	adeq.	N	min.	G	2	Y	SRA	G	U	50	N	60	collector
56	E	adeq.	N	min.	G	2	Y	SRA	G	U	50	N	60	collector
56	W	adeq.	N	min.	G	2	Y	SRA	G	U	50	N	60	collector
57	N	adeq.	N	min.	G	2	N	SRA	G	U	50	N	80	collector

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
57	S	adeq.	N	min.G	2	N	SRA	G	U	50	N	80	collector	
57	E	adeq.	N	min.G	2	N	SRA	G	U	50	N	80	arterial	
57	W	adeq.	N	min.G	2	N	SRA	G	U	50	N	80	arterial	
58	N	adeq.	N	min.G	2	N	OCD	P	S	50	N	70	arterial	
58	S	adeq.	N	min.G	2	N	OCD	P	S	50	N	70	arterial	
58	E	adeq.	Y	min.G	2	N	OCD	P	U	50	Y	70	arterial	
58	W	adeq.	N	min.G	2	N	OCD	P	U	50	N	70	arterial	
59	N	adeq.	N	min.G	2	N	OCD	G	S	50	N	80	collector	
59	S	adeq.	N	min.G	2	N	OCD	G	S	50	N	80	collector	
59	E	adeq.	Y	min.G	2	N	OCD	G	U	50	N	80	arterial	
59	W	adeq.	Y	min.G	2	N	OCD	G	U	50	N	80	arterial	
60	N	adeq.	Y	min.G	2	N	OCD	G	S	50	N	80	arterial	
60	S	adeq.	Y	min.G	2	N	OCD	G	S	50	N	80	arterial	
60	W	adeq.	N	min.G	2	N	OCD	G	U	50	N	80	arterial	
61	N	inadeq	Y	min.P	2	N	CBD	G	S	50	N	80	collector	
61	S	adeq.	Y	min.G	2	N	CBD	G	U	50	N	80	collector	
61	W	adeq.	Y	min.G	2	N	CBD	G	U	50	N	80	collector	
62	N	adeq.	N	min.P	2	N	RC	G	S	50	N	80	arterial	
62	S	adeq.	N	min.P	2	N	RC	G	S	50	N	80	collector	
62	E	adeq.	N	min.G	2	N	RC	G	U	50	N	80	collector	
62	W	adeq.	N	min.G	2	N	RC	G	U	50	N	80	arterial	
63	N	adeq.	Y	min.G	2	N	SRA	G	U	50	Y	80	arterial	
63	S	adeq.	Y	min.G	2	N	SRA	G	U	50	N	80	arterial	
63	E	adeq.	N	min.G	2	N	SRA	G	U	50	Y	80	collector	
63	W	adeq.	N	min.G	2	Y	SRA	G	U	50	N	80	collector	
64	N	adeq.	N	min.G	2	N	OCD	G	U	50	N	80	local	
64	E	adeq.	Y	min.G	2	N	OCD	G	S	50	N	80	arterial	
64	W	adeq.	Y	min.G	2	N	OCD	G	S	50	N	80	arterial	
65	N	adeq.	N	min.G	2	N	SRA	G	U	50	N	100	local	
65	S	adeq.	N	min.G	2	N	SRA	G	U	50	N	100	local	
65	E	adeq.	Y	min.P	2	N	SRA	G	U	70	N	100	arterial	
65	W	adeq.	Y	min.P	2	N	SRA	G	U	70	N	100	arterial	
66	N	adeq.	N	min.P	2	N	SRA	G	S	50	N	80	collector	
66	S	adeq.	N	min.P	2	N	SRA	G	S	50	N	80	collector	
66	E	adeq.	N	min.P	2	Y	SRA	G	U	50	N	80	arterial	
66	W	adeq.	N	min.P	2	Y	SRA	G	U	50	N	80	arterial	
68	S	adeq.	N	min.G	2	N	SRA	G	U	50	N	70	collector	
68	E	adeq.	Y	min.G	2	N	SRA	G	S	50	N	70	arterial	
68	W	adeq.	Y	min.G	2	N	SRA	G	S	50	N	70	arterial	
69	N	adeq.	Y	min.G	2	N	SRA	G	U	50	N	60	arterial	
69	S	adeq.	Y	min.G	2	N	SRA	G	U	50	N	60	arterial	
69	E	adeq.	N	min.P	2	N	SRA	G	U	50	N	60	collector	
70	W	adeq.	N	min.G	2	N	SRA	G	S	50	N	80	collector	
70	S	adeq.	N	min.G	2	Y	SRA	G	S	50	N	80	collector	
70	E	adeq.	Y	min.G	2	Y	SRA	G	U	50	N	80	collector	
70	W	adeq.	Y	min.G	2	Y	SRA	G	U	50	N	80	collector	
71	N	adeq.	N	min.G	2	N	SRA	G	U	50	N	100	local	
71	E	adeq.	Y	min.G	2	N	SRA	G	U	70	N	100	arterial	
71	W	adeq.	Y	min.G	2	N	SRA	G	U	70	N	100	arterial	
72	N	adeq.	Y	min.G	2	N	SRA	G	U	50	N	100	arterial	

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
72	S	adeq.	Y	min.G	2	N	SRA	G	U	50	N	100	arterial
72	E	adeq.	N	min.G	2	N	SRA	G	U	50	N	100	local
73	N	adeq.	Y	min.G	2	N	OCD	G	S	50	N	100	arterial
73	S	adeq.	Y	min.G	2	N	OCD	G	S	60	N	100	arterial
73	E	adeq.	N	min.G	2	N	OCD	G	U	50	N	100	collector
73	W	adeq.	N	min.G	2	N	OCD	G	U	50	N	100	collector
74	N	adeq.	Y	min.G	2	N	OCD	G	U	60	N	100	arterial
74	S	adeq.	Y	min.G	2	N	OCD	G	U	60	N	100	arterial
74	E	adeq.	N	min.G	2	N	OCD	G	U	50	N	100	local

COL. DESCRIPTION

1	intersection identification number
2	approach direction
3	lane width adequacy
4	turning movements present
5	presence of pedestrians
6	driving surface condition
7	type of traffic operation
8	is parking allowed on approach
9	location type
10	visibility of the signal
11	suitability of approach gradient
12	speed limit
13	traffic interference present
14	length of cycle
15	classification of street

Appendix B

Recorded elapsed time data

This Appendix contains the database of 18,296 elapsed times that were recorded at the five study intersection approaches during the Spring of 1986

veh +7.2	1	[illegible]	3	4	5	6	7
cycle							
1	5.10	9.43	10.65	12.21	14.09	15.64	16.88
2	5.52	7.09	9.14	10.69	12.47	14.44	
3	4.07	7.13	10.03	11.32	13.26	14.97	16.03
4	4.78	7.75	10.10	11.8[illegible]	13.65	14.76	16.00
5	4.99	6.83	8.36	10.50	12.38	14.60	16.05
6	6.83	8.08	9.88	11.98	12.18	14.20	16.12
7	6.12	8.33	11.44	13.79	15.70	17.91	20.50
8	6.04	8.02	10.87	12.80	13.97	16.12	17.46
9	6.57	7.99	9.68	11.04	12.54	14.67	16.17
10	6.42	7.85	10.44	13.14	14.81	16.[illegible]	18.64
11	5.24	7.40	9.00	11.3[illegible]	13.94	15.24	17.42
12	6.20	8.24	10.08	11.52	12.68	14.33	18.30
13	5.01	6.69	8.54	9.84	11.34	12.73	13.93
14	5.53	6.76	7.98	9.04	11.32	13.01	14.10
15	5.93	8.84	10.39	11.93	14.07	14.95	17.31
16	4.58	5.99	7.29	8.90	10.83	12.34	13.86
17	4.74	6.22	9.10	10.94	12.89	15.80	17.04
18	6.58	7.78	10.09	11.94	13.75	15.04	16.68
19	5.77	8.24	10.14	13.46	15.84	17.06	18.69
20	5.54	7.91	9.50	10.81	12.43	13.55	15.45
21	4.74	7.46	8.80	9.92	11.68	13.05	16.94
22	5.52	7.60	9.04	11.39	13.65	16.71	18.09
23	8.51	10.39	11.78	13.57	15.01	16.25	18.37
24	6.34	8.44	11.04	12.80	13.93	15.87	17.64
25	6.55	8.24	11.08	12.96	14.17	16.19	17.48
26	6.75	9.07	10.93	12.46	14.38	16.31	18.42
27	6.67	8.39	9.87	11.64	12.66	14.35	15.99
28	5.80	9.64	10.91	12.60	14.14	15.84	17.20
29	7.13	8.27	9.65	11.74	14.43	16.64	17.72
30	10.71	13.18	15.34	16.79	19.34	21.47	23.22
31	5.20	6.84	8.12	9.66	10.96	12.67	14.47
32	7.04	8.22	9.40	11.18	13.14	14.91	17.92
33	[illegible].38	7.71	9.86	11.61	14.76	16.08	
34	6.31	7.94	9.18	10.58	12.66	13.90	15.26
35	7.17	9.20	10.45	12.80	14.56	15.97	16.94
36	7.23	8.56	10.35	13.30	14.48	16.00	17.70
37	6.43	8.83	10.48	11.84	13.98	15.50	17.33
38	5.09	7.74	9.62	11.85	14.35	15.50	17.24
39	5.51	6.86	8.98	10.87	13.28	15.17	16.63
40	5.84	8.11	9.15	10.94	12.38	13.64	15.67
41	4.80	6.71	8.87	9.96	11.93	14.70	16.64
42	4.96	6.84	9.59	11.53	12.79	14.71	16.27
43	5.24	7.14	9.91	11.84	13.18	14.69	15.94
44	4.92	8.15	10.40	13.84	15.78	16.97	18.24
45	5.52	7.44	9.80	11.11	12.35	14.00	15.35
46	6.92	8.96	11.03	12.24	13.64	15.29	16.40
47	6.97	8.95	10.85	12.73	14.14	15.56	17.41
48	4.94	8.34	9.80	12.21	15.28	16.80	18.10
49	4.92	7.30	8.88	11.64	13.00	14.90	16.10

veh +7.2	1	2	3	4	5	6	7
cycle							
50	4.26	6.91	8.13	9.17	10.21	11.17	12.54
51	4.85	6.60	7.87	9.19	13.43	14.97	18.15
52	4.92	7.04	9.14	11.51	12.75	14.74	15.95
53	5.00	6.73	7.88	10.94	13.74	14.91	16.25
54	5.07	7.48	10.75	11.95	13.47	14.94	16.46
55	5.91	7.13	9.56	11.52	13.97	15.74	17.17
56	6.57	8.17	9.88	11.23	12.72	14.52	15.58
57	5.22	7.79	9.09	11.75	13.63	14.76	16.93
58	5.78	7.86	9.46	10.83	12.81	14.07	15.24
59	5.84	7.57	8.97	10.40	13.96	15.34	16.90
60	5.40	6.90	7.91	8.91	11.04	13.14	15.04
61	7.02	8.08	9.37	10.73	13.40	15.00	17.01
62	5.74	7.30	9.16	10.22	12.07	14.02	15.40
63	5.29	7.33	10.32	11.67	13.02	14.21	15.84
64	5.10	6.54	8.57	9.89	11.34	13.64	15.63
65	4.28	5.76	7.22	8.88	11.41	12.97	14.45
66	5.78	7.64	9.60	11.58	13.39	15.01	17.38
67	5.30	7.78	9.27	10.64	12.20	13.38	15.09
68	7.07	9.44	11.96	14.63	16.60	19.01	21.24
69	8.83	10.24	11.71	13.64	15.27	16.83	18.74
70	5.81	7.44	8.17	10.24	12.22	13.55	15.36
71	7.06	9.53	11.00	12.10	13.60	15.03	16.73
72	5.00	6.84	9.44	11.64	13.67	15.22	17.17
73	5.29	7.26	9.97	11.14	12.96	14.77	16.28
74	6.31	7.98	9.44	10.82	13.56	14.18	16.22
75	4.27	6.19	7.64	9.02	10.11	12.41	15.58
76	7.82	8.12	11.03	13.27	15.09	16.22	18.38
77	5.28	8.01	9.19	11.59	13.45	15.96	17.27
78	4.63	6.66	8.22	11.20	12.16	17.63	19.03
79	4.65	7.35	9.43	11.40	13.10	14.81	17.55
80	4.44	7.00	9.54	11.37	14.11	15.27	17.62
81	5.56	6.99	9.60	11.10	12.96	15.67	17.19
82	4.02	8.04	10.37	12.14	13.17	14.58	16.61
83	5.16	7.92	9.65	12.10	13.50	14.43	17.79
84	5.26	8.09	10.11	11.43	14.94	17.01	18.22
85	5.21	7.07	8.42	9.87	11.82	13.24	15.98
86	5.54	6.74	8.40	10.87	12.95	14.07	17.53
87	4.51	7.80	9.10	10.29	12.07	14.30	15.57
88	4.09	6.65	8.34	9.95	11.65	14.02	16.02
89	6.34	7.73	11.21	13.01	15.28	17.06	18.97
90	5.59	8.96	10.74	12.74	15.62	16.91	19.67
91	4.31	6.25	7.59	9.63	13.02	14.68	16.03
92	5.46	6.68	9.42	11.55	14.84	16.54	17.17
93	5.78	7.21	8.98	10.58	12.36	13.64	15.58
94	6.30	8.17	9.21	10.84	13.14	14.94	16.21
95	6.09	7.97	9.66	12.07	13.94	15.82	17.61
96	4.26	5.74	9.48	12.24	13.44	14.67	17.10
97	8.06	9.96	11.21	12.55	14.48	16.73	19.51
98	6.37	8.56	9.81	12.17	14.40	16.69	18.90

veh +7.2	1	2	3	4	5	6	7
cycle							
99	5.55	7.59	8.87	11.27	13.86	16.50	18.17
100	4.56	6.57	8.12	10.29	13.30	14.49	16.16
101	5.96	7.54	9.40	10.81	12.29	14.32	16.74
102	5.94	8.25	9.69	11.78	13.17	15.22	17.14
103	4.93	7.10	9.32	11.44	13.64	15.22	17.14
104	5.00	6.43	8.15	10.10	12.26	14.14	15.79
105	3.81	6.15	7.97	10.04	11.90	13.17	14.93
106	6.42	8.58	9.98	11.70	13.60	15.06	16.57
107	6.11	8.13	11.24	12.88	14.92	17.61	19.60
108	4.53	7.42	8.70	10.41	13.05	14.34	15.94
109	2.59	5.14	7.43	9.06	10.91	12.57	15.55
110	4.72	6.69	9.52	11.15	13.50	16.40	19.64
111	5.73	7.70	9.58	11.56	13.50	15.14	17.34
112	4.66	6.54	8.39	11.34	12.93	14.57	16.37
113	8.15	9.87	12.48	14.06	16.37	18.19	19.24
114	4.87	6.20	7.62	9.96	12.12	13.59	15.19
115	5.50	8.58	10.76	13.54	15.52	16.10	18.00
116	6.13	7.34	9.21	11.44	13.92	15.46	16.74
117	8.10	9.37	10.81	12.54	15.28	17.37	
118	3.52	5.30	7.02	9.10	11.05	12.87	14.54
119	6.44	8.47	10.59	12.21	14.31		
120	6.27	8.56	10.94	13.03	15.35	18.52	20.42
121	7.11	8.76	10.55	12.15	14.21	15.48	19.20
122	3.63	5.82	9.40	11.30	12.81	14.47	16.52
123	6.37	7.69	9.42	11.57	12.80	15.27	16.72
124	7.99	10.34	12.40	14.18	16.50	18.66	21.31
125	6.09	8.80	10.22	12.14	13.34	15.06	16.30
126	3.94	7.14	10.14	11.55	13.64	15.61	17.09
127	6.07	8.47	9.95	11.85	14.14	16.31	18.03
128	5.43	7.76	10.50	12.83	15.92	17.81	19.55
129	4.20	6.25	7.74	9.87	11.89	13.97	15.85
130	4.81	7.05	9.93	11.23	13.16	16.07	18.80
131	6.08	7.99	9.49	12.10	14.83	16.13	18.43
132	4.11	5.83	7.92	9.88	11.20	13.43	14.97
133	7.43	8.50	10.07	9.50	12.41	14.69	17.33
134	5.80	7.55	10.94	12.10	14.07	15.42	18.28
135	4.85	8.11	9.79	12.08	13.24	15.50	17.48
136	4.28	6.95	8.90	10.55	11.67	12.92	14.56
137	4.26	7.26	10.33	12.69	14.00	15.71	17.34
138	5.34	7.81	11.18	12.33	13.95	16.10	18.85
139	4.44	6.28	9.44	11.39	13.10	16.74	18.31
140	4.34	5.72	7.69	10.02	11.75	13.91	15.78
141	5.04	7.58	3.80	11.38	12.90	14.44	15.67
142	5.60	9.67	11.48	12.91	14.98	16.44	18.23
143	5.18	8.07	9.38	11.64	13.18	15.47	17.28
144	4.16	7.66	9.08	11.07	13.51	15.35	17.31
145	3.90	5.60	7.54	9.57	11.44	13.10	14.76
146	4.27	7.28	9.34	10.61	12.53	14.17	15.75
147	5.99	7.94	11.04	14.19	15.67	17.87	20.04

veh +7.2	1	2	3	4	5	6	7
cycle							
148	5.03	6.70	7.94	11.13	12.27	14.04	15.25
149	4.02	5.87	7.87	11.01	12.14	13.87	16.77
150	5.43	8.34	9.87	11.46	13.09	15.05	17.07
151	5.42	8.16	9.93	11.03	13.00	15.67	
152	4.45	5.74	8.08	10.44	12.27	13.64	14.77
153	6.94	9.67	11.57	13.01	14.34	15.37	17.05
154	4.58	7.24	9.57	12.41	13.93	15.50	17.28
155	5.70	7.48	10.37	12.84	15.09	16.60	17.89
156	5.50	6.70	9.31	11.34	13.86	15.96	19.34
157	4.10	7.74	10.62	11.89	15.42	18.90	20.51
158	4.43	6.74	9.71	11.23			
159	4.31	7.16	8.90	11.65	13.41	15.12	16.53
160	5.48	7.38	8.64	11.38	12.73	16.13	17.36
161	5.05	6.88	8.20	9.69	11.57	14.68	16.46
162	6.71	9.29	10.70	11.79	12.78	14.00	15.61
163	6.48	7.80	9.50	11.07	12.79	14.89	16.00
164	4.41	6.90	8.22	9.28	11.14	13.24	14.90
165	3.70	5.23	7.73	9.09	10.35	12.01	14.55
166	5.25	6.48	8.75	10.84	12.15	13.50	17.12
167	4.37	6.45	7.90	9.27	11.21	13.49	15.44
168	5.53	12.04	15.22	17.97	20.54	23.20	24.97
169	6.11	7.50	10.03	11.64	13.40	14.61	15.85
170	4.53	7.36	8.96	11.09	13.00	15.42	16.70
171	5.22	6.86	8.59	9.70	13.10	14.24	15.73
172	5.86	8.02	9.99	11.76	13.11	14.34	15.59
173	5.60	7.21	9.08	11.23	12.32	14.96	16.07
174	5.47	7.06	8.16	12.32	13.72	15.44	17.43
175	3.61	5.27	7.74	9.60	13.04	14.29	15.87
176	5.98	7.75	9.40	11.13	13.22	14.97	16.30
177	5.33	7.31	8.94	11.30	13.04	15.02	16.05
178	4.87	7.13	8.64	10.77	12.84	13.95	16.44
179	4.89	7.34	8.54	10.35	13.02	14.98	16.50
180	5.27	6.78	8.34	10.33	13.30	15.04	18.04
181	4.03	5.80	7.30	9.11	11.31	12.67	13.94
182	5.26	8.27	11.41	13.00	14.85	17.06	18.74
183	6.00	7.23	9.41	12.25	13.98	15.37	16.77
184	5.90	7.80	8.74	9.87	11.04	12.97	14.60
185	2.97	5.50	7.36	10.71	12.34	14.18	15.43
186	6.17	8.64	10.41	13.22	15.26	16.86	18.67
187	6.15	7.99	9.58	11.62	12.74	14.81	17.04
188	5.52	7.82	9.77	11.49	14.60	16.51	18.14
189	6.69	8.30	9.57	11.53	12.69	14.18	16.20
190	5.76	7.44	9.43	11.80	15.94	18.72	20.17
191	5.72	7.67	10.04	11.57	13.11	16.38	
192	5.90	8.00	9.93	13.64	15.11	16.78	18.35
193	4.84	6.81	8.77	10.74	13.94	15.99	16.88
194	6.10	7.70	8.75	11.80	13.25	14.85	16.46
195	5.49	7.43	9.72	11.14	12.30	13.47	16.50
196	5.30	7.72	10.00	11.22	13.62	15.04	16.38

veh +7.2	1	2	3	4	5	6	7
cycle							
197	4.22	7.22	8.48	10.14	11.65	12.83	14.47
198	5.66	8.65	10.20	11.97	13.64	19.00	20.87
199	5.07	8.00	9.62	10.87	12.34	13.74	15.04
200	6.39	7.58	9.49	11.27	12.89	15.30	16.60
201	6.39	8.20	9.84	12.79	14.95	16.99	18.80
202	4.91	6.25	7.68	9.74	11.97	13.64	15.78
203	7.29	9.29	11.29	13.41	15.02	16.65	19.40
204	5.79	7.20	8.74	10.44	12.30	14.09	16.04
205	6.63	8.17	10.86	13.02	14.60	16.42	17.59
206	4.85	6.54	8.47	9.79	10.93	12.17	13.41
207	6.62	7.94	10.16	11.53	12.80	14.97	16.60
208	3.90	6.00	7.86	10.32	11.99	13.34	15.97
209	4.18	5.64	7.67	9.90	11.73	13.64	14.87
210	6.25	7.43	9.65	12.31	14.40	16.02	17.54
211	6.14	7.82	10.84	12.20	13.54	15.76	17.53
212	5.85	7.40	10.46	11.90	13.21	14.77	15.99
213	5.00	7.02	8.12	10.13	12.00	13.10	14.48
214	5.97	14.79	18.94	21.62	25.20	27.71	29.90
215	4.10	5.57	7.32	9.33	11.54	13.26	14.86
216	5.14	7.40	9.31	10.66	12.80	15.67	17.20
217	2.98	4.63	6.61	8.44	9.80	11.29	13.17
218	5.43	6.76	8.16	11.50	12.87	14.43	16.20
219	6.34	8.01	10.53	12.85	14.21	15.58	16.94
220	5.12	7.40	9.73	12.70	13.95	15.29	17.60
221	4.88	8.14	9.65	11.01	13.06	14.73	16.08
222	4.21	6.90	8.40	10.64	11.84	12.86	14.31
223	4.84	7.17	9.00	10.24	11.76	12.77	13.56
224	4.57	6.94	7.98	9.71	11.36	13.02	14.38
225	6.50	7.66	9.30	11.74	14.27	15.63	16.96
226	6.10	6.54	8.95	10.97	12.00	13.56	14.91
227	4.16	6.46	8.43	10.04	12.74	14.54	16.02
228	5.35	7.04	9.30	10.71	12.77	14.58	16.38
229	6.06	8.59	9.74	13.24	14.31	15.97	18.76
230	5.06	6.45	11.67	13.12	17.70	20.06	21.89
231	4.50	7.11	8.60	10.97	12.00	13.84	15.18
232	6.12	7.26	9.51	11.18	13.00	14.63	15.74
233	5.70	8.71	9.95	11.33	12.74	14.44	17.14
234	5.57	6.59	8.46	9.99	11.16	13.67	15.72
235	4.04	6.92	8.89	10.47	12.32	13.82	15.27
236	4.77	6.94	8.94	11.20	13.64	14.81	16.69
237	6.17	9.03	10.50	12.23	16.34	18.20	20.40
238	6.57	7.84	10.19	11.12	12.36	14.66	16.34
239	5.15	6.71	8.50	10.06	11.54	14.32	15.62
240	6.30	8.60	10.42	13.16	14.50	16.41	18.87
241	8.20	9.87	12.07	14.92	16.47	18.34	19.69
242	4.54	7.29	10.25	12.31	13.77	15.36	16.58
243	6.94	8.51	9.88	12.50	14.27	15.54	16.86
244	5.94	8.40	10.21	11.60	13.66	16.57	18.00
245	5.44	7.78	9.57	11.14	12.87	16.03	18.37

veh +7.2	1	2	3	4	5	6	7
cycle							
246	7.73	9.20	10.56	14.02	15.30	17.05	18.84
247	7.83	9.74	11.81	14.64	15.98	17.04	18.33
248	4.93	7.18	8.90	10.32	12.65	13.99	15.70
249	5.48	6.91	8.90	10.54	13.43	14.83	16.58
250	6.79	8.21	8.64	10.82	11.47	15.02	16.64

veh	1	2	3	4	5	6	7
no. of cycles	250	250	250	250	249	248	243

veh +7.2	8	9	10	11	12	13	14
cycle							
1	18.65	19.81	22.20				
2							
3	17.14	19.20	20.60				
4	19.54	21.60	23.72				
5	17.58	18.92	20.11	21.44	23.20	25.10	26.94
6	18.48	20.30	22.33	24.59			
7	21.77	23.65	25.20	27.19	28.88	31.39	
8	19.00	20.24	21.89	23.52	24.93	26.70	29.43
9	17.65	20.13	21.42	23.67	25.34	27.84	29.88
10	19.88	21.20	22.67	25.88	27.17	28.63	30.60
11	19.55	21.68	23.45	25.17	26.66	29.07	31.00
12	19.94	21.81	23.54	25.37	28.28	29.85	31.74
13	15.69	17.18	18.56	19.57	21.57	23.22	25.24
14	15.79	17.48	18.97	20.68	22.88	24.65	
15	18.54	20.37	22.46	25.05	26.52	28.24	29.70
16	15.91	17.77	18.80	20.37	22.87	24.02	25.62
17	18.79	20.40	21.70	23.63	24.73	27.10	28.81
18	17.96	20.12	21.33	22.70	24.80	26.29	27.58
19	20.16						
20	17.61	19.13	21.50	23.27	25.67	27.81	
21	19.13	20.22	21.54	22.91	24.20	26.17	27.67
22	19.54	21.09	22.65	24.14	26.25	27.82	29.12
23	19.57	21.99	23.74	25.20	28.57	31.47	
24	18.94	20.64	23.90	26.64	28.04	31.14	
25	18.84	20.11	21.56	22.80	25.02	26.56	27.72
26	19.61	20.95	22.30	24.14	25.57	26.85	29.04
27	17.33	18.44	19.83	21.80	23.90	25.58	27.01
28	18.64	20.32	21.62	24.42	26.40	28.22	29.91
29	19.02	21.18	23.11	24.83	26.41	27.99	29.40
30	25.10	27.64	30.09	32.16			
31	16.47	18.70	21.00	22.27			
32	19.57						
33							

veh +7.2	8	9	10	11	12	13	14
cycle							
34	16.63	17.65	19.97				
35	18.48						
36	19.82	22.02	25.30				
37	18.51	20.24	21.49				
38							
39	18.29	20.01	22.53	25.34	26.81	28.01	30.09
40	17.87	20.49	22.37	25.62			
41	18.22	19.97	21.67				
42	18.18	19.40	20.61	23.23	24.75	25.34	26.68
43	17.17	18.96	20.43	22.14	23.47	24.74	27.26
44	19.97						
45	16.17	18.43	20.15	21.16	22.63	23.90	25.44
46	17.95	19.79	21.20	22.57	24.40	25.61	28.13
47	18.80	19.97	21.29	22.54	24.70	27.05	29.15
48	19.42	20.80	23.74	25.97	27.10	28.24	30.88
49	18.00	19.54	21.54	23.26	25.13	26.92	28.28
50	14.27	16.00	17.43	18.82	21.19		
51	19.54	22.45	24.04	25.75	27.70	29.00	30.44
52	17.68	18.76	20.27	21.63	24.70	25.96	28.84
53	18.40	19.77	21.32	22.16	24.09	25.43	26.79
54	17.72	19.30	21.41	23.74	25.94	27.29	28.99
55	19.15	21.44	23.27	26.68	28.80	29.81	31.19
56	18.10	19.51	21.62	23.56	24.95		
57	19.21	21.11	22.61	24.25	26.96	27.97	29.25
58	17.77	19.36	21.32	23.84	25.63	28.84	30.07
59	18.19	19.48	20.68	22.27	23.64	25.87	27.70
60	16.20	18.07	20.17	21.60	23.50	24.78	26.47
61	18.69	20.15	22.50	24.58	26.09	27.19	28.54
62	16.87	18.18	19.85	21.07	22.24	23.87	25.65
63	18.03	21.24	22.39	24.03	25.48	28.47	30.38
64	17.11	18.80	20.08	21.60	23.10	24.34	25.33
65	17.06	18.90	20.55	23.04	24.54	26.46	27.73
66	20.08	21.48	23.04	24.33	25.69	27.79	29.70
67	16.31	19.34	21.86	23.47	25.04	26.46	
68	22.48	24.34	26.89				
69	20.17	21.20	22.84	23.90	25.13	26.32	28.57
70							
71	18.45	20.14	22.02	23.62	25.66	26.91	28.56
72	18.50	19.97	21.40	22.74	24.07	25.34	26.99
73	18.89						
74	18.21	20.44	22.50				
75	18.71	20.18	21.18	23.24	24.26		
76	20.58	21.97	23.46				
77	18.78	20.64	22.66	25.17	26.34	28.53	30.04
78	22.52	24.45	25.98	27.90	29.46		
79	19.14	22.04	24.84	26.78			
80	20.01	22.30	23.19				
81	19.53	22.38	23.58	25.35	27.94	29.72	31.14
82	18.36	20.77	22.17	24.68	26.46	29.41	30.08

veh +7.2	8	9	10	11	12	13	14
cycle							
83	19.54	21.33	24.22	26.05	27.67	29.99	31.98
84	19.46	20.52	22.33	23.72	25.04	26.47	28.37
85	17.50	19.19	21.23	23.76	25.78		
86	19.00	20.19	25.14	26.34	27.78	29.95	30.04
87	17.25	19.17	21.34	22.75	25.26	28.23	30.17
88	17.35	18.83	20.30	24.17	26.69	29.44	31.58
89	20.97	23.19	24.03	25.70	28.07	29.82	31.56
90	21.44	23.88	26.05	28.50	30.69	32.10	
91	17.45	19.43	20.94	22.77	25.18	26.50	28.81
92	19.08	21.35	22.62	24.23	25.94	27.58	29.10
93	16.95	18.35	20.68	22.39	24.58	25.61	26.72
94	18.25	19.34	20.69	22.19	24.12	25.50	26.94
95	20.17	21.74	23.82	26.35	28.94	30.99	
96	18.65	20.76	23.97	25.90	27.68	29.47	31.06
97	20.79	22.18	23.71	25.38	26.86		
98	20.17	22.28	24.00	25.44	27.64	30.48	
99	20.43	22.70	23.84	25.27	27.24	28.88	29.30
100	18.43	20.23	21.91	23.52	25.22	27.04	28.47
101	18.90	20.57	22.03	23.93	25.54	28.16	29.78
102	18.80	20.54	23.02	25.29	28.03	30.61	31.91
103	18.96	20.42	23.24	24.55	27.00	28.89	30.34
104	17.79	19.70	21.34	22.82	24.60	26.54	29.34
105	16.49	18.07	19.96	21.51	23.14	24.67	26.10
106	17.67	19.93	21.43	22.98	24.44	26.85	28.90
107	21.39	22.54	24.64	26.20	28.09	30.17	31.87
108	17.44	19.82	21.07	22.62	25.55	27.36	29.17
109	16.93	18.55	20.08	22.19	24.21		
110	22.00						
111	18.24						
112	17.67	19.26	22.34	24.48	26.47	28.71	
113	20.25	22.46	24.45	26.60	28.85	30.67	
114	18.15	20.58	22.18	25.26			
115	19.98	21.59	23.02	25.82			
116	18.99	20.72	24.02	25.74	27.33	30.30	31.80
117							
118	16.29	19.27	21.80	23.08	25.82	28.22	
119							
120	22.04						
121	20.82						
122	17.81	19.44	22.55	24.12	25.99		
123	18.46	19.85	22.03	23.32	27.17	28.56	30.75
124	23.11	24.52	27.10	28.54	30.64	32.88	
125	18.47	20.64	22.15	24.10	26.64	27.77	
126	18.65	20.95	23.01	24.20	27.13	28.97	31.34
127	19.67	21.40	23.03	24.64	26.07	28.27	29.97
128	21.02	23.01	25.43	28.31	30.25		
129	17.14	18.47	20.74	22.02	23.97	25.03	
130	21.98	23.33	25.48	27.28	29.43	31.33	32.42
131	19.89	21.84	23.23	24.31	25.61	28.23	29.86

veh	+7.2 8	9	10	11	12	13	14
cycle							
132	16.87	18.14	20.30	24.57	26.10		
133	18.82	20.10	21.54	23.79	25.44	27.77	29.77
134	19.62	21.10	23.40	24.86	26.54	27.85	30.01
135	18.84	21.25	23.09	24.38	27.35	28.67	30.23
136	16.37	19.20	21.51	22.84	24.27	25.93	27.75
137	20.52	21.54	23.49	25.82	28.41	30.14	31.04
138	20.33	21.99	23.80	26.23	28.34	30.65	32.69
139	19.73	21.20	23.82				
140	17.67	20.18	22.16	23.81	25.96	27.88	29.56
141	17.33	19.50	21.55	22.47	25.04	27.34	29.74
142	20.76	21.80	23.35	24.60	27.19	28.49	31.15
143	19.94	21.27	22.94	24.01	26.21	27.58	28.89
144	18.37	20.39	22.14	23.58	25.00	26.98	29.14
145	16.84	18.91	20.55	22.01	24.13	25.92	27.44
146	17.65	19.74	21.94	23.99	25.64	27.99	29.81
147	23.17	26.25	28.64	31.17	33.14		
148	18.34	20.34	22.66	24.04	25.97	28.09	29.98
149	19.17	20.63	21.74	23.11	25.14	27.83	29.80
150	19.57	21.29	22.94	24.84	27.07	29.25	31.27
151							
152	16.06	18.00	19.23	21.98	24.32	26.05	28.07
153	18.17	19.61	21.20				
154	18.54	20.40	22.18	25.59			
155	19.47	21.40	24.55	26.75	28.20	30.04	
156	22.38	24.13	27.39	29.94	30.86		
157	21.94	23.67	25.52				
158							
159	17.46	19.65	20.86	22.28	24.01	26.50	28.19
160	19.26	20.80	22.51	24.17	25.19	26.98	27.30
161	18.64	20.07	22.34	25.00	26.56	30.57	32.54
162	16.59	18.44	20.31	21.94	23.31	26.15	27.57
163	17.30	18.98	20.17	22.51	24.53	25.75	27.68
164	17.64	19.04	20.46	21.77	22.73	24.85	26.97
165	15.87	17.14	18.62	19.56	21.64	23.62	24.97
166	18.66	20.94	22.63	24.58	27.14	28.50	31.37
167	16.97	18.90	20.11	21.44	22.92	24.14	26.78
168	28.17	30.69	33.07				
169	17.63	20.91	21.75	23.00	24.27	26.19	27.21
170	19.10	20.43	21.74				
171	18.06	20.14	21.33	23.08	24.42	26.54	27.87
172	18.22	19.28	20.61	23.63	25.90	26.97	30.59
173	17.64	18.67	20.84	21.90	25.05	26.96	
174	19.64	22.54	23.87	26.00	27.40	28.86	30.07
175	18.33	20.03	21.57	22.67	26.02	28.47	
176	18.00	19.26	20.92	22.47	25.41	26.72	29.02
177	17.64	19.69	21.22	22.35	24.65	27.20	29.15
178	18.21	20.57	22.57	24.07	26.24	27.45	29.56
179	18.86	19.82	21.32	22.46	23.84	25.05	27.03
180	20.09	22.06	23.24	24.45	26.14	27.41	29.20

veh +7.2	8	9	10	11	12	13	14
cycle							
181	15.70	17.50	19.29	22.16	24.17	26.19	28.12
182	20.82	22.54	23.78	25.74	27.83	30.35	32.35
183	17.76	20.22	21.86	23.39	24.78	26.03	
184	15.73	16.94	20.68	22.87	24.01	25.48	26.94
185	20.05						
186	20.07	21.69					
187	19.23	22.30	23.81	26.05	28.81		
188	20.99						
189	18.84	21.42	24.66	27.27	29.25		
190	23.21	24.87	26.39				
191							
192	20.78	22.19					
193	18.44	21.30	22.64	23.82	26.14	27.76	
194	19.22	20.16	22.43	24.04	24.99		
195	17.87	19.82	20.78	22.72	24.45	26.17	27.94
196	17.52	19.31	20.78	22.58			
197	16.06	17.36	19.60	21.07	24.02	25.54	27.00
198	23.12	24.45	25.67	27.89	29.94	31.90	33.54
199	16.62	18.20	19.88	21.68	23.14	25.47	27.87
200	18.04	20.24	22.46	23.98	25.16	26.33	27.63
201	20.83	22.13	24.34	25.84	26.87	29.54	31.60
202	17.19	19.86	21.41	23.78	25.91	26.96	30.10
203	20.76	22.17	24.07	25.33	26.59	27.73	29.21
204	17.83	19.86	21.96	23.20	24.70	25.64	27.84
205	19.23	21.14	23.03	24.98	27.16	28.31	30.00
206	16.08	17.90	18.94	20.74	22.50	24.97	
207	17.64	19.08	20.82	22.44	23.54	24.56	27.17
208	17.88	19.56	21.84	24.32	25.54	26.78	27.97
209	16.23	18.74	20.25	22.34	23.50	25.00	26.15
210	19.59	21.43	22.92	24.19	25.80	27.07	29.80
211	19.15	20.56	22.17	23.64	24.96	26.89	28.52
212	17.91	19.44	20.90	22.69	24.70	26.02	28.74
213	17.71	20.04	21.52	22.80	24.22	25.89	27.33
214	32.19						
215	16.33	19.17	20.51	22.16	23.87	25.39	27.12
216	19.92	20.91	22.43	24.97	26.18	27.74	29.13
217	14.43	16.55	18.00	19.69	21.34	22.99	24.75
218	17.74	19.38	20.95	22.26	23.57	24.86	27.47
219	18.29	20.92	22.80	24.47	26.30	27.58	28.91
220	20.13						
221	17.69	19.97					
222	16.36						
223							
224	17.90	19.10	20.24	21.50			
225	18.17	21.14	22.48	24.30	26.95		
226	16.98	18.85	20.40	21.81	23.23	24.84	26.01
227	17.10	18.23	19.57	21.04	23.83	26.61	29.48
228	18.11	20.22	22.29	24.20	26.72	28.46	30.94
229	20.49	22.17	24.23	26.47	28.91		

veh +7.2	8	9	10	11	12	13	14
cycle							
230	23.21	25.00	27.38	29.04	30.92	32.54	
231	17.42	18.50	20.06	21.20	23.55	25.46	27.31
232	17.28	19.12	21.42	23.20	25.70	28.91	
233	18.97	21.31	22.94	24.20			
234	16.98	18.19	19.26	20.80	22.98	25.83	28.49
235	16.93	18.51	20.50	21.32			
236	18.17	20.20	22.02	23.30	24.89	26.56	28.30
237	21.68	23.30	24.80	26.36	28.18	30.10	31.58
238	18.65	20.42	22.87	24.81	28.44	30.95	33.07
239	17.87	19.63	21.35	22.54	24.05	26.74	28.36
240	20.58	22.27	23.82	26.71	27.97	30.24	31.44
241	21.67	23.03	24.27	26.69	28.69	31.20	33.47
242	18.41	20.17	21.74	22.84	24.48	26.84	28.72
243	18.32	19.91	21.68	23.37	24.64	27.33	29.58
244	20.13	21.74	23.84	25.76	27.40	29.51	31.09
245	20.04	21.33	22.72	24.84	27.74	29.15	31.00
246	21.26	22.60	25.07	26.75	28.84	30.17	
247	20.12	23.30	24.62	26.04	28.13	29.81	31.39
248	17.44	18.85	20.75	22.30	23.57	24.77	27.04
249	18.07	19.62	22.18	24.01	26.28	28.03	29.77
250	18.70	20.51	22.87				

veh	8	9	10	11	12	13	14
no. of cycles	240	226	223	205	193	176	152

veh +7.2	15	16	17	18	19	20	count
cycle							
1							12
2							8
3							12
4							12
5							16
6							13
7							15
8	31.13						17
9							16
10	31.82	33.39					18
11							16
12	34.43	35.98					18
13	27.26	28.24	29.82	31.71			20
14							15
15	32.05						17
16	26.60	27.80	29.25	31.09			20

veh+7.2	15	16	17	18	19	20	count
cycle							
17							16
18							16
19							10
20							15
21	29.43						17
22	30.87	32.45					18
23							15
24							15
25							16
26	30.66	32.74					18
27	29.06	30.43	32.01				19
28	32.03	33.32					18
29	31.50	32.54					18
30							13
31							13
32							10
33							8
34							12
35							10
36							12
37							12
38							9
39							16
40							13
41							12
42	28.36	29.35	31.22	32.67			20
43	28.52						17
44							10
45	27.96	29.30	30.77	32.43			20
46	29.20	31.70					18
47	30.62						17
48	32.10	33.57					18
49	29.80	31.26					18
50							14
51	31.74	33.40					18
52	30.25	31.70					18
53	27.96	30.97					18
54							16
55							16
56							14
57	30.89	32.08					18
58	32.27						17
59	30.03						17
60	27.67	28.91	30.55	31.97			20
61	30.36	32.35					18
62	27.04	28.86	30.21	31.41			20
63	31.88	33.64					18
64	27.14	28.73	29.88	31.12	32.32		21
65	28.90	31.11	32.27				19

veh	+7.2 15	16	17	18	19	20	count
cycle							
66							16
67							15
68							12
69	30.70	32.20					18
70							9
71	30.00						17
72	28.32						17
73							10
74							12
75							14
76							12
77	32.01	33.82					18
78							14
79							13
80							12
81							16
82	32.84						17
83	33.13						17
84							16
85							14
86							16
87	31.35	33.20					18
88							16
89	33.22						17
90							15
91	30.09	31.37					18
92	30.42	32.05					18
93	28.51	30.08	31.24				19
94	28.00	30.13					18
95							15
96	33.42						17
97							14
98							15
99	31.87						17
100	29.56	31.20					18
101	31.79						17
102							16
103	31.74						17
104	31.27	33.13					18
105	28.04	29.71	31.29				19
106	30.28	32.20					18
107							16
108	30.57	32.11					18
109							14
110							10
111							10
112							15
113							15
114							13

veh +7.2	15	16	17	18	19	20	count
cycle							
115							13
116							16
117							8
118							15
119							7
120							10
121							10
122							14
123	32.25	33.78					18
124							15
125							15
126	32.83						17
127	31.13	32.67					18
128							14
129							15
130							16
131	32.16						17
132							14
133	31.78	33.50					18
134	32.70						17
135							16
136	29.61	31.42					18
137	33.00						17
138	34.78						17
139							12
140	30.84						17
141							16
142	33.11						17
143	31.30	32.38					18
144	31.37	32.16					18
145	29.39	30.94					18
146	31.87						17
147							14
148	31.76						17
149	31.40	32.85					18
150							16
151							8
152	29.92						17
153							12
154							13
155							15
156							14
157							12
158							6
159	30.80						17
160	31.29						17
161							16
162	28.56	30.74	31.88				19
163	28.79	30.54	31.79				19

veh +7.2	15	16	17	18	19	20	count
cycle							
164	29.80	31.22					18
165	26.71	29.47	30.89	32.05			20
166	32.93						17
167	28.94	31.24					18
168							12
169							16
170							12
171	29.09	30.07					18
172	32.70						17
173							15
174	32.37	33.94					18
175							15
176	30.14	31.55					18
177	31.70	32.97					18
178	30.41						17
179	28.97	30.37					18
180	30.78	32.42					18
181	30.38	32.61					18
182							16
183							15
184	28.53	30.08	31.27				19
185							10
186							11
187							14
188							10
189							14
190							12
191							8
192							11
193							15
194							14
195	30.53	31.59					18
196							13
197	28.98	31.64					18
198							16
199	29.70	32.07					18
200	28.69	30.08	31.30	32.49			20
201							16
202	31.58						17
203	30.90						17
204	29.04	30.95	32.33				19
205	31.77						17
206							15
207	28.31						17
208	29.00	31.02					18
209	28.00	29.56	31.24				19
210	30.57	31.87					18
211	31.34	33.10					18
212	30.04	32.84					18

veh +7.2	15	16	17	18	19	20	count
cycle							
213	29.06	30.96					18
214							10
215	29.20	30.70					18
216	30.66	33.04					18
217	25.71	28.54	30.21	32.00			20
218	28.69	30.01					18
219	30.79	31.87					18
220							10
221							11
222							10
223							9
224							13
225							14
226	27.27	28.72	30.05	31.83	33.50	35.03	21
227	31.21	32.74					18
228							16
229							14
230							15
231	29.61	30.92	33.11				19
232							15
233							1[illegible]
234	30.64						17
235							13
236	31.36	32.54					18
237	32.75						17
238							16
239	30.50	32.86					18
240							16
241	34.50						17
242	30.54	33.80					18
243	31.07	33.61					18
244	33.30						17
245							16
246							15
247	32.50	33.56					18
248	28.85	30.77	32.57	34.04			20
249	31.22	32.63					18
250							12

veh	15	16	17	18	19	20
no. of cycles	122	83	22	12	2	1

vehicle	-7.2% 1	2	3	4	5	6	7
cycle							
1	4.67	6.65	8.64	10.44	12.04	13.13	15.20
2	4.42	5.72	7.11	10.61	12.37	13.89	15.46
3	4.50	6.14	8.27	10.64	11.87	13.08	14.70
4	6.17	7.93	9.38	11.20	13.20	17.04	18.81
5	3.37	5.24	7.13	10.40	11.44	13.94	15.75
6	6.25	7.71	9.93	12.09	13.94	15.91	17.22
7	4.84	6.80	8.94	10.30	11.40	13.44	15.22
8	7.04	8.27	10.18	11.57	13.57	15.75	17.54
9	5.24	7.67	9.54	11.50	13.43	15.43	17.35
10	5.27	6.94	8.70	12.20	14.60	16.30	17.76
11	6.03	8.24	14.07	15.18	17.68	18.88	20.20
12	5.60	7.90	9.47	12.29	13.46	15.47	16.55
13	7.10	8.75	10.34	12.07	13.87	16.42	17.90
14	4.23	6.14	8.21	10.25	12.05	14.50	16.08
15	5.72	7.07	8.82	10.40	12.10	15.70	17.53
16	4.27	5.74	7.50	9.13	11.87	13.75	15.26
17	5.45	7.82	11.87	13.43	14.87	17.79	20.44
18	5.58	8.11	9.64	12.68	16.69		
19	3.82	6.12	7.73	9.70	11.65	12.86	16.14
20	5.90	8.02	10.24	12.31	13.90	15.52	17.40
21	6.18	7.65	9.70	10.74	13.44	14.60	16.94
22	4.02	6.39	7.89	8.23	10.46	12.75	14.78
23	5.37	6.58	10.00	11.47	13.15	14.16	18.46
24	4.35	7.53	9.47	11.48	13.99	15.23	16.96
25	5.89	7.78	9.10	10.58	12.29	13.54	15.46
26	5.14	9.57	11.17	12.48	13.09	14.51	16.15
27	3.76	6.19	8.63	10.87	12.70	15.87	17.60
28	5.86	8.74	11.84	14.43	16.67	18.39	20.30
29	6.05	7.71	9.50	12.34	14.15	16.71	19.20
30	5.13	6.36	8.74	10.32	12.15	13.57	14.78
31	5.26	7.86	10.68	12.31	13.57	14.76	17.87
32	5.17	6.77	9.44	11.14	14.55	16.39	19.50
33	4.60	5.82	7.71	10.60	11.61	13.14	15.79
34	4.75	6.60	8.59	10.20	11.81	13.69	15.77
35	4.84	6.33	7.64	9.64	11.36	14.33	15.00
36	4.71	6.20	9.28	11.12	13.00	15.52	16.93
37	4.70	7.94	9.28	11.84	15.00	16.24	17.90
38	5.35	7.27	8.79	11.30	14.47	15.17	17.13
39	5.20	6.74	9.28	10.28	11.50	14.56	15.97
40	5.30	6.80	8.00	9.31	11.15	13.19	16.40
41	5.29	7.27	9.03	11.43	14.05	16.10	17.42
42	5.34	6.12	8.05	11.17	12.58	14.17	16.47
43	7.11	8.25	9.67	11.35	12.06	14.61	15.89
44	3.97	6.69	8.87	10.20	11.68	13.14	14.18
45	4.74	7.24	9.14	11.40	13.40	15.91	17.39
46	5.49	8.22	9.30	11.18	13.04	16.33	17.83
47	6.14	7.81	10.95	12.11	13.36	14.57	15.78
48	5.38	7.20	8.43	9.77	12.58	13.98	15.91

vehicle	-7.2% 1	2	3	4	5	6	7
cycle							
49	4.77	8.30	10.46	13.31	14.33	17.72	19.14
50	6.97	8.76	10.14	11.94	13.27	15.31	17.50
51	3.92	6.15	7.92	10.10	11.98	13.05	15.11
52	4.33	5.84	7.57	8.71	12.16	13.81	15.68
53	5.19	6.78	9.66	11.94	13.58	15.12	18.52
54	5.34	7.52	9.50	10.94	12.47	13.53	15.10
55	6.15	7.69	9.92	11.37	12.76	15.87	17.27
56	5.74	7.04	8.54	9.79	11.87	13.96	15.04
57	4.80	6.12	8.95	11.24	12.62	14.14	15.45
58	4.02	5.74	7.28	10.32	11.67	12.80	14.92
59	5.03	7.07	9.07	10.71	13.28	16.90	18.31
60	7.27	9.10	10.77	12.07	13.48	14.02	16.15
61	4.58	6.32	8.15	10.91	12.19	15.24	17.25
62	6.01	7.45	9.15	11.08	13.53	15.60	16.78
63	9.00	11.37	13.38	15.57	18.61	20.97	22.27
64	4.98	8.26	9.94	12.00	13.99	15.34	17.74
65	6.13	7.63	9.49	11.27	12.67	14.57	16.49
66	4.81	6.68	8.86	10.21	14.24	15.15	17.19
67	5.46	7.53	9.07	10.80	12.17	14.22	17.38
68	5.26	6.94	7.64	11.10	12.75	15.74	17.74
69	3.24	4.87	6.05	8.74	10.60	12.04	13.92
70	4.46	6.01	8.14	9.84	12.34	13.96	15.34
71	4.64	7.06	9.04	10.16	12.52	14.84	16.26
72	5.73	6.34	9.50	12.64	13.42	15.45	16.80
73	5.22	6.62	7.90	9.76	13.12	15.38	16.71
74	5.88	8.10	10.83	12.39	14.98	16.39	18.16
75	5.20	6.57	8.34	9.66	11.52	14.55	16.20
76	5.97	7.25	8.55	9.67	11.97	13.40	16.20
77	5.35	6.43	8.45	9.88	11.87	13.82	15.88
78	5.28	6.64	9.01	11.94	13.67	14.47	15.99
79	4.16	7.65	8.81	10.92	15.40	18.34	20.10
80	4.67	6.43	9.77	12.74	14.59	16.20	18.14
81	5.67	7.51	9.39	11.79	13.86	15.99	18.16
82	6.33	7.07	8.77	10.41	12.00	13.57	16.08
83	3.84	5.37	7.30	9.16	11.34	12.97	15.22
84	3.60	5.47	7.54	9.97	11.50	13.63	15.87
85	5.78	6.94	9.47	10.90	13.07	15.50	16.68
86	6.33	8.14	9.17	10.98	12.47	14.49	15.61
87	4.00	6.11	8.40	9.17	11.16	12.17	14.74
88	3.82	5.62	8.24	9.61	11.19	12.9[illegible]	18.20
89	4.98	7.24	9.80	12.04	13.43	14.45	16.27
90	4.29	6.08	9.30	10.97	12.91	15.31	18.85
91	3.85	5.07	6.73	8.99	10.94	12.87	14.94
92	2.77	3.99	6.61	7.96	9.44	12.42	14.25
93	4.03	5.71	7.26	9.50	11.09	14.75	17.07
94	4.95	6.87	7.89	10.38	12.03		
95	5.87	7.82	10.21	12.24	14.10	15.13	17.91
96	8.43	10.38	11.63	13.04	14.84	16.59	18.00

-7.2% vehicle	1	2	3	4	5	6	7
cycle							
97	5.62	8.81	10.62	12.52	14.58	16.06	18.70
98	8.70	10.27	11.78	12.88	16.67	18.35	19.44
99	5.46	7.27	9.24	11.96	13.60	15.60	18.11
100	6.52	8.02	8.96	11.38	13.97	15.53	16.94
101	6.15	7.66	9.57	10.90	14.34	17.74	19.51
102	8.34	9.30	10.57	13.12	17.30	19.36	20.63
103	6.88	8.43	10.13	11.86	13.25	14.37	16.20
104	4.34	5.97	7.60	9.12	11.16	14.25	15.87
105	5.38	6.51	7.84	10.21	11.85	13.96	17.54
106	6.20	7.32	9.83	10.80	12.42	13.81	15.18
107	4.17	5.71	9.04	11.87	14.38	16.62	18.60
108	4.18	6.96	10.21	11.43	14.51	16.34	17.47
109	4.46	6.74	9.37	12.54	13.56	15.17	17.47
110	5.74	7.31	9.40	11.64	12.78	14.67	16.32
111	5.47	6.81	10.22	12.55	13.84	15.67	17.46
112	9.41	13.56	16.05	18.07	19.69	20.93	23.34
113	5.19	10.19	13.72	16.80	19.18	21.83	23.02
114	4.25	6.17	7.52	9.17	11.10	12.64	15.70
115	4.60	6.10	7.71	8.98	11.39	13.33	14.61
116	6.28	8.96	10.26	11.92	13.61	15.64	17.02
117	5.55	6.96	8.74	10.63	12.39	13.90	15.56
118	6.79	8.27	10.32	12.33	14.06	16.26	17.91
119	4.73	6.21	8.40	10.61	12.60	13.83	15.27
120	5.42	6.67	9.58	10.97	13.41	16.19	18.45
121	5.48	6.73	9.64	11.67	13.44	14.74	16.08
122	4.43	6.33	7.67	10.00	11.82	13.76	17.01
123	6.84	9.34	10.86	12.91	14.07	15.80	17.06
124	3.84	5.57	7.52	9.39	10.96	12.50	15.27
125	6.04	8.04	9.69	11.76	13.67	14.90	16.87
126	5.07	6.74	8.84	10.03	11.81	13.85	15.83
127	4.53	6.33	10.30	12.53	14.10	15.83	17.35
128	5.50	7.14	8.76	10.50	13.09	15.40	17.95
129	6.27	7.51	9.81	12.16	13.58	15.26	17.96
130	3.90	6.34	10.19	11.90	13.95	16.10	18.40
131	6.25	7.35	9.59	12.50	15.20	16.31	18.93
132	5.80	7.15	9.19	10.45	11.78	14.25	16.19
133	5.48	7.18	9.37	10.78	12.78	14.06	15.14
134	5.70	7.60	8.91	10.48	12.58	14.46	16.94
135	4.12	6.50	7.80	9.96	11.81	13.95	15.86
136	5.23	7.66	9.46	10.04	11.84	13.86	15.50
137	5.47	6.82	7.97	10.60	12.64	14.04	16.44
138	4.34	7.38	9.23	10.53	12.34	13.78	15.57
139	5.04	7.24	8.69	11.24	13.00	14.16	15.44
140	5.90	8.27	9.57	11.27	13.72	15.22	17.04
141	5.18	7.18	9.32	10.54	11.91	14.70	16.81
142	5.87	8.34	9.60	11.82	12.85	14.51	16.06
143	7.52	9.64	11.20	13.00	14.25	16.54	18.91
144	5.12	6.69	10.31	12.14			

vehicle	-7.2% 1	2	3	4	5	6	7
cycle							
145	6.37	8.00	10.09	11.52	12.85	14.73	16.13
146	5.5[illegible]	7.25	10.90	13.33	14.68	16.49	18.65
147	5.73	6.73	8.71	10.52	12.47	14.71	16.37
148	6.60	9.47	11.09	13.01	14.57	16.80	18.60
149	4.82	7.22	8.30	9.68	11.20	12.97	14.22
150	4.89	7.80	9.01	10.52	14.10	15.21	16.44
151	5.93	7.72	8.83	9.98	11.92	14.04	16.77
152	4.07	5.49	10.43	12.30	15.17	16.55	18.54
153	5.04	6.47	9.61	10.69	12.70	14.12	15.26
154	4.11	5.87	7.25	8.37	9.66	11.00	13.74
155	4.73	6.74	9.10	11.00	12.86	15.16	16.70
156	4.65	6.70	8.76	9.72	10.59	13.35	14.88
157	4.65	7.09	8.40	10.48	12.42	16.44	18.34
158	5.53	8.67	10.37	11.69	13.80	15.55	17.45
159	6.02	7.30	10.42	11.94	13.74	15.47	17.20
160	3.31	5.72	7.47	9.51	13.93	16.32	18.18
161	5.68	8.41	9.82	11.47	13.46	14.97	16.62
162	5.37	6.61	8.29	10.04	11.85	13.17	15.39
163	6.10	8.44	9.85	11.54	13.67	15.44	17.60
164	4.80	6.10	7.71	9.74	10.87	12.31	14.02
165	5.04	6.49	9.08	11.30	12.56	13.97	16.34
166	3.94	5.54	7.43	9.29	10.19	13.09	15.27
167	4.78	6.08	7.74	10.30	12.44	13.66	16.50
168	6.56	9.00	10.31	12.14	14.50	15.87	16.84
169	5.48	7.57	8.60	9.73	11.05	12.38	14.41
170	8.46	10.71	12.69	14.42	16.54	17.66	20.19
171	3.83	6.49	8.71	10.66	11.89	13.54	15.51
172	5.56	6.80	9.95				
173	4.28	6.19	8.21	9.95	11.28	12.35	13.99
174	4.60	6.47	8.61	10.02	11.71	13.19	14.30
175	5.63	8.04	10.08	11.69	13.84	15.83	18.47
176	4.45	6.59	8.07	9.68	11.83	13.79	14.82
177	5.10	7.18	8.64	10.99	12.66	14.08	15.70
178	[illegible].37	7.15	9.11	11.22	12.70	14.07	15.94
179	4.47	6.37	8.27	9.47	10.93	12.70	14.10
180	7.00	8.42	9.80	11.21	12.60	13.97	16.85
181	5.23	6.97	8.67	11.22	13.32	15.59	18.20
182	4.84	6.20	8.47	10.14	12.53	14.60	16.23
183	4.65	5.88	8.83	10.70	11.82	13.71	16.14
184	4.41	5.97	7.67	9.48	11.07	12.80	14.33
185	5.73	8.17	10.46	12.44	13.70	15.22	16.30
186	7.90	9.06	11.27	12.86	14.27	15.52	16.83
187	4.03	6.60	8.76	12.89	15.14	16.49	18.14
188	4.16	6.04	7.50	9.21	11.01	13.75	14.89
189	5.47	7.35	9.56	12.15	14.98	16.60	18.40
190	5.20	7.52	9.13	10.48	11.45	12.48	14.99
191	5.41	7.04	9.80	11.70	12.75	14.32	16.91
192	4.84	9.18	10.53	11.84	13.40	16.53	17.87

vehicle	-7.2% 1	2	3	4	5	6	7
cycle							
193	7.04	8.41	9.95	10.92	13.53	15.43	17.86
194	5.96	7.39	9.44	11.27	12.68	13.57	16.04
195	5.52	8.25	9.89	11.50	13.95	14.97	16.87
196	5.90	6.98	8.17	9.46	11.39	14.36	17.27
197	4.84	6.10	7.80	9.77	11.40	12.47	15.09
198	5.05	6.11	7.95	10.59	12.47	15.17	16.70
199	5.54	6.61	8.18	9.80	11.80	12.69	14.20
200	4.30	7.67	9.49	11.04	12.67	14.44	17.48
201	6.52	8.21	10.56	11.72	14.30	16.31	17.84
202	4.21	6.19	8.37	10.00	11.64	14.80	17.87
203	5.66	7.16	8.49	11.75	12.56	14.29	16.80
204	8.46	9.97	11.61	13.79	15.67	17.24	18.34
205	5.40	8.24	9.69	10.84	13.25	14.96	16.32
206	4.99	6.35	8.38	11.50	14.67	16.64	18.51
207	6.33	7.59	11.53	13.36	14.92	16.25	18.20
208	5.71	7.88	10.01	11.33	12.91	14.60	17.26
209	5.28	6.85	10.66	12.03	14.06	16.81	18.42
210	5.04	6.51	8.04	12.44	13.53	14.87	16.30
211	6.03	7.79	9.91	11.20	13.41	15.17	16.40
212	3.49	5.57	7.73	9.18	10.57	13.70	16.27
213	4.15	5.62	8.24	9.85	11.58	12.66	13.98
214	5.19	7.31	10.18	11.74	13.17	15.53	17.71
215	5.65	7.52	8.85	11.03	13.24	14.50	15.78
216	5.47	6.78	8.47	9.98	12.29	13.87	15.42
217	4.36	5.86	8.27	9.99	11.26	13.60	14.82
218	5.87	8.73	10.10	12.07	14.91	17.40	19.28
219	3.25	5.20	7.95	9.46	11.85	13.96	15.59
220	5.71	7.36	9.29	10.39	12.23	14.14	15.28
221	4.00	5.07	7.68	10.50	12.21	13.99	16.54
222	4.74	6.01	7.77	9.78	12.42	14.58	16.89
223	6.08	8.39	10.49	12.07	13.52	14.90	16.92
224	5.59	6.94	9.21	11.76	13.76	15.33	17.49
225	4.66	8.11	11.64	13.46	15.05	16.57	18.70
226	7.79	9.45	10.17	13.83	15.46	16.93	19.14
227	5.46	6.99	8.70	10.01	11.67	13.50	16.74
228	6.31	7.94	9.60	11.34	12.72	14.03	15.52
229	4.67	7.33	9.86	11.24	12.70	16.38	18.41
230	6.61	8.13	10.42	12.05	13.42	16.32	18.30
231	4.94	7.07	8.95	10.50	12.27	14.17	15.94
232	4.58	6.19	8.00	9.88	11.79	13.77	15.20
233	5.55	7.50	8.90	10.70	12.45	14.57	16.89
234	5.55	7.23	9.04	10.67	13.02	15.82	17.55
235	6.84	9.07	11.39	12.03	14.18	15.63	17.42
236	3.36	4.39	6.92	8.67	10.10	12.32	13.74
237	3.69	5.50	7.50	9.47	11.44	13.27	15.13
238	5.64	7.24	9.37	11.43	13.94	16.44	17.82
239	5.30	6.87	8.16	11.49	13.57	15.87	17.41
240	5.12	7.67	10.59	12.18	13.97	17.18	18.70

-7.2%

vehicle	1	2	3	4	5	6	7
cycle							
241	4.05	5.24	7.17	9.50	11.63	13.18	14.76
242	5.28	7.57	8.79	10.35	12.71	14.77	16.79
243	3.80	6.17	7.64	9.07	10.80		
244	5.54	7.20	8.84	10.57	12.28	13.58	15.30
245	4.41	6.34	8.95	10.34	11.81	13.36	14.97
246	7.37	9.07	10.44	12.97	14.68	16.36	17.67
247	4.81	6.56	8.27	12.41	15.90	17.20	19.62
248	5.31	7.10	8.82	10.03	11.90	13.18	15.97
249	4.14	6.12	8.20	11.89	13.84	15.47	17.46
250	6.82	7.84	9.33	10.97	13.07	15.29	17.66
251	4.67	7.17	10.57	12.24	13.61	15.63	17.92
252	5.85	7.64	9.14	11.30	12.58	14.41	15.84
253	4.74	7.67	9.65	11.59	13.71	15.77	18.96
254	2.89	4.06	9.37	12.62	13.94	15.22	16.84
255	4.57	6.34	7.82	9.54	10.67	12.70	14.50
256	6.37	9.08	10.57	11.84	14.17	15.74	17.48
257	6.14	7.17	8.70	10.05	11.99	14.30	16.80
258	4.30	6.38	8.19	9.40	11.95	13.25	14.97
259	5.03	6.80	8.36	9.92	11.38	12.22	13.88
260	6.32	7.54	8.90	10.43	11.72	13.92	15.50
261	5.85	7.64	9.88	11.74	14.90	16.65	18.67
262	3.33	4.97	6.48	8.10	10.10	12.51	13.84
263	5.19	6.26	7.84	9.85	11.52	12.84	14.19
264	4.89	7.34	8.19	12.12	13.76	17.03	18.57
265	4.58	6.32	9.02	11.74	13.00	15.67	17.14
266	5.76	7.23	8.69	11.80	13.75	15.73	17.63
267	4.38	7.49	9.85	11.09	13.17	14.36	16.17
268	4.36	6.13	7.75	9.83	11.46	13.62	17.02
269	4.86	6.61	8.32	9.84	11.20	13.22	14.57
270	5.34	6.97	8.13	10.40	11.88	13.45	15.75
271	6.08	7.72	9.67	11.07	12.70	14.88	17.48
272	4.05	7.13	9.02	11.63	13.38	14.06	16.21
273	4.26	6.74	8.55	10.27	11.85	13.27	15.13
274	5.43	6.64	9.73	12.11	13.98	15.46	17.36
275	5.93	7.84	9.80	13.82	15.94	17.16	18.26
276	5.08	7.12	8.57	9.66	12.17	14.10	15.53
277	5.77	7.21	9.10	10.78	12.46	14.73	16.24
278	6.17	7.44	9.74	11.58	13.32	15.09	17.12
279	4.23	5.71	7.51	10.14	12.12	13.31	14.79
280	5.94	8.27	9.33	12.37	14.26	15.37	17.34
281	6.08	7.19	8.85	10.69	12.30	13.98	15.12
282	4.00	6.27	8.08	10.05	12.27	15.91	18.80

vehicle	1	2	3	4	5	6	7
no. of cycles	282	282	282	281	280	277	277

mean elapsed time	5.28	7.16	9.16	11.08	12.97	14.86	16.77

vehicle	-7.2% 8	9	10	11	12	13	14
cycle							
1	18.14	19.73	21.97	23.27			
2	16.68	19.10	20.68	22.62	24.53		
3	16.07	18.63	22.10				
4	20.55	22.43	23.77	25.90	28.65	30.50	32.04
5	17.15	18.97	20.24	21.88	23.97	25.78	29.48
6	19.00	20.52	23.33	24.64	26.82	29.98	31.02
7	17.25	18.73	20.19	22.33	24.17	25.70	27.78
8	19.81	21.94	23.71	25.10	27.05	28.02	29.63
9	19.82	21.28	23.29	26.65	29.31	30.70	32.15
10	19.20	21.21	23.28	26.54	29.39	31.51	33.17
11	21.45	26.64	29.45	31.24	33.28		
12	18.21	20.14	22.70	24.33	26.50	28.61	29.30
13	20.32	21.86					
14	17.34	19.32	21.82	23.50			
15	19.35	22.23	24.27	26.34			
16	16.60	18.80	23.47				
17	22.04	23.80	25.14				
18							
19	17.84	19.26	20.69	23.34	25.14	26.85	28.34
20	19.96	21.79	23.63	25.33	28.27	30.22	32.76
21	18.24	19.60	20.57	22.46	24.11	25.90	27.46
22	16.35	19.32	21.22	23.57	25.22	26.94	30.09
23	19.63	21.58	22.87	24.38	27.44	28.34	29.85
24	18.25	19.87	21.04	23.21	24.59	26.07	28.94
25	17.89	19.79	21.78	24.04	25.25	27.43	29.12
26	17.95	20.42	23.14	24.84	26.97	29.45	31.79
27	20.36	21.73	23.24	25.31			
28	21.97	23.40	24.51	26.68	28.20	30.04	31.86
29	21.22						
30	15.77	17.31	19.22	20.22	21.75	24.46	26.99
31	19.86	21.10	25.40	26.51	28.70	30.05	32.34
32	20.64	23.14	26.83	28.88			
33	18.60	20.90	22.57	24.84	26.74	29.33	30.99
34	16.97	18.19	20.12	22.03	24.87	26.35	28.27
35							
36	18.73	20.37	21.84	23.10	24.33	27.14	28.77
37	19.54	21.06					
38	18.87	20.79	22.80	23.79	25.99	27.46	28.87
39	17.27	20.15	21.75	24.50	27.10	29.29	30.58
40	18.19						
41	18.92	20.87	23.20	24.25	26.85	29.77	31.23

vehicle	-7.2% 8	9	10	11	12	13	14
cycle							
42	18.85	19.96	22.40	24.91	26.57		
43	17.26	21.19	23.30				
44	16.11	18.48	19.50	20.80	22.39	24.63	26.56
45	19.46	21.87	23.37	24.59	28.38	30.89	31.89
46	19.04	20.64	22.13	23.95	25.34	26.80	28.76
47	18.91	20.97	22.72	23.93	25.17	28.54	
48	17.16	18.09	20.34	22.57	23.72		
49	22.53	24.05	25.12	27.32	28.27	29.73	31.84
50	19.06	20.64	22.07	23.39	25.65	26.97	29.14
51	18.01	19.27	21.11	22.98	26.08	27.15	29.18
52	17.64	19.41	21.26	23.26	25.16	26.78	28.20
53	21.18	22.83	25.03	26.54	28.17	29.63	31.56
54	16.89	19.85	22.22	23.85	25.44	27.53	29.74
55	18.92	20.75	23.47	26.06	28.98	31.10	32.26
56	17.09	18.17	20.78	22.31	24.75	26.33	28.27
57	18.64	20.84	22.34	23.78	25.04	28.26	31.00
58	16.53	18.30	20.72	23.20	25.17	27.22	29.80
59	19.25	21.22	23.36	14.97	26.65	28.20	31.07
60	17.99	19.62	21.18	23.91	25.67	27.29	29.84
61	18.87	20.97	24.14	25.68	27.52		
62	18.22	19.39	21.09	23.26			
63	23.75	25.00	26.38	27.24	29.88	31.17	32.73
64	18.45	20.02	21.47	22.74	26.97	28.29	30.09
65	18.31	19.97	21.90	25.24	26.30	28.56	30.62
66	19.37	21.33	22.76	25.87	28.00		
67	19.43	21.04	22.20	24.04	27.16	29.19	
68	20.53	22.04	24.85				
69	17.66	19.86	22.24	25.35	27.34	28.69	30.73
70	18.50	20.93	22.47				
71	17.93	20.46	23.06	24.65	26.53	28.25	29.74
72	18.37	19.64	21.79	23.64	24.83	27.73	29.40
73	18.60	19.90	22.64	23.93	24.76	28.93	31.28
74	20.54	26.34	27.81	30.53			
75	18.44	21.21	23.37	25.97	26.94	29.05	30.78
76	17.97	19.77	20.88	22.80	24.34	26.42	27.32
77	17.16	19.74	20.94	24.89	26.54	28.09	30.31
78	17.80	20.43	22.10	23.55	25.44	27.87	29.73
79	21.26	22.66	24.90	28.17	29.20	30.85	32.74
80	20.66	22.78	24.40	25.86	27.97	29.75	31.44
81	21.10	22.45	24.14	25.48	26.93	28.94	30.31
82	18.57	19.93	21.34	23.36	26.07	27.81	29.50
83	17.82	23.17	24.35	26.09	28.20	30.09	31.77
84	18.10	21.42	23.73	25.20	26.41	30.64	
85	18.31	20.14	21.61	23.95	26.26	28.34	30.06
86	17.63	19.19	21.44	23.21	24.25	25.55	27.26
87	19.01	20.86	21.97	23.61	25.03	28.02	29.94
88							
89	18.42	19.43	21.93	22.97	25.07		

	-7.2%						
vehicle	8	9	10	11	12	13	14
cycle							
90	20.58	23.37	24.84	26.22	28.72	31.08	33.51
91	17.42	19.83	21.24	22.32	23.84	26.32	27.92
92	16.08	19.64	21.31	22.94	25.33		
93	19.73	22.64	24.47	25.66	27.16	29.74	32.35
94							
95	19.25	22.22	24.33	27.21	30.02	31.15	33.04
96	19.20	20.57	22.17	23.54	26.72	28.44	31.62
97	20.83	22.32	24.64	26.30	27.68	33.10	
98	21.13	25.95	27.24	28.80	30.45	32.21	
99	19.62	21.55	23.11	25.47	28.18	29.47	32.43
100	19.18	21.49	23.83	25.18	26.57	30.04	31.45
101	21.27	22.64	23.79	25.36	26.90	28.97	31.07
102	25.64	27.64	28.67	29.83			
103	17.94	21.04	23.13	25.33	27.20	31.09	32.47
104	18.34	21.16	23.27	24.89	28.07	29.74	
105	18.99	20.78	23.15	25.20	26.41	27.56	29.24
106	18.23	19.53	21.84	23.71	27.67	29.50	31.10
107	20.22	22.17	25.35	27.22			
108	19.04	21.34	23.50	24.77			
109	18.91	21.17	23.51	24.84	27.93	29.42	30.50
110	18.13	20.25	21.84	23.54	24.54	25.89	27.64
111	18.92	20.33	21.55	24.17	26.91	28.64	
112	25.93	29.04	30.97				
113	25.32	27.27					
114	18.02	19.99	21.96				
115	16.62	17.68	19.74	22.86			
116	18.48	19.66	20.58	22.80	25.27	28.34	
117	17.53	19.86	23.10	24.70	27.14		
118	19.48	20.82	22.03				
119	16.74	19.80	20.96				
120	21.41	23.45	25.97	29.21	30.75	32.46	
121	17.89	19.98	21.50	23.51	26.09	27.58	30.74
122	18.74	22.64	25.70	27.16	28.50	31.54	
123	19.64	22.08	23.85	25.49	27.68	29.44	31.13
124	19.06	22.80	25.61	27.21	28.58	31.70	33.24
125	19.58	22.57	24.40	26.45	27.89	30.40	32.94
126	17.20	19.43	21.14	22.65	23.88	25.74	26.74
127	19.14	20.59	21.76	23.04	26.08	28.34	30.23
128	19.12	21.50	23.69	25.38	27.24	29.06	31.38
129	20.17	22.98	24.95	27.35	29.28	31.56	33.17
130	21.08	24.48	27.04	28.97	30.40		
131	21.51	22.71					
132	18.21	19.62	21.66	23.66	27.98	29.07	31.98
133	17.92	20.18	22.03	24.50	26.06	27.85	30.14
134	18.22	20.50	21.55	22.66	23.91	26.36	28.48
135	18.27	19.71	21.50	23.04	24.08	26.08	28.41
136	16.57	18.47	20.01	21.90	23.48	25.07	26.76
137	17.71	18.77	20.79	22.99	25.24	27.06	28.66

vehicle	-7.2% 8	9	10	11	12	13	14
cycle							
138	17.23	18.40	19.90	22.31	23.30	25.94	28.82
139	18.00	19.68	21.17	24.19	26.23	28.96	
140	18.28						
141	18.61	20.90	23.47	26.45	28.15		
142	17.69	19.05	21.10				
143	20.07	21.40	23.03	25.33	27.24		
144							
145	17.78	20.30	22.20	25.34	26.73		
146	22.16	24.05	25.04	26.44	28.68	30.85	32.24
147	18.56	21.11	22.96	24.85	27.14	29.30	31.37
148	19.54	21.74	23.78	25.20	27.19	30.24	31.80
149	15.81	17.00	18.48	21.20	25.22	27.05	29.48
150	17.97	19.90	21.75	23.17	25.54	26.99	29.42
151	17.96	19.52	21.62	23.17	24.39	25.89	27.69
152	20.20	22.31	23.96	25.54	27.44	28.82	30.80
153	18.29	19.77	20.83	22.94	25.89	27.94	29.50
154	15.17	16.66	18.34	20.84	23.25	24.00	25.23
155	18.55	20.10	21.65	23.20	24.67	26.22	28.40
156	17.20	19.30	20.63	22.04	23.94	25.47	27.27
157	19.63	23.01	27.13	28.40	30.90	32.36	34.01
158	18.57	19.62	22.60	24.54	26.76	27.57	28.93
159	19.24	20.96	22.13	24.07	25.59	27.76	29.07
160	19.97	20.19	22.57	23.98	24.84	25.70	27.33
161	18.27	19.84	21.76	23.08	25.26	26.56	28.62
162	16.91	18.41	20.07	22.07	23.66	25.06	26.27
163	18.75	21.06	22.70	24.11	26.41	27.39	29.58
164	15.72	18.14	19.70	21.10	22.76	25.25	26.70
165	17.85	19.47	22.12	24.92	26.34	27.82	29.86
166	16.61	18.75	21.25	23.34	26.00	27.38	29.56
167	18.02	21.20	23.16	25.19	27.19	28.95	30.46
168	17.87	19.49	21.85	23.72	27.50	29.67	32.57
169	16.30	18.80	22.83				
170	21.90	24.13	26.24	29.23			
171	17.27	18.65	20.59	22.30	23.75		
172							
173	15.58	17.96	19.50	20.95	22.94	24.78	27.44
174	16.36	18.62	21.52	23.35	25.15	26.27	27.50
175	19.93	22.70	24.88	26.40	27.70	29.38	30.98
176	17.21	20.07	22.31	24.14			
177	17.62	19.48	21.07	22.48	25.43	27.55	29.25
178	18.70	20.30	21.53	23.15	26.34	28.53	30.26
179	15.27	16.93	18.49	20.31	21.60	23.60	26.91
180	18.44	19.61	21.05	22.84	24.61	26.84	28.52
181	19.98	21.40	23.64	26.80	27.84	28.91	31.76
182	18.27	19.81	21.72	23.01	24.06	26.07	27.56
183	18.98	20.97	22.51	23.90	24.96	27.20	28.17
184	15.87	17.47	20.08	22.36	23.42	25.19	26.35
185	17.57	19.51	21.80	23.01	25.27	27.50	28.87

	-7.2%						
vehicle	8	9	10	11	12	13	14
cycle							
186	18.58	20.04	22.48	24.84	27.01	29.97	31.49
187	19.46	20.59	22.17	23.89	25.38	27.86	30.30
188	16.31	18.21	19.90	21.30	22.74	24.00	25.40
189	20.07	21.71	23.07	24.33	26.52	28.14	29.91
190	16.20	18.64	20.02	21.77	23.61	24.81	26.93
191	18.39	20.71	23.44	25.87	28.58	30.44	31.79
192	19.84	21.45	23.46	26.03	27.54	30.36	
193	20.32	24.11	25.83	27.59	29.71	31.69	33.04
194	17.98	20.19	22.78	25.50	26.67	28.67	30.23
195	18.38	21.16	24.27	25.80	27.35	29.81	31.87
196	19.74	22.14	23.66	25.43			
197	16.11	19.44	22.32	24.51	26.92	29.86	
198	18.97	20.41	21.81	23.51	25.06	26.43	27.54
199	15.79	17.36	18.42	20.00	21.07	24.01	25.21
200	19.29	20.50	22.22	23.27	25.54	28.42	29.80
201	19.51	21.35	22.86	25.33	27.30	30.00	31.28
202	20.25	21.86	24.24	25.42	27.23	28.09	30.73
203	19.16	20.53	22.48	26.12	29.47		
204	19.44	21.49	22.87	24.50	26.83	28.96	30.74
205	17.94	20.07	22.05	23.62	25.25	27.95	29.17
206	19.88	22.76	25.53	27.00	29.28	30.52	32.54
207	20.03	21.52	23.21	24.61	27.67	29.07	30.87
208	19.59	23.19	25.00	26.49	27.57	29.27	31.32
209	20.06	22.30	25.50	26.74	29.72	31.54	33.77
210	19.02	21.43	23.62	25.43	26.60	28.97	30.89
211	17.78	19.04	20.47	21.74	23.27	24.92	27.50
212	18.26	22.00	23.60	25.59	28.31	30.00	31.67
213	16.63	18.32	19.95	21.84	24.38	27.27	30.10
214	20.02	22.65	23.90	26.37	28.09	29.39	31.01
215	17.56	19.70	21.50	23.47	24.65		
216	18.14	19.61	21.65	23.60	26.01	27.55	29.75
217	16.08	20.00	21.43	22.55	25.28	27.53	28.56
218	20.71	22.13	23.04	28.48	30.17	33.34	
219	16.64	18.67	19.96	21.90	23.54	24.64	25.68
220	16.60	19.38	20.64	22.01	23.89	26.65	28.17
221	18.05	19.98	21.28	23.06	25.54	28.26	31.55
222	19.73	21.62	24.14	26.22	27.50	30.51	31.88
223	19.00	22.38					
224	19.70	20.94	22.76	24.48	25.95	27.54	28.78
225	20.12	21.83	23.54	25.11			
226	20.58	21.96	23.33	25.73	27.07	29.36	30.66
227	18.14	19.87	21.42	23.46	26.74	28.24	30.50
228	17.24	19.20	20.58	22.43	24.08	26.51	28.84
229	20.28	21.75	23.38	25.67	26.73	29.38	31.41
230	20.06	22.60	24.70	26.31	28.24	29.61	31.59
231	17.78	19.20	21.15	23.44	25.12	26.70	28.14
232	16.34	17.78	19.53	22.37	25.38		
233	19.18	20.24	21.72	24.88	27.52	28.43	29.67

	-7.2%						
vehicle	8	9	10	11	12	13	14
cycle							
234	19.62	21.72	23.44	26.13	27.40	29.84	31.53
235	19.57	21.08	23.07	25.27	27.64	30.13	32.41
236	16.33	17.32	20.33	22.68			
237	16.59	18.09	21.90	23.10	24.56	25.64	27.77
238	19.80	21.68	23.66	24.77	27.17	30.57	32.86
239	18.37	20.34	21.60	24.03	25.20	26.34	28.55
240	20.97	22.26	24.05	25.16	27.03	29.82	32.40
241	17.06	18.78	20.32	23.67	25.00	26.14	27.54
242	18.70	20.17	21.63	23.40	26.30	28.24	30.24
243							
244	17.43	19.40	21.12	22.42	24.16	25.49	26.98
245	16.73	19.21	20.78	22.86	24.55	25.94	27.03
246	19.77	21.55	23.07	25.25	26.68	29.36	31.18
247	21.09	22.54	24.39	26.70	27.84	31.27	32.66
248	19.87	21.40	22.74	24.90	27.14	28.98	30.38
249	20.28	21.33	23.15	24.29	26.45	28.31	30.07
250	20.14	22.96	24.24				
251	20.31	21.70	24.17	27.05			
252	18.18	19.88	21.36				
253	20.44	22.41	24.23	26.07	27.75		
254	19.75	22.15	23.76	26.35			
255	15.64	17.58	20.23	22.20	24.10	25.86	26.80
256	19.07	21.14	24.03	25.46	27.76		
257	18.50	19.97	22.55	23.84	27.06	29.67	31.07
258	17.74	19.16	20.94	22.69	25.86	28.10	29.64
259	15.97	17.69	19.16	20.55	22.70	24.24	27.07
260	17.34	19.12	20.94	22.14	23.92	25.45	26.67
261	20.03	30.94	22.67	24.65	26.15	27.55	28.97
262	16.01	17.36	19.50	21.62	23.79	25.86	27.43
263	16.94	18.07	19.05	21.11	22.70	25.10	26.42
264	19.94	21.57	22.86	24.09	25.38	27.15	28.72
265	18.74	19.95	21.91	23.34	25.87	27.12	29.50
266	20.42	21.76	24.80	27.23	28.70	30.27	31.74
267	17.82	19.45	20.94	22.50	24.12	25.07	26.57
268	18.38	20.60	22.55	25.60	27.70	30.67	32.21
269	18.43	20.56	21.72	24.32	25.05	27.36	30.35
270	17.15	19.07	21.25	22.82	24.92	26.40	29.57
271	21.67	23.05	26.31	28.42	29.97	32.34	
272	18.00	21.87	23.27	24.85	26.74	28.27	29.63
273	17.94	19.91	21.35	22.84	25.27	28.13	29.29
274	19.62	21.18	22.76	24.51	25.81	27.67	29.43
275	20.04	23.64	26.54	28.91	30.79	32.34	33.93
276	17.83	18.71	20.03	21.63	23.07	24.54	26.04
277	18.34	19.77	23.20	24.58	26.54	28.27	29.81
278	18.82	20.54	23.33	25.24	26.72	28.41	29.47
279	16.79	18.30	19.87	21.87	23.05	24.61	25.84
280	21.25	23.50	24.79	25.99	26.90	28.97	31.57
281	16.56	19.08	21.25	22.74	24.01	26.31	27.78

vehicle	-7.2% 8	9	10	11	12	13	14
cycle							
282	21.30	22.79	24.20				

vehicle	8	9	10	11	12	13	14
no. of cycles	275	272	267	252	234	215	200
mean elapsed time	18.71	20.74	22.58	24.40	26.28	28.20	29.86

vehicle	-7.2% 15	16	17	18	19	count
cycle						
1						11
2						12
3						10
4						14
5	30.59	32.41				16
6	32.68	33.80				16
7	28.85	31.35				16
8	31.77	33.34				16
9	33.21					15
10						14
11						12
12	31.33					15
13						9
14						11
15						11
16						10
17						10
18						5
19	29.71	30.90	32.96			17
20						14
21	29.04	32.51				16
22	31.30	32.39				16
23	31.08	32.77				16
24	30.67	32.27				16
25	30.57	32.78				16
26						14
27						11
28						14
29						8
30	29.02	31.41				16
31	34.03					15
32						11

vehicle	-7.2% 15	16	17	18	19	count
cycle						
33	32.79	34.00				16
34	31.12	32.70				16
35						7
36	30.00	31.44				16
37						9
38	30.21					15
39	33.70					15
40						8
41						14
42						12
43						10
44	27.39	29.87	31.57			17
45	33.15					15
46						14
47						13
48						12
49	32.86					15
50	30.66	33.40				16
51	31.74					15
52	29.74					15
53	33.51					15
54	30.60	32.96				16
55						14
56	30.39					15
57						14
58						14
59	32.66					15
60	32.59					15
61						12
62						11
63						14
64						14
65	31.98					15
66						12
67						13
68						10
69	32.48					15
70						10
71	32.64					15
72	30.64	32.93				16
73						14
74						11
75	32.11					15
76	29.63	32.75				16
77	31.67	33.20				16
78	31.24	32.74				16
79						14
80						14

	-7.2%					
vehicle	15	16	17	18	19	count
cycle						
81	32.86					15
82						14
83	33.58					15
84						13
85	31.77	33.70				16
86	29.91	32.62				16
87	32.57					15
88						7
89						12
90						14
91	29.68	31.67				16
92						12
93	33.42					15
94						5
95						14
96	32.77					15
97						13
98						13
99	33.87					15
100	33.22					15
101	32.30	33.34				16
102						11
103	34.04					15
104						13
105	30.65	31.20				16
106	32.83					15
107						11
108						11
109	32.91					15
110	30.67					15
111						13
112						10
113						9
114						10
115						11
116						13
117						12
118						10
119						10
120						13
121	32.36					15
122						13
123						14
124						14
125						14
126	28.88	30.91	32.14			17
127	31.53	33.48				16
128	32.94					15

vehicle	-7.2% 15	16	17	18	19	count
cycle						
129						14
130						12
131						9
132	33.15					15
133						14
134	30.00	31.84				16
135	30.14	31.84	32.58			17
136	29.53	31.14				16
137	31.22	33.99				16
138	30.16	32.97				16
139						13
140						8
141						12
142						10
143						12
144						4
145						12
146	33.56					15
147	33.27					15
148						14
149	31.98	33.16				16
150	30.96	32.68				16
151	29.23	32.44				16
152	33.63					15
153	31.00	32.66				16
154	27.43	29.57	31.82	33.56		18
155	30.19	32.26				16
156	28.74	30.64				16
157						14
158	30.90	32.66				16
159	31.54	33.40				16
160	29.61	31.94				16
161	30.62	33.04				16
162	27.44	30.07	31.94			17
163	30.72	32.34				16
164	28.36	29.80	31.51	32.89		18
165	31.70					15
166	30.98					15
167						14
168						14
169						10
170						11
171						12
172						3
173	28.90	30.58	32.56			17
174	30.06	31.10				16
175						14
176						11

vehicle	-7.2% 15	16	17	18	19	count
cycle						
177	30.98					15
178	32.40					15
179	29.32	31.14				16
180	29.95	31.57	32.85			17
181						14
182	30.34					15
183	30.14	31.16	33.18			17
184	27.34	30.06	31.60			17
185	31.76	32.63				16
186	33.07					15
187	32.16					15
188	27.74	29.94	33.35			17
189	31.56	32.95				16
190	28.54	30.87	32.49			17
191						14
192						13
193						14
194	31.85	33.74				16
195						14
196						11
197						13
198						14
199	26.84	28.12	29.42	31.22	32.71	19
200	31.97					15
201	32.33					15
202	32.87	33.97				16
203						12
204						14
205	30.98	32.71				16
206						14
207	32.94					15
208	32.93					15
209						14
210	32.73					15
211	28.79	30.05	32.42			17
212						14
213	31.74					15
214						14
215						12
216	31.34	35.02				16
217						14
218						13
219						14
220						14
221	34.49					15
222						14
223						9
224	31.40					15

vehicle	-7.2% 15	16	17	18	19	count
cycle						
225						11
226	32.03					15
227	31.89					15
228	31.43					15
229	33.28					15
230						14
231	29.24	30.97				16
232						12
233	31.15	32.44				16
234						14
235	33.40					15
236						11
237	29.63	31.20				16
238						14
239	29.92	31.20				16
240						14
241	29.44	33.02	34.07			17
242	31.54					15
243						5
244	28.23	30.25	32.41			17
245	28.57	30.20	31.78	32.79		18
246	32.90					15
247	33.89					15
248	31.47					15
249	34.11					15
250						10
251						11
252						10
253						12
254						11
255	29.18	30.85	32.23	34.11		18
256						12
257	32.80					15
258	31.07					15
259	28.47	29.91				16
260	28.97	30.06				16
261	30.08	31.25	32.77	33.88		18
262	29.29	29.99	30.75			17
263	27.57	29.21	31.09	32.50		18
264	30.50	32.44	33.99			17
265						14
266						14
267	28.04	29.22	30.95	32.36	33.22	19
268	34.12					15
269						14
270	31.27	32.60				16
271						13
272	30.97	33.20				16

vehicle	-7.2% 15	16	17	18	19	count
cycle						
273	30.80	32.76				16
274	31.92					15
275						14
276	27.47	29.64	31.86			17
277	31.64	32.58	33.61	35.37		18
278	30.75	32.60	34.13			17
279	27.39	29.11	30.57	32.00		18
280	33.45					15
281	30.78	32.60				16
282						10

vehicle	16	17	18	19	20
no. of cycles	150	86	28	10	2
mean elapsed time	31.10	31.86	32.24	33.07	32.97

vehicle	+0.6% 1	2	3	4	5	6	7
cycle							
1	4.84	7.23	9.74	11.88	13.60	14.70	16.92
2	5.87	7.83	10.83	13.38	14.59	16.55	17.07
3	4.24	5.58	7.87	10.39	11.95	13.24	14.87
4	5.77	7.15	9.76	12.47	13.80	15.33	16.91
5	5.29	9.04	11.71	13.59	16.22	17.92	20.80
6	8.14	10.01	11.31	13.15	14.66	15.97	17.36
7	5.84	8.62	10.18	11.89	13.08	15.65	16.87
8	7.33	10.30	11.57	13.20	15.94	18.61	20.12
9	3.35	4.73	7.01	9.08	11.71	13.17	15.00
10	7.71	9.67	11.61	14.18	16.18	17.97	20.57
11	5.60	7.54	8.95	10.31	11.79	13.93	15.19
12	4.39	6.29	8.47	9.84	11.60	12.92	15.64
13	4.25	6.70	9.59	10.74	12.20	15.08	17.12
14	5.54	6.81	9.13	11.50	13.01	16.15	18.14
15	5.36	7.71	9.44	11.67	13.94	15.18	16.67
16	4.94	6.77	8.45	10.34	12.08	14.30	16.47
17	6.01	7.57	9.69	11.99	13.54	15.29	17.43
18	4.96	6.77	9.88	13.90	15.86	17.99	19.46
19	6.11	7.52	9.11	11.31	12.86	14.86	16.14
20	5.04	7.78	9.68	11.74	13.33	14.62	16.47
21	6.00	8.23	9.46	10.86	12.67	14.60	16.17
22	4.56	5.89	7.70	9.46	12.29	14.07	15.86

vehicle	+0.6% 1	2	3	4	5	6	7
cycle							
23	5.90	8.54	10.90	12.30	14.35	15.93	17.39
24	5.95	8.06	12.78	13.90	15.93	17.53	18.84
25	5.60	7.48	.95	10.65	12.64	14.71	16.34
26	5.76	7.83	10.01	13.46	14.97	15.90	17.29
27	7.19	9.09	11.49	13.20	14.63	17.92	19.07
28	5.39	7.33	8.89	10.58	11.94	13.74	16.31
29	6.00	7.67	9.90	11.54	13.10	14.84	17.39
30	5.81	7.23	9.95	11.17	12.62	14.27	16.27
31	5.70	8.04	10.97	12.81	14.32	16.07	18.47
32	5.96	7.82	10.49	12.29	13.96	17.17	19.47
33	5.98	7.80	9.78	12.10	15.13	17.50	19.18
34	3.44	6.00	7.68	9.17	11.20	15.60	17.29
35	5.92	8.69	10.71	12.20	13.26	15.24	17.28
36	8.43	10.08	11.25	12.69	14.01	15.10	16.87
37	6.80	9.27	10.74	11.99	13.97	15.99	17.29
38	4.66	7.64	10.11	12.49	15.44	17.04	19.06
39	4.25	6.51	8.33	9.71	12.70	15.97	17.88
40	4.14	8.87	11.82	13.63	15.57	17.10	18.84
41	6.41	7.49	9.40	12.50	14.04	16.24	17.27
42	5.02	7.92	10.02	11.91	13.30	15.78	17.10
43	4.88	6.57	8.40	9.81	12.44	14.01	15.85
44	7.02	8.70	10.97	13.01	14.11	15.20	18.20
45	5.81	7.41	9.50	11.57	13.90	15.03	16.90
46	4.30	6.25	7.82	7.82	10.67	12.17	13.71
47	9.00	10.40	13.67	15.51	16.74	18.64	20.03
48	4.85	6.25	8.60	10.02	11.90	13.77	14.70
49	4.12	8.55	9.69	12.29	15.14	17.09	19.04
50	6.59	7.80	9.40	11.03	12.97	14.64	17.02
51	6.48	7.79	9.50	11.02	13.34	14.63	15.71
52	5.19	6.50	8.25	9.70	11.73	14.07	15.82
53	4.55	6.52	8.15	10.04	11.84	13.12	16.59
54	5.84	8.86	10.52	11.98	14.05	16.06	19.17
55	4.73	7.71	10.80	16.31	19.00	20.37	23.32
56	5.32	7.70	9.61	11.42	13.75	15.75	16.90
57	4.44	6.41	8.50	9.97	11.18	13.21	15.54
58	6.16	7.74	9.72	12.04	13.49	15.20	16.71
59	5.65	7.50	9.46	10.93	12.48	14.45	
60	5.70	7.91	9.90	11.87	13.60	15.42	16.77
61	6.53	8.75	11.20	12.30	14.16	15.95	17.54
62	5.14	6.38	8.42	11.04	12.50	13.76	15.13
63	4.14	6.24	9.04	11.49	12.99	14.80	16.77
64	6.89	8.43	11.83	13.40	14.68	16.00	19.02
65	4.17	6.47	7.97	9.07	11.22	12.70	15.46
66	7.65	9.21	11.61	13.68	15.78	17.49	18.87
67	6.89	10.45	13.04	15.67	17.64	19.10	20.23
68	7.90	9.14	11.97	13.97	16.21	17.67	19.16
69	5.39	6.96	8.56	11.08	13.34	15.40	17.65
70	6.50	8.51	10.80	12.59	14.47	16.14	17.97

vehicle	+0.6% 1	2	3	4	5	6	7
cycle							
71	6.27	8.41	10.32	12.10	13.79	15.62	17.80
72	5.33	7.08	10.40	11.96	13.41	14.42	15.80
73	4.17	5.40	7.53	9.46	11.73	13.80	16.24
74	4.77	7.74	10.54	11.74	13.07	14.77	16.71
75	5.07	8.09	9.76	11.21	12.52	14.94	17.17
76	5.26	6.95	8.95	11.80	12.87	14.08	15.64
77	6.97	8.38	10.32	13.07	14.80	15.90	17.54
78	5.14	6.83	8.67	10.15	11.94	13.64	14.84
79	4.44	5.87	7.40	11.02	13.00	14.38	16.01
80	4.98	5.94	8.19	10.56	12.87	14.27	15.98
81	4.07	5.63	7.07	9.37	10.79	13.53	15.27
82	4.28	6.47	8.17	10.15	11.74	12.79	15.33
83	5.43	7.23	10.72	14.19	15.50	16.84	18.28
84	5.19	6.90	12.65	14.52	17.50	19.10	20.75
85	4.83	7.20	8.67	10.37	12.57	14.23	15.85
86	3.85	7.57	9.14	10.29	13.53	14.84	17.70
87	6.08	7.52	9.90	12.25	14.00	15.60	17.61
88	5.94	8.04	9.98	11.34	12.96	15.08	16.37
89	5.64	7.78	9.17	11.70	13.63	17.79	18.92
90	5.12	7.30	8.90	12.17	13.18	14.40	15.94
91	4.18	6.07	7.74	9.20	11.40	12.86	14.46
92	6.87	8.42	10.60	12.42	16.98		
93	5.18	10.87	12.60	14.94	16.57	18.79	20.24
94	3.63	6.54	8.70	11.07	13.34	15.07	17.73
95	6.80	7.94	9.24	10.63	12.57	14.41	
96	6.30	7.53	9.99	11.79	13.38	16.02	17.23
97	5.48	7.39	8.95	10.91	12.70	14.24	16.07
98	5.71	6.83	8.40	10.31	11.58	13.97	15.02
99	4.08	6.21	7.49	9.32	12.86	14.81	16.55
100	5.81	7.28	8.59	10.58	11.54	13.34	14.81
101	5.83	7.80	9.47	11.50	12.79	15.17	17.17
102	4.50	6.78	9.93	11.89	13.78	16.14	17.57
103	5.51	6.73	8.17	10.51			
104	6.10	7.61	9.60	11.34	12.70	13.97	15.73
105	4.06	6.18	8.50	9.62	12.00	13.57	14.87
106	5.36	7.57	10.14	12.29	13.97	17.08	17.97
107	4.28	7.64	9.09	10.57	12.30	13.52	15.84
108	4.15	6.34	7.70	11.14	12.30	13.64	14.95
109	4.36	7.49	10.04	12.64	13.77	15.27	19.18
110	3.34	5.53	7.20	9.43	11.56	12.82	14.19
111	3.28	4.71	6.60	8.34	9.81	11.56	14.01
112	3.70	6.83	8.64	9.93	11.51	13.10	15.08
113	4.58	6.96	9.50	11.67	13.56	14.80	16.57
114	3.69	4.82	5.85	9.50	12.00	15.22	17.44
115	6.19	7.60	8.63	11.22	12.85	14.67	17.89
116	6.09	8.43	10.28	11.50	13.00	15.33	17.46
117	7.69	8.60	10.78	13.07	14.40	16.73	17.84
118	5.23	7.69	9.57	11.61	12.94	14.06	15.37

vehicle	+0.6% 1	2	3	4	5	6	7
cycle							
119	4.67	8.16	10.00	11.33	12.83	15.04	17.39
120	4.67	6.97	9.47	10.75	13.03	14.39	15.84
121	4.95	8.93	9.73	12.44	13.78	15.88	
122	5.67	7.48	9.09	10.53	12.55	13.84	14.87
123	5.39	7.70	9.51	11.50	13.04	16.58	
124	5.80	6.94	8.55	12.09	13.33	15.30	17.16
125	5.58	8.17	9.85	11.46	13.57	16.06	
126	3.01	4.40	6.75	10.04	14.01	17.51	19.06
127	5.73	8.00	11.14	13.87	15.59	20.16	22.20
128	5.41	7.76	10.20	11.87	12.99	14.90	16.30
129	5.88	8.16	9.55	11.26	12.74	14.16	15.21
130	5.84	8.38	10.22	11.62	13.19	16.05	17.42
131	5.94	8.17	9.63	11.45	13.16	15.08	16.38
132	5.02	6.41	8.31	10.24	12.52	14.09	16.97
133	5.65	7.98	9.19	11.76	14.13	16.79	19.55
134	4.87	7.50	9.18	10.61	11.81	14.07	15.75
135	5.24	7.47	8.74	11.20	12.55	15.54	16.91
136	5.34	6.60	8.81	10.14	11.51	14.57	16.13
137	6.05	10.25	12.32	14.30	16.80	18.57	20.27
138	7.15	9.54	11.10	13.11	15.02	17.05	18.30
139	6.34	7.33	9.20	10.27	13.41	15.33	
140	5.61	7.66	10.19	12.22	13.58	15.51	16.68
141	4.85	6.34	7.88	10.45	11.90	14.84	16.23
142	6.35	7.84	9.39	11.13	13.47	15.00	17.34
143	7.25	9.41	10.68	12.75	13.98	15.73	18.00
144	5.74	7.73	11.13	12.68	14.12	15.85	17.40
145	5.34	6.77	9.00	10.29	12.80	14.80	16.29
146	5.05	7.40	9.00	10.34	12.33	13.58	17.20
147	5.50	6.76	8.31	9.65	11.23	13.33	15.27
148	6.28	7.73	9.40	11.04	12.27	13.89	15.68
149	6.80	8.60	10.06	12.66	14.71	15.90	19.20
150	8.48	10.38	12.26	14.09	15.60	17.72	19.25
151	4.45	7.57	9.32	10.99	12.55	14.30	16.51
152	3.98	6.27	8.50	9.94	11.85	13.50	15.24
153	5.38	7.30	9.79	10.87	13.69	18.07	20.48
154	4.87	6.33	8.16	10.15	14.45	17.34	20.03
155	4.22	5.87	7.94	9.03	11.27	12.68	14.30
156	5.07	8.47	9.97	11.92	13.57	15.51	17.34
157	6.70	8.07	10.42	11.54	13.10	14.79	18.47
158	3.52	5.34	7.75	9.81	11.11	12.84	15.70
159	3.90	5.65	8.19	13.74	15.42	17.17	19.47
160	8.34	10.93	12.56	14.07	15.21	16.27	18.41
161	5.26	7.57	9.25	10.85	12.74	13.87	15.80
162	5.90	7.91	10.54	11.87	13.43	15.10	16.46
163	5.16	6.50	7.97	11.39	12.90	14.15	15.92
164	6.51	8.26	9.86	11.63	13.14	14.66	15.64
165	5.10	7.17	9.25	10.74	12.31	14.48	17.29
166	6.74	8.33	9.84	11.38	13.00	15.33	17.05

vehicle	+0.6% 1	2	3	4	5	6	7
cycle							
167	15.27	19.74	21.60	22.94	24.45	26.84	28.64
168	6.22	9.47	10.97	12.66	15.21	16.20	18.14
169	6.07	8.48	10.10	11.88	13.86	15.28	16.84
170	5.69	8.34	11.19	13.03	15.59	16.71	17.97
171	10.48	11.83	13.29	14.87	17.17	18.37	19.42
172	4.47	6.15	8.52	10.00	11.25	12.93	14.15
173	5.28	6.51	8.34	9.72	11.43	13.29	16.95
174	5.38	6.96	8.29	12.19	13.73	16.20	18.48
175	4.70	7.50	10.06	11.75	13.31	15.41	18.32
176	4.34	6.60	7.86	9.59	12.24	14.29	15.31
177	6.64	8.66	10.17	11.25	12.53	14.54	15.87
178	5.74	7.95	9.54	11.41	12.84	14.42	15.97
179	6.19	8.57	11.60	14.24			
180	4.89	6.68	8.11	10.13	12.11	14.21	16.31
181	4.33	5.96	7.62	9.54	11.08	12.90	15.32
182	4.95	7.99	9.67	10.91	12.29	13.90	15.84
183	5.70	8.24	10.34	12.40	14.12	16.03	18.00
184	4.61	7.84	10.24	12.27	13.41	15.81	18.24
185	4.26	5.95	8.14	9.85	12.28	15.07	16.78
186	8.38	10.58	11.92	14.16	15.86	17.56	19.04
187	5.92	7.41	9.50	10.83	13.84	15.80	17.65
188	6.61	8.16	10.14	12.31	13.63	15.04	16.99
189	4.54	6.28	10.40	11.74	13.35	14.57	16.15
190	7.33	9.62	11.40	13.24	14.23	15.88	
191	5.17	7.82	9.77	12.28	13.50	15.15	16.53
192	4.94	7.42	9.05	10.12	11.51	13.55	14.90
193	6.78	11.41	15.10	17.77	19.35	21.04	22.20
194	4.60	6.19	7.68	9.60	12.19	13.84	15.25
195	5.61	7.40	9.14	10.92	12.56	14.32	16.11
196	2.64	4.72	7.10	8.62	9.91	12.31	
197	6.57	9.32	10.47	12.27	14.39	16.83	18.24
198	5.18	8.10	9.26	11.20	13.23	16.37	19.15
199	5.34	9.55	12.96	14.34	16.29		
200	3.34	4.47	5.94	8.73	10.46	12.76	15.15
201	3.34	5.14	8.94	10.58	11.83	13.46	14.79
202	6.18	9.36	10.89	11.84	14.23	16.20	18.27
203	4.70	6.97	8.59	9.84	12.21	14.28	15.35
204	5.10	9.13	13.08	14.65	16.30	17.84	18.93
205	5.86	8.55	9.58	11.46	13.06	14.94	16.40
206	5.44	7.24	9.17	10.80	12.74	18.42	21.56
207	6.45	8.31	9.57	11.27	12.87	13.94	15.37
208	5.02	7.09	8.94	10.73	12.98	14.44	16.28
209	4.75	6.29	7.63	8.56	10.13	12.98	13.87
210	3.96	6.51	7.64	8.49	9.84	12.10	13.89
211	4.00	6.04	8.08	10.14	11.44	12.40	14.34
212	3.91	5.28	7.05	9.37	11.18	12.88	14.72
213	4.88	9.65	10.95	12.20	13.40	14.67	16.81
214	5.26	7.67	9.79	11.37	13.52	17.27	18.80

vehicle	+0.6% 1	2	3	4	5	6	7
cycle							
215	3.74	6.85	8.47	9.90	11.26	13.87	15.79
216	5.76	9.76	10.87	12.47	13.59	16.09	17.73
217	4.50	6.75	8.10	9.72	12.19	14.32	15.86
218	3.97	7.14	10.28	11.62	14.44	15.80	17.07
219	5.41	7.40	9.07	10.23	11.90	13.23	17.64
220	5.65	7.14	10.50	13.20	14.65	16.64	18.36
221	3.71	4.86	6.41	8.60	10.07	11.12	12.64
222	5.09	7.52	10.16	11.44	12.64	17.24	19.97
223	3.96	6.42	9.44	10.77	13.77	14.71	16.60
224	5.57	7.89	9.52	11.66	13.11	14.31	15.69
225	4.82	7.40	9.84	11.07	13.00	15.31	17.33
226	4.85	6.94	9.55	11.71	14.14	16.89	18.78
227	6.19	9.27	10.61	11.89	13.35	15.23	18.20
228	6.29	7.90	9.51	11.85	13.80	14.90	
229	3.41	5.10	6.14	8.49	11.36	17.14	19.54
230	4.27	5.70	7.83	10.12	12.39	15.83	11.75
231	5.35	7.63	8.97	10.15	12.97	14.53	15.91
232	6.30	9.09	10.93	12.19	13.53	14.94	16.56
233	4.24	6.11	7.18	9.84	11.72	13.45	15.67
234	4.97	6.83	8.40	10.18	12.07	13.94	16.08
235	5.95	7.77	9.63	11.30	14.86	15.79	17.75
236	4.19	6.40	8.52	12.41	13.98	15.31	16.57
237	3.96	7.41	9.40	11.61	13.22	15.11	17.17
238	4.49	5.98	7.41	10.41	12.14	13.98	15.55
239	7.91	12.58	13.74	15.02	16.50		
240	4.76	8.83	10.67	11.89	14.30	16.26	18.00
241	6.68	8.18	9.56	11.60	12.94	14.48	16.94
242	5.10	8.03	9.57	11.20	12.62	14.74	16.59
243	4.90	6.64	8.38	10.56	12.71	15.07	17.05
244	3.71	6.24	8.41	9.53	11.94	13.24	14.68
245	4.36	6.60	8.21	10.13	11.60	13.62	16.95
246	5.90	7.61	10.00	11.18	12.92	14.53	16.09
247	5.00	7.07	8.21	9.52	11.60	13.44	15.16
248	5.60	7.74	9.42	11.55	13.41	15.27	17.87
249	5.58	6.87	8.67	10.33	12.58	14.07	15.64
250	6.13	8.72	10.11	14.50	17.64	19.51	21.28
251	6.05	7.68	9.04	10.35	12.39	14.15	17.05
252	4.57	7.80	9.42	10.62	13.07	17.46	19.08
vehicle	1	2	3	4	5	6	7
no. of cycles	252	252	252	252	250	247	238
mean elapsed time	5.43	7.60	9.58	11.49	13.34	15.25	17.09

vehicle	+0.6% 8	9	10	11	12	13	14
cycle							
1	19.10	21.23					
2	18.77	21.01	22.70	24.97			
3	16.02	18.17	19.90	22.18	24.44		
4	19.54	21.72	23.38	24.91	26.09	29.28	30.81
5	22.94	24.55	26.51	27.77	29.50	31.54	34.06
6	19.76	21.55	23.64	25.24	26.51	28.55	30.33
7	18.64	21.26	24.02	25.08	26.95	28.90	31.80
8	21.98	23.67	25.16	27.16	29.14	30.92	32.50
9	19.08	21.02	22.80	24.17	26.35	28.43	30.08
10	21.90	23.47	25.63	28.07	29.91	31.23	33.25
11	17.22	19.37	21.99	24.49	26.98	28.80	31.98
12	19.26	23.97	26.32	28.53	32.97	34.52	35.61
13	18.34	19.54	21.02	22.88	24.43	25.66	28.32
14	19.18	21.07	22.60	24.50	26.23	27.90	29.13
15	18.57	20.87	22.82	24.00	25.57		
16	17.49	20.22	21.76	24.60	27.77	30.28	33.67
17	18.90	20.01	21.34	22.94	25.64	27.08	28.45
18	21.34	28.40	30.51	31.64	34.44	36.08	37.94
19	18.00	19.39					
20	17.89	21.36	23.26	25.07	28.91	31.29	33.90
21	18.99	21.54	24.74	26.70	28.44	29.76	31.63
22	17.78	19.66	21.37	24.28	26.39	27.63	29.36
23	19.34	20.98	23.84	26.07	28.53	30.98	32.65
24	19.90	21.59	23.27	24.73	26.56	29.24	31.56
25	17.86	19.23	20.03	20.92	24.52	25.74	27.50
26	18.74	20.13	21.36	22.28	24.22	25.86	27.15
27	20.72	23.35	24.95	27.12	29.07	30.87	33.03
28	18.08	19.56	22.73	25.07	27.89	29.95	31.25
29	19.28	21.14	22.80	24.42	26.10	28.50	31.00
30	18.27	20.11	21.82	24.23	26.04	28.07	29.81
31	20.25	22.50	24.62	26.17	27.04	30.01	32.13
32	21.92	24.43	26.19	27.95	29.36	30.47	32.90
33	20.57	21.98	23.95	26.59	28.31	30.41	32.57
34	20.00	21.41	24.54	26.87			
35	18.82	20.50	23.90	25.33	29.14	31.54	33.08
36	18.11	19.30	21.37	22.96	24.14	25.61	27.36
37	18.74	20.57	22.42	23.79	24.95	26.54	28.43
38	20.95	23.04	24.57	25.50	26.79	29.57	31.82
39	19.44	22.38	26.49	29.03	33.83	36.06	37.89
40	20.57	24.12	26.17	27.57	29.17	30.93	35.11
41	19.14	21.10	23.80	26.00	28.38	30.59	32.10
42	19.60	26.97	28.78	30.43	33.14	36.26	39.07
43	19.27	21.74	23.90	25.49	26.95	28.29	29.52
44	19.72	22.08	23.91	26.67	28.16	30.30	32.00
45	18.63	20.74	22.16	24.19	25.60	27.78	29.84
46	15.80	17.06	18.80	21.23	22.77	23.72	26.91
47	21.36	24.94	26.73	28.19	29.58	31.85	33.57

vehicle	+0.6% 8	9	10	11	12	13	14
cycle							
48	18.04	20.31	22.19	24.69	25.99	30.62	31.77
49	21.36	23.02	25.61	27.36	29.58	32.23	33.67
50	18.43	19.71	22.67	25.69	27.82	29.33	31.00
51	19.14	21.51	23.10	24.47	26.46	27.60	29.96
52	17.07	19.83	21.21	23.67	27.78	29.91	32.21
53	18.25	19.94	21.74	24.57	26.43	28.08	30.21
54	20.70	23.04	26.83	29.67	33.15	36.59	40.90
55	25.29						
56	18.70	19.65	21.77	23.30	25.04	25.94	27.36
57	17.56	20.15	22.70	24.44	25.77	27.54	28.84
58	19.65	21.30	24.00	25.44	27.24	29.96	
59							
60	18.20	21.27	23.50	25.84	27.34	29.94	31.34
61	20.14	21.67	22.80	26.54	28.78	31.08	33.13
62	17.99	19.67	21.45				
63	18.79	22.13	24.00	26.80			
64	21.08	22.12	25.07	26.80	27.94		
65	16.94	18.22	19.97	22.19	24.36	25.86	28.64
66	20.55	22.21	23.83	26.13	28.20	31.07	32.26
67	21.47	23.07	24.98	27.81	29.68	31.27	33.28
68							
69	19.31	21.00	22.69	25.06	28.77	30.79	32.57
70	19.34	20.57	22.55	23.45	24.74	26.97	28.35
71	19.66	22.07	23.94	26.70	28.24	29.81	31.01
72	17.17	19.13	23.90	26.52			
73	17.30	18.63	20.30	22.13	26.47	28.33	29.74
74	18.25	19.64	21.29	23.68	25.27	28.33	30.56
75	19.93	21.70	23.66	25.00	27.71	31.27	33.10
76	18.18	20.4	23.98	26.06	28.09	31.43	33.42
77	48.84	20.13	22.50	24.36	26.01	28.51	29.67
78	17.21	18.78	21.05	24.04	25.41	28.35	30.26
79	17.57	19.59	21.97	23.52	25.40	26.80	28.86
80	18.36	19.97	21.65	23.45	26.55	27.79	29.13
81	16.47	18.21	19.80	22.36	23.87	25.38	27.75
82	17.23	18.67	20.24	22.39	27.30	28.32	29.42
83	20.06	22.34	24.65	25.88	27.80	32.48	33.66
84	21.99	23.69	26.74	28.12	30.01	31.64	33.61
85	17.27	19.99	22.04	23.19	24.94	28.13	29.69
86	19.91	21.43	23.04	25.92	27.88		
87	18.92	20.98	22.59	24.30	26.20	27.50	28.93
88	18.82	20.10	21.37	23.80	28.27	29.30	30.73
89	20.92	23.10	26.42	27.84			
90	16.91	18.60	20.34	21.64			
91	17.33	19.04	21.40	23.92	25.87	27.98	29.58
92							
93	22.36	24.38	26.84	29.20	31.74	34.00	36.75
94	19.60						
95							

vehicle	+0.6% 8	9	10	11	12	13	14
cycle							
144	18.88	21.30	24.62	26.47	28.55	30.71	32.09
145	18.19	21.53	24.07	25.67	26.94		
146	20.62	23.16	25.64				
147	17.64	20.27	21.41	23.59	27.44	29.07	
148	17.99	19.86	21.28	22.73			
149	20.61	22.08	24.28	26.17	28.52	30.59	33.39
150	20.80	23.70	25.81	28.28			
151							
152	16.50	18.39	20.14	22.53	23.87	26.74	28.54
153	22.26	24.00	25.60				
154							
155	15.42	17.67	20.44	23.24	25.32	29.21	31.24
156	19.18	21.72	22.63	26.27	27.91	30.29	31.57
157	20.80	21.96	23.71	26.20	27.84	30.87	32.23
158	17.92	19.38					
159	21.61	24.06	27.11	28.44	29.57	30.66	32.19
160	20.00	22.44	24.10	25.07	26.30	28.21	29.97
161	18.41	19.69	21.02	22.33	23.63	24.77	28.31
162	17.69	19.91	22.75	30.09	32.13	35.13	37.75
163	17.57	20.22	21.75	23.43	25.14	27.53	29.08
164	17.31	19.60	21.04	22.26	23.60	25.84	27.07
165	19.82	21.02	22.62	25.98	27.76	29.14	30.62
166	19.91	20.97	22.59	25.68	26.94	29.27	32.66
167	29.86	31.95	33.30	35.87	38.29	40.19	
168	19.22	20.52	22.04	23.83	26.71	28.20	30.42
169	19.30	20.84	23.18	26.05	28.37	30.22	
170	20.07	21.36	23.61	25.60	28.41		
171	20.76	22.19	23.87	24.80	26.04	27.50	29.21
172	16.20	17.54	18.95	20.91	24.03	26.15	29.28
173	19.27	20.87	22.87				
174	20.87	23.64	25.10	26.60	28.41	30.57	
175							
176							
177	17.37						
178	18.04	20.19	21.40	22.41			
179							
180	17.59	19.17	20.24	21.46	23.07	24.67	
181							
182	22.11	25.47	26.87	28.37	30.33	34.27	
183	20.14	21.85	23.71	25.13	26.70	29.33	31.67
184							
185	18.95	20.44	22.46	24.30	25.54	27.58	28.79
186	20.65	22.01	24.82	27.17	29.03		
187	20.07						
188	17.84	19.17	21.42	23.29	26.20	28.23	30.60
189	17.91	19.81	22.47	25.64	27.76		
190							
191	18.41	19.66	20.93	22.24	24.69	25.81	27.79

vehicle	+0.6% 8	9	10	11	12	13	14
cycle							
96	18.83	20.67	21.68	24.94	26.43	28.66	30.31
97	17.46	19.14	21.75	22.45	23.66	26.15	
98	18.30	19.90	21.48	23.19	25.95	27.54	29.13
99	17.84	19.37	21.27	22.67	25.07		
100	16.64	18.31	20.00	21.60			
101	18.46	20.27	21.48	23.63	27.20	28.77	31.62
102	20.61	22.11	24.07	25.35	26.94	27.82	29.87
103							
104	17.84	19.86	21.36	23.20	25.75	27.64	28.60
105	16.74	19.18	21.52	23.40	25.66		
106	20.26	24.15	25.09	26.67	27.80	29.25	31.17
107	17.39	19.45	21.44	22.40	24.05		
108	16.94	19.03	21.98	24.94	26.54	28.20	29.30
109	20.93	22.50	24.50	27.74	29.24	31.85	33.41
110	16.63	18.81	20.35				
111	15.75	17.32	19.17	20.63	22.89	25.47	26.91
112	16.61	18.70	20.66	22.25	25.80		
113	18.23	20.21	21.23	23.50	25.14	27.46	30.14
114	19.37						
115	19.60	21.30	22.55	24.47	26.20		
116	19.57	22.88	24.30	26.11	27.80	29.62	31.77
117	19.64	20.69					
118	17.77	18.90	20.17	21.20	23.44	25.17	27.27
119	18.31	21.54	23.19	25.29	26.27	28.20	30.27
120	17.37	18.87	20.20	22.01	23.36	24.51	26.30
121							
122	16.24	18.57	20.02	21.07	21.94	23.09	
123							
124	18.68	21.36	23.45	25.70			
125							
126	20.47	21.94	24.05	25.40	26.89	27.99	29.40
127	23.69	25.21	26.33				
128	18.32	20.21					
129	16.52	21.53	23.56	25.23			
130	19.20	21.10	22.12	23.04	24.28	25.81	27.13
131	18.04	24.20	27.93	30.42	31.64	33.90	36.42
132	18.58	20.68	22.30	23.69	25.91	27.15	29.24
133	21.54	23.19	26.32	28.86			
134	18.31	20.10	21.31	25.06	27.19	28.91	31.28
135	18.94						
136	17.26	18.71	20.27	21.77	24.58	27.01	28.80
137	21.69	23.34	25.93	27.07	29.67	31.10	32.20
138	20.50	22.27	24.06	25.07	28.61	30.00	33.81
139							
140	18.15	20.70	22.75	24.42	26.38	28.30	
141	17.78	20.30	21.68	24.60	27.15	28.86	31.14
142	19.92	21.74	24.05	26.09	28.50	31.40	34.34
143	19.71	21.29	23.50	25.01	27.14	28.78	30.34

vehicle	+0.6% 8	9	10	11	12	13	14
cycle							
192	16.07	20.34	22.58	23.95	25.57	28.15	
193	25.00	27.46	28.60	30.66	32.25	33.64	35.76
194	16.59	19.04	21.34				
195	18.84	21.09	23.16	25.25	28.20		
196							
197	19.85	24.24	26.05	27.90	30.[illegible]1	33.60	36.30
198	20.52	21.59					
199							
200	16.16	17.58	19.59				
201	16.06	17.70	20.14	21.80	25.92		
202	20.64	22.59	23.84	24.80			
203	16.52	18.06	20.15	22.38			
204	20.37	21.70	24.15	26.34	28.29	29.87	31.63
205	17.70	19.53	21.97	24.34	25.78	27.07	28.81
206	23.41	25.76	27.38	30.35	32.35	33.91	
207	18.76	20.92	22.24	23.67	25.30	27.14	28.84
208	18.13	19.77	21.51	23.57	25.25	27.27	29.18
209	16.10	18.16	21.19	22.57	24.54	26.54	27.70
210	15.56	17.65	19.59	21.35	23.60	25.05	27.12
211	16.57	18.56	19.74	21.10	23.46	25.19	27.00
212	16.89	19.64	22.38	24.00	25.86	27.47	28.92
213	18.34	19.74	20.68	22.57	24.76	26.67	[illegible].44
214	20.44	21.97	23.80	25.81	27.48	29.88	31.85
215	17.76	20.57	21.87	23.17	25.23	26.76	29.23
216	21.04	22.42	23.62	25.74	27.45	28.67	29.92
217	17.54	19.25	22.25	25.20			
218	18.25	19.90	21.51	22.91	24.18	25.40	26.81
219	20.23	21.80	24.13	26.38			
220	20.44	22.27					
221	15.69	16.83	19.81	21.84			
222							
223							
224	17.60	19.35	21.28	26.60	28.46	30.22	32.14
225	20.26	21.92					
226	22.00	23.61	25.74				
227	20.95	22.18	24.32	26.10	28.24	30.17	33.03
228							
229	21.69	24.75	26.27				
230	19.15	20.77	21.90	24.56	26.21	29.35	31.42
231	16.99	19.29	22.74				
232	18.34	20.02	21.80	23.50	25.05	27.05	29.07
233							
234	18.24	20.42	22.09	24.98			
235	19.23	21.74	23.22	24.48	26.40	28.81	31.46
236	18.14	19.40	22.46	25.08	26.46		
237	19.38	20.93	23.00	24.49	26.34	27.94	29.88
238	18.55	21.58	22.79	24.50	25.84	27.19	28.59
239							

+0.6%

vehicle	8	9	10	11	12	13	14
cycle							
240	19.41	20.85	23.65	25.62	27.86	29.44	32.29
241	18.59	20.20	21.44	22.97	24.71		
242	18.37	20.10					
243	20.97	22.83					
244	18.48	20.29	21.74	23.63	25.31	26.96	28.41
245	18.84	20.35	22.62	24.07	25.67	27.60	29.19
246	18.14	22.11	25.22	27.65	29.53	31.23	
247	16.41	18.10	19.89	22.13	24.02	26.03	27.45
248	19.92	21.27	22.36	30.30	33.56	35.97	
249	17.17	18.53	20.30	22.64	24.89	26.44	
250	23.21	25.84					
251	19.30	20.54	23.17	25.05	26.20	27.46	30.53
252	21.02	23.56					

vehicle	8	9	10	11	12	13	14
no. of cycles	228	222	210	199	180	163	148
mean elapsed time	19.16	21.04	22.99	24.98	27.03	29.08	30.93

+0.6%

vehicle	15	16	17	18	19	20	21
cycle							
1							
2							
3							
4	33.32	34.74	37.50	40.84	41.87	45.53	47.54
5	36.63	38.54	40.97				
6	32.33	33.50	35.24	37.30	39.49	42.07	44.14
7	33.98						
8	34.36	36.41	38.10	40.04	41.49	43.50	44.76
9	31.57	34.24	36.15	38.06	40.39	42.59	44.82
10	34.48	36.02	38.86	41.44	42.73	44.04	45.84
11	33.70						
12	37.30	38.57	40.94	43.09	44.70	45.97	48.72
13	30.23	33.53	34.78	36.26	39.30	42.11	44.36
14	30.87	34.24	35.76	38.31	41.33	42.60	46.47
15							
16	34.98	37.54	39.29	41.08	43.55	44.94	46.01
17	31.56	33.63	35.05	36.98	38.27	41.64	43.62
18	39.88	42.38	44.06	46.13	49.74	51.09	52.10
19							

+0.6%

vehicle	15	16	17	18	19	20	21
cycle							
20	36.66	38.28	41.59	45.70			
21	33.36	35.63	37.96	39.67	42.07	43.15	45.31
22	32.41	35.64	37.22	38.87	41.06	43.27	47.52
23	34.80	36.87	39.82	42.14	44.47	47.01	49.07
24	33.33	34.52	37.22	39.14	40.46	41.84	44.09
25	30.30	32.72	33.78	34.87	35.92	39.64	42.07
26	28.72	31.26	34.61	36.78	39.48	42.61	43.97
27	37.41	38.74	40.34	42.21	44.53	46.00	47.28
28	33.63	37.17	38.80	41.04	43.33	44.76	45.92
29	32.68	35.53	39.82				
30	31.00	34.36	35.91	37.76	40.47	41.97	44.67
31	35.03	36.78	38.65	40.36	42.28	43.86	45.19
32	38.90	40.22	42.02	44.14	46.64	48.95	50.77
33	34.12	36.98	39.17	41.96	43.50	45.69	47.32
34							
35	35.16	38.65	39.84	41.47	42.75	45.30	47.53
36	31.41	34.62	35.72	37.01	38.10	39.71	41.64
37	31.14	32.70	33.74	35.40	36.41	38.40	39.55
38	36.03	38.04	39.67	41.38	42.90	44.74	45.76
39	40.57	41.88	43.50	45.16	46.59	47.57	49.16
40	37.29	39.47	40.80	42.23	45.11	47.60	52.04
41	33.60	36.12	37.70	38.94	40.34	42.78	44.13
42	40.71	45.80	47.27	48.94	50.82	53.40	55.95
43	30.83	33.10	36.73	39.02	40.35	42.72	45.29
44	35.92	37.25	39.45	41.43	44.27	45.97	48.04
45	31.55	33.85	36.27	40.37	42.91	46.16	49.54
46	29.75	31.22	33.82	36.93	37.87	40.10	42.26
47	35.00	37.64	41.98	43.63	45.72	47.57	49.15
48	35.59	37.20	39.67	42.07	43.70	49.40	51.34
49	35.44	37.39	40.29	41.45	42.97	44.87	47.90
50	33.78	35.80	37.18	38.58	40.25	41.96	43.27
51	33.47	35.32	37.44	38.46	41.26	43.15	45.56
52	34.39	35.71	37.23	39.29	41.51	42.73	44.05
53	32.02	34.10	35.40	37.66	39.14	41.17	42.69
54	44.21	46.85	48.65	51.96	54.29	55.94	58.24
55							
56	29.87	31.48	33.60	35.01	36.50		
57	30.18						
58							
59							
60	32.72	36.24	39.99	41.63	43.40	44.80	46.29
61	35.20	36.82	38.26	39.80	41.96	43.69	46.22
62							
63							
64							
65	30.17	32.02	34.69	36.23	38.94	40.58	
66	34.04	35.79	37.73	40.14	41.81		
67	35.56	37.76	39.30	40.97	42.92	44.51	45.66

+0.6% vehicle	15	16	17	18	19	20	21
cycle							
68							
69	34.19	35.53	37.50	39.39	42.09		
70	29.60	32.57	33.98				
71	34.14						
72							
73	31.72	34.77	36.48	38.15	41.53	44.39	46.02
74	33.61	35.68	38.43	40.32	41.99	43.45	45.27
75	34.27	35.60	38.54	40.59	41.60	42.75	44.68
76	35.44	37.17	38.99	40.24	41.55	43.29	45.07
77	31.33	33.33	35.88	37.21	39.64	41.59	42.87
78	32.08	33.48	34.36	36.96	38.87	40.59	43.22
79	31.00	33.53	36.18	38.49	40.29	41.72	44.01
80	30.41	32.57	34.52	36.02	39.13	40.70	41.76
81	29.80	35.38	37.04	38.25	39.61	41.24	43.20
82	31.85	35.64	38.13	40.90	43.77	45.07	46.34
83	35.04	38.00	40.44	43.05	45.34	47.45	49.27
84	35.41	36.45	39.02	40.55	43.02	45.50	
85	32.34	33.99	35.27	37.59	39.51	42.35	43.40
86							
87	30.22	32.04	33.56	36.21	37.84	39.13	40.47
88	32.39	34.14	35.91	37.07	38.65	40.82	42.54
89							
90							
91	32.01	34.09	35.67	38.21	40.02	41.89	
92							
93							
94							
95							
96	32.84	35.14					
97							
98	30.57	33.10	35.87	37.84	40.51	41.51	
99							
100							
101	34.27	36.20	37.43	39.98	42.07	43.48	46.14
102	33.77	34.96	35.16	38.10	41.27	43.84	45.10
103							
104	30.19	31.43	34.07	35.34	36.51	38.84	40.27
105							
106	33.29	34.56	36.10	37.54	40.08	42.12	44.78
107							
108	30.37	33.78	34.80	36.58			
109	34.86	37.53	38.63	41.86	43.20	45.01	46.10
110							
111	29.20	31.70	34.60	35.29	39.43	41.67	42.95
112							
113	32.94	34.96	37.69	39.71	42.71	44.55	47.00
114							
115							

+0.6% vehicle	15	16	17	18	19	20	21
cycle							
116							
117							
118	28.44						
119							
120	27.78	29.64	31.47				
121							
122							
123							
124							
125							
126							
127							
128							
129							
130	28.65						
131	38.44						
132							
133							
134	33.01	34.44	36.67	37.99			
135							
136	31.46	33.99	35.87	37.61			
137	35.72	37.10					
138	35.24						
139							
140							
141	32.57	34.60	37.16	39.50	41.65	44.61	46.79
142	35.65						
143	32.08	33.86	36.03				
144							
145							
146							
147							
148							
149	35.25	36.75	38.50	40.02	42.20	44.54	
150							
151							
152	30.66	32.20	34.90	36.10	38.60	39.35	41.87
153							
154							
155	32.73	34.66	35.70	38.56			
156	33.34	35.48	38.53	40.93	42.14	44.24	45.91
157	34.05	35.60	38.47	40.29	42.96	44.07	47.07
158							
159	34.18	36.29	37.99	39.95	41.34	43.39	46.40
160	34.69	36.37	38.87	40.76	43.26	46.38	48.14
161	30.07	32.12	34.74	37.10	38.57	39.73	41.20
162	39.64	41.26	43.06	46.80	48.91	50.80	52.24
163	30.89						

+0.6% vehicle	15	16	17	18	19	20	21
cycle							
164	30.24	33.09	34.47	35.68	36.93	38.99	40.96
165	33.28	34.42	36.04	37.44	39.38	41.74	
166							
167							
168	32.30	33.58	35.97	37.96	39.56	41.39	
169							
170							
171	30.56						
172	31.25	33.90	36.04				
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183	34.00						
184							
185							
186							
187							
188	32.29	34.00					
189							
190							
191							
192							
193	38.02	40.28	42.53	45.82	48.06	49.51	51.20
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205	30.91	32.52					
206							
207	30.89	32.49	33.75	35.67			
208	30.97	32.97	35.54	37.47	39.09		
209	29.47	31.47	32.76	34.42	37.00	38.17	39.87
210	28.70	29.70	31.21	32.87	35.34	38.30	40.97
211	28.50	29.40	30.13				

vehicle	+0.6% 15	16	17	18	19	20	21
cycle	212	30.53					
213	30.61	32.40					
214	33.29	35.03	38.34	42.33			
215	30.81	33.62	35.15	36.95	38.16	40.13	43.07
216							
217							
218	28.46	30.72	31.83				
219							
220							
221							
222							
223							
224							
225							
226							
227	34.89	37.56					
228							
229							
230							
231							
232	30.51						
233							
234							
235	33.31						
236							
237	32.29						
238	31.94	34.51	36.18				
239							
240							
241							
242							
243							
244							
245	31.48	32.97					
246							
247	29.60	31.87	33.44	34.93	37.22	39.36	
248							
249							
250							
251							
252							
vehicle	15	16	17	18	19	20	21
no. of cycles	131	115	108	99	92	88	80

mean elapsed time	33.02	35.21	37.27	39.47	41.53	43.61	45.74

vehicle	+0.6% 22	23	24	25	26	27	28
cycle							
1							
2							
3							
4	50.40	51.87	52.93				
5							
6	46.02	49.57	51.79	53.27	55.29	57.18	58.59
7							
8	46.50	47.60	50.42	52.94	54.27	55.85	57.39
9	46.87						
10	47.71	49.77	51.68	53.81	55.53	58.01	59.81
11							
12	49.43	50.97	52.28	53.50	55.01	56.87	
13							
14	48.20	50.60	52.44	55.18	58.57	61.26	63.33
15							
16	47.77	49.53	51.58	55.08	56.50	59.57	60.81
17	45.65	47.26	48.35	50.14	51.17	52.42	53.70
18	53.84	55.52	56.64	59.30	60.99	62.17	64.40
19							
20							
21	47.12	50.74	51.99	53.09	55.76	58.07	60.15
22	49.40	51.61	54.07	56.29	58.41	60.97	
23	52.26	53.70	55.60	58.94	60.28	61.70	63.15
24	45.21	46.32	48.05	49.17	50.13	51.68	53.87
25	44.07	46.40	47.36	48.70	50.41	54.08	56.17
26	45.52	48.52	53.13				
27	50.55	53.57	56.33	58.96	61.27		
28	47.03	49.34	53.00				
29							
30	47.10	48.29	50.10	52.51	55.23	57.96	59.82
31	47.19	48.66	51.18	52.67	54.63	57.78	60.95
32	52.16	55.49	56.95	59.07	60.51	62.02	
33	48.44	49.87	53.04				
34							
35	51.20	53.24	54.81	56.44	58.99	60.47	63.30
36	43.12	44.14	46.03	47.02	49.02	51.54	53.30
37	41.80	43.70	44.80	46.26	48.40	49.55	50.83
38	48.71	51.27	53.41	55.84	58.52	60.07	63.31
39	50.32	52.27	53.74	56.70	58.40	63.69	65.50
40	54.50	56.30	58.21	60.07	61.97	63.84	65.30
41	46.22	47.62	49.39	50.24	59.04	61.45	63.27
42	58.42	59.84	60.93	63.67	65.74	67.51	
43	46.60	48.03	49.35	50.96	54.08	55.90	62.74

	+0.6%						
vehicle	22	23	24	25	26	27	28
cycle							
44	49.54	54.09	56.27	58.29	60.77	62.68	65.83
45	51.12	54.47	56.43	58.91	61.26	63.39	67.65
46	44.40	46.97	48.01	49.97	51.58	53.34	59.56
47	51.44	53.62	56.69	57.70	58.57	62.07	63.79
48	52.57	53.95	55.57	57.20	60.80	62.54	65.50
49	49.39	50.47	52.27	54.46	56.09	58.18	59.85
50	45.01	47.20	48.73	50.06	51.64	54.74	56.72
51	47.15	51.11	52.50	53.64	55.90	57.54	59.06
52	47.30	48.51	50.08	52.34	55.04	56.84	59.90
53	44.72	46.68	48.09	49.28	50.40	52.00	53.31
54	61.87	63.00	67.20				
55							
56							
57							
58							
59							
60	48.72	50.30	51.51				
61	48.29	50.39					
62							
63							
64							
65							
66							
67	47.65	48.64					
68							
69							
70							
71							
72							
73							
74	47.67	48.88	50.34	51.38	54.09	55.42	56.96
75	47.74	49.15	50.50	52.50	53.68	55.55	57.14
76	46.53	48.64	49.93	51.32	53.53	55.67	56.96
77	45.24	46.91	48.29	50.10	53.20	55.38	57.11
78	44.70	47.47	49.74	51.50	53.02	54.78	56.83
79	47.61	49.76	51.94	54.47	57.10	58.21	59.89
80	43.56	45.78	48.29	50.03	51.48	53.60	55.40
81	45.02	46.97	48.30	50.06	52.30	54.94	56.44
82	48.44	49.97	51.94	56.33	58.27	59.79	61.36
83	51.43	53.70	55.33	57.92	60.25	62.92	64.43
84							
85	44.96	47.46	49.79	51.93	53.47	55.21	56.97
86							
87	42.07	44.00	45.99	48.96			
88	44.66	46.28	48.32	50.16	51.77	52.91	54.35
89							
90							
91							

vehicle	+0.6% 22	23	24	25	26	27	28
cycle							
92							
93							
94							
95							
96							
97							
98							
99							
100							
101	49.94	48.91	49.56	51.41	52.69	54.34	55.35
102	48.32	49.76	51.30	54.22	56.20	58.43	59.71
103							
104	41.76	43.56	44.69	46.54	49.89	52.22	53.70
105							
106	46.41	47.99	50.04	51.14	53.94	56.08	57.01
107							
108							
109	47.41	48.55	51.39				
110							
111	44.40	45.72	47.55	48.64	53.45	55.23	56.90
112							
113	50.38	52.11	53.70	55.30	56.05	59.10	60.11
114							
115							
116							
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135							
136							
137							
138							
139							

vehicle	+0.6% 22	23	24	25	26	27	28
cycle							
140							
141							
142							
143							
144							
145							
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156	47.56	49.60	51.34	53.70	55.63	56.58	58.81
157	48.50	50.43	52.93	55.44	57.80	60.94	63.65
158							
159	48.86	50.60	52.90	53.92	55.77	57.45	58.68
160	49.70	51.99	53.17	55.52	57.11	59.01	60.50
161	42.58	43.96	44.87	46.02	48.00	49.43	51.01
162	53.33	54.64	56.23	58.44	59.87	63.66	64.89
163							
164							
165							
166							
167							
168							
169							
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187							

vehicle	+0.6% 22	23	24	25	26	27	28
cycle							
188							
189							
190							
191							
192							
193	54.04	55.74					
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209	41.74	43.26	45.43	46.47	49.87	51.64	54.74
210	43.03	44.67	48.80	51.14	53.29	54.94	51.24
211							
212							
213							
214							
215	45.09	46.91	48.74	50.30	52.11	53.69	55.92
216							
217							
218							
219							
220							
221							
222							
223							
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227							
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232							
233							
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235							

vehicle	+0.6% 22	23	24	25	26	27	28
cycle							
236							
237							
238							
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251							
252							

vehicle	22	23	24	25	26	27	28
no. of cycles	75	74	71	64	63	62	58
mean elapsed time	47.88	49.79	51.61	53.23	55.46	57.45	59.08

vehicle	+0.6% 29	30	31	32	33	34	35
cycle							
1							
2							
3							
4							
5							
6							
7							
8	59.08	62.36					
9							
10	61.10	62.46					
11							
12							
13							
14	64.72	66.64	68.40				
15							
16	63.79	67.53	68.64				

vehicle	+0.6% 29	30	31	32	33	34	35
cycle							
17	55.69	57.80	59.76	61.03	62.27		
18	65.81	67.42					
19							
20							
21	61.68						
22							
23							
24	55.67	58.29	60.70				
25	58.34	59.91	62.14				
26							
27							
28							
29							
30	60.97	62.17					
31							
32							
33							
34							
35	65.81	67.89					
36	55.57	57.28	58.83	60.88	62.45	63.82	64.97
37	52.73	55.88	56.95	56.42	60.97	62.72	66.15
38	65.52	68.00					
39	67.50						
40							
41	65.52	67.64					
42							
43	63.96	65.95	67.78				
44	68.36						
45							
46	62.38	63.60	66.93				
47	65.11	67.80					
48	68.17						
49	61.48	64.34	66.43	69.00			
50	59.02	60.58	61.97	64.04	67.22	68.69	
51	60.45	62.18	63.91	65.10	66.44	69.12	
52	64.14	65.50	66.74				
53	54.40	55.84					
54							
55							
56							
57							
58							
59							
60							
61							
62							
63							
64							

vehicle	+0.6% 29	30	31	32	33	34	35
cycle							
65							
66							
67							
68							
69							
70							
71							
72							
73							
74	60.67	63.18	64.73	66.04	68.03	69.87	
75	58.41	59.62	60.32	62.57	64.39		
76	58.83	60.53	62.24	63.44	65.03	66.46	68.62
77	59.05	61.62	63.27	64.98	66.01	67.27	
78	57.92	60.57	62.50	64.49	65.83	68.01	
79	62.99	64.61	66.60	68.25	69.80		
80	56.94	58.74	62.15	64.26	65.67	67.69	69.99
81	57.87	60.06	61.35	65.89	67.30		
82	63.16	65.38	66.99				
83							
84							
85	58.52	59.90	63.46	66.23			
86							
87							
88	58.23	60.40	61.70				
89							
90							
91							
92							
93							
94							
95							
96							
97							
98							
99							
100							
101	56.37	57.86	59.01	61.14			
102	61.96	64.30	66.26				
103							
104	54.97	56.48	60.39	61.94	64.44	66.96	
105							
106	58.99	61.29	62.49	64.66	65.80	67.46	
107							
108							
109							
110							
111	58.43	59.52	60.87	65.96	67.47	68.39	
112							

vehicle	+0.6% 29	30	31	32	33	34	35
cycle							
113							
114							
115							
116							
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156	62.34	65.57	66.89				
157	65.60	66.98	68.76				
158							
159	60.00	62.06	63.28	64.52	66.33	67.77	
160	61.49	62.73	63.77	65.04	67.05	68.66	

vehicle	+0.6% 29	30	31	32	33	34	35
cycle							
161	53.64	56.40	58.73	60.65	62.66	64.58	66.17
162	66.44	67.71					
163							
164							
165							
166							
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204							
205							
206							
207							
208							

+0.6%

vehicle	29	30	31	32	33	34	35
cycle							
209	57.22	59.40	60.23	62.84	64.94	67.10	
210	58.14	60.45	61.87	63.66	65.63		
211							
212							
213							
214							
215	57.64	59.29	60.48	61.89	63.13	65.26	66.10
216							
217							
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220							
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250							
251							
252							
vehicle	29	30	31	32	33	34	35

vehicle	+0.6% 29	30	31	32	33	34	35
no. of cycles	51	47	37	25	22	17	6
mean elapsed time	60.64	62.16	63.18	63.80	65.40	67.05	67.00

vehicle	1	2	3	4	5	6	7
cycle	+3.0%						
1	5.53	7.43	9.78	11.59	12.78	15.44	16.94
2	5.57	7.10	9.25	10.87	14.20	15.70	16.94
3	6.57	8.67	10.60	12.91	15.04	16.36	17.53
4	5.53	7.87	10.18	13.16	14.20	16.40	18.15
5	5.17	7.23	8.33	10.70	11.97	13.33	14.74
6	5.80	7.80	9.69	11.60	12.52	15.47	16.75
7	6.88	8.63	11.06	13.37	14.89	17.99	19.86
8	5.41	6.79	9.67	11.01	12.36	14.36	16.40
9	4.98	7.60	8.70	9.90	12.21	15.25	17.63
10	8.22	9.54	11.28	12.35	13.79	14.85	16.75
11	8.08	9.30	10.82	12.05	13.40	15.22	16.39
12	5.73	7.07	10.47	11.50	12.82	14.07	15.32
13	4.85	6.49	7.65	10.07	12.48	17.10	18.06
14	5.87	8.04	9.87	11.49	13.44	15.57	17.26
15	6.82	9.18	11.46	13.09	15.09	17.30	20.00
16	5.75	8.28	9.45	10.57	13.11	15.17	17.23
17	3.39	4.81	7.41	8.63	10.47	12.65	14.11
18	5.20	7.97	9.60	11.54	13.58	15.27	17.06
19	5.55	6.72	9.23	10.64	12.58	16.63	17.79
20	4.90	8.51	10.00	11.22	12.56	13.78	15.48
21	6.86	8.31	9.64	11.40	13.33	16.34	18.53
22	5.29	7.64	9.43	11.22	12.70	13.84	15.43
23	7.29	8.36	10.62	12.44	13.84	15.80	17.09
24	4.60	7.28	9.82	13.65	15.21	16.98	18.70
25	6.40	7.69	10.18	11.74	13.72	15.68	17.50
26	5.70	7.40	9.51	11.31	12.74	14.17	16.44
27	5.97	7.65	9.17	10.63	11.92	13.52	14.78
28	3.31	4.88	6.61	7.65	8.67	10.28	11.69
29	5.39	7.89	10.00	11.44	13.21	15.07	18.53
30	6.07	7.31	12.45	15.13	17.02	18.40	19.84
31	5.67	8.38	11.03	13.24	15.75	16.84	20.27
32	7.61	9.17	10.54	11.87	13.53	14.90	17.26
33	4.85	7.24	9.74	12.02	13.26	15.10	18.02
34	5.75	7.41	8.64	9.79	11.49	13.15	14.64
35	7.41	9.01	10.71	13.07	14.66	17.27	19.50

vehicle	1	2	3	4	5	6	7
cycle	+3.0%						
36	5.88	7.45	9.37	11.31	13.60	15.54	17.50
37	5.29	7.18	9.17	11.43	14.39	16.32	18.62
38	4.78	6.48	6.28	10.00	11.00	12.17	14.21
39	5.20	8.58	11.17	13.09	14.53	16.67	17.93
40	6.07	7.49	8.90	10.09	11.56	13.12	15.10
41	5.82	8.15	11.38	13.04	14.31	15.74	17.20
42	7.84	9.32	11.60	14.47	15.66	16.98	18.25
43	6.30	7.92	9.44	10.97	12.43	13.92	15.54
44	5.74	7.34	9.48	12.28	14.03	15.96	17.40
45	5.82	7.49	10.20	11.66	12.94	15.33	16.65
46	6.74	8.21	9.67	11.44	13.02	14.20	15.61
47	6.45	8.11	9.74	11.76	13.00	14.37	15.99
48	4.97	6.84	9.16	11.97	13.34	14.75	16.57
49	9.91	11.18	12.85	15.28	16.54	18.35	19.87
50	7.03	8.57	9.88	11.31	15.19	17.10	18.58
51	6.26	7.67	9.90	11.82	13.04	14.87	16.21
52	4.49	6.33	8.34	9.75	10.97	13.23	14.93
53	5.67	7.41	8.94	10.50	12.45	14.04	16.29
54	3.82	6.77	8.44	10.27	13.10	14.57	16.27
55	5.18	7.29	8.20	9.43	10.64	11.89	15.14
56	5.95	7.24	9.55	11.12	13.07	14.17	15.71
57	7.56	8.57	10.09	11.73	14.25	16.07	18.81
58	5.71	7.88	9.61	11.94	13.57	15.03	17.27
59	9.58	11.04	15.21	16.91	18.30	20.27	22.29
60	4.96	7.10	8.98	10.52	12.02	13.20	15.79
61	6.24	7.30	10.90	12.17	13.80	15.30	16.72
62	7.41	9.17	10.91	12.04	13.52	15.07	16.53
63	7.51	9.41	11.83	13.57	15.06	16.56	18.00
64	6.19	8.06	10.27	12.74	14.22	16.27	18.67
65	6.00	7.59	11.13	12.17	14.02	16.42	18.01
66	8.39	10.41	11.92	13.34	14.74	16.02	17.59
67	8.17	9.37	10.70	12.26	14.31	16.64	18.14
68	7.31	9.35	11.64	12.95	14.40	16.98	19.29
69	5.81	7.53	9.68	12.01	14.20	15.85	17.81
70	6.20	8.43	9.85	11.58	13.69	14.84	16.10
71	5.47	7.20	8.96	10.47	12.50	13.99	16.00
72	6.40	8.43	10.48	13.94	15.39	16.95	19.45
73	6.17	7.51	8.71	10.00	11.42	14.13	15.97
74	5.65	7.20	9.37	10.73	12.27	14.07	15.13
75	5.57	7.50	9.28	10.60	13.35	14.89	16.75
76	6.12	8.51	9.94	11.60	13.51	15.5	18.96
77	4.30	7.51	9.06	10.46	11.84	13.13	14.81
78	5.84	7.57	9.29	10.85	13.59	16.19	17.41
79	6.46	8.78	10.72	13.64	15.15	18.15	19.74
80	2.80	4.44	6.29	8.06	12.52	13.85	15.52
81	6.44	9.60	12.45	13.67	15.41	17.22	20.56
82	7.23	8.86	10.84	12.34	14.99	16.54	18.20
83	5.52	6.94	8.80	10.77	16.02	18.54	21.63
84	7.81	9.64	11.04	12.90	14.99	17.00	18.90

vehicle	1	2	3	4	5	6	7
cycle	+3.0%						
85	5.92	7.30	10.73	13.07	14.90	16.10	19.50
86	6.69	8.76	10.50	11.54	13.27	15.30	17.06
87	5.14	6.99	9.24	11.65	13.99	16.27	19.16
88	6.10	8.05	9.44	11.03	12.31	14.61	16.27
89	5.67	7.38	9.10	11.62	13.19	15.52	17.16
90	5.71	7.19	9.84	12.30	13.71	15.74	18.67
91	6.52	8.12	10.33	12.14	14.50	15.88	17.18
92	5.15	6.57	8.03	10.67	12.78	14.44	16.24
93	5.50	7.65	10.17	11.77	13.20	14.64	16.08
94	5.86	7.33	8.99	11.47	12.88	14.88	16.43
95	6.58	8.72	11.12	12.65	14.13	16.09	17.38
96	7.55	10.13	11.54	12.97	14.60	16.30	17.73
97	6.88	11.78	14.33	16.26	18.10	19.81	21.24
98	4.74	7.46	9.02	10.80	12.40	14.24	16.87
99	5.08	6.75	9.25	12.27	13.67	16.64	17.85
100	6.78	8.34	10.20	12.31	14.19	16.24	17.84
101	6.47	8.04	9.43	11.36	13.19	14.60	16.84
102	6.21	7.64	9.14	11.34	12.74	14.04	16.87
103	5.22	7.60	9.35	10.69	12.67	14.35	16.20
104	5.89	7.21	8.44	10.27	11.80	13.33	15.97
105	5.64	7.86	9.94	11.38	13.00	14.08	15.71
106	5.44	6.75	8.39	10.30	11.93	13.35	15.40
107	6.30	8.66	10.55	12.03	13.44	15.13	16.73
108	6.00	7.65	10.09	12.70	13.89	15.63	17.57
109	5.74	7.42	8.70	10.48	12.83	14.94	18.08
110	5.54	8.34	9.70	11.20	12.34	14.86	15.31
111	5.97	7.63	11.10	12.74	14.60	17.34	18.59
112	5.80	7.48	9.19	10.51	12.97	14.50	16.44
113	4.47	5.76	7.17	8.33	10.76	13.27	14.54
114	6.87	9.07	10.89	13.63	15.00	16.83	18.66
115	6.40	8.30	9.79	11.61	13.03	14.77	16.08
116	5.79	8.33	9.44	11.01	12.84	15.10	17.44
117	6.30	7.47	8.91	10.53	12.04	14.31	15.84
118	5.10	7.42	8.65	10.57	12.87	14.18	16.38
119	5.70	6.99	9.17	10.47	12.04	13.50	14.86
120	7.60	8.97	11.43	12.64	14.15	15.84	18.69
121	4.07	5.84	7.94	9.54	11.90	15.00	16.53
122	6.54	8.85	10.63	11.78	12.86	13.14	15.74
123	5.14	6.67	8.15	9.85	11.52	13.43	14.84
124	7.54	8.84	10.27	11.50	12.60	15.37	16.84
125	7.43	8.61	10.30	11.70	14.11	16.57	19.00
126	6.29	7.81	9.51	10.91	12.59	14.79	16.87
127	7.57	8.80	10.16	11.26	12.40	13.66	15.96
128	5.07	6.44	8.13	9.91	12.05	13.68	14.97
129	5.45	9.74	10.88	12.38	15.00	16.00	18.27
130	5.34	7.94	9.48	10.95	14.44	16.49	17.81
131	6.02	8.07	11.85	12.84	14.16	16.26	17.90
132	4.88	6.57	8.07	11.82	13.84	15.84	16.62
133	4.78	6.94	10.05	12.80	14.10	15.24	18.50

vehicle	1	2	3	4	5	6	7
cycle	+3.0%						
134	5.60	7.60	8.55	10.84	13.20	14.61	15.99
135	5.46	6.67	8.84	10.19	11.58	13.70	15.28
136	4.91	7.58	9.20	10.55	12.13	13.86	15.40
137	5.03	6.47	9.17	10.54	12.82	14.41	17.47
138	4.71	6.68	8.10	9.64	12.52	14.28	15.74
139	6.07	8.87	10.10	11.18	13.11	16.48	17.85
140	3.53	5.30	6.88	8.57	10.00	11.71	13.83
141	7.46	8.98	11.10	12.59	13.54	15.16	16.84
142	5.60	8.72	10.53	11.87	13.05	14.54	15.96
143	4.80	8.87	10.46	12.47	14.00	15.22	16.00
144	4.22	7.39	8.79	10.61	12.08	13.27	15.17
145	6.02	7.50	9.81	11.73	13.18	14.61	16.95
146	6.18	7.35	10.06	11.71	14.89	18.63	21.00
147	7.11	10.12	12.67	15.30	17.84	20.05	22.15
148	7.27	9.12	11.56	12.61	14.11	15.64	19.15
149	5.78	7.72	15.38	19.44	21.23	23.02	25.17
150	6.64	8.84	9.52	11.25	14.05	15.86	17.23
151	7.67	8.92	10.20	11.57	13.12	14.86	16.49
152	5.54	7.87	9.32	11.21	14.13	16.07	17.81
153	5.87	8.61	10.14	11.71	12.67	15.59	17.94
154	6.55	8.48	10.40	11.35	13.04	14.97	17.52
155	6.47	7.80	9.04	10.74	12.28	13.35	15.14
156	5.49	7.63	8.70	11.10	12.47	13.48	16.45
157	6.85	8.45	10.21	11.63	13.14	14.21	15.64
158	5.93	7.80	9.10	12.74	14.56	16.07	17.85
159	5.29	6.58	8.59	10.56	12.04	13.97	15.87
160	6.80	8.21	10.67	12.45	13.83	15.60	17.33
161	6.68	8.75	10.67	12.45	13.83	15.60	17.33
162	6.88	9.24	11.02	12.46	13.72	15.97	17.66
163	7.20	8.93	10.91	12.24	13.88	16.21	18.38
164	5.30	7.12	9.81	10.84	12.07	13.34	15.40
165	6.34	8.64	10.37	12.15	14.53	15.76	18.06
166	4.38	5.69	8.73	10.87	13.27	14.50	16.31
167	6.57	10.05	11.33	13.08	14.82	16.04	18.24
168	5.02	8.48	11.74	13.20	14.69	16.27	17.78
169	5.92	8.66	10.15	11.91	13.00	14.67	16.03
170	7.30	9.10	10.14	11.66	13.34	14.59	16.65
171	4.99	6.57	8.45	10.22	12.10	13.50	14.82
172	2.23	5.93	7.83	9.44	13.35	15.10	16.22
173	4.23	6.18	8.54	9.84	11.73	14.79	17.22
174	6.20	7.49	9.26	10.97	12.11	14.14	15.53
175	7.17	8.50	10.47	12.14	14.22	15.48	17.48
176	5.90	7.72	9.15	10.36	12.21	14.47	15.59
177	5.90	9.92	11.08	16.03	17.67	18.19	20.04
178	6.14	7.74	9.72	11.25	12.51	14.04	16.34
179	5.80	8.47	9.74	11.57	13.50	15.70	16.95
180	5.64	7.12	8.71	11.50	12.90	14.59	15.97
181	5.64	8.29	10.10	11.27	12.72	14.10	15.47
182	5.67	7.10	8.09	11.97	13.50	15.03	17.84

vehicle	1	2	3	4	5	6	7
cycle	+3.0%						
183	6.64	8.58	9.40	11.16	12.07	16.17	19.42
184	5.12	7.27	9.62	11.50	14.27	15.86	17.52
185	6.48	8.26	9.84	11.43	13.54	14.80	17.20
186	6.63	9.30	11.02	12.60	13.95	15.64	17.50
187	6.16	7.60	10.54	12.35	13.80	14.67	16.83
188	5.10	7.97	13.17	16.90	19.01		
189	5.69	7.80	9.12	16.50	19.86	21.60	23.00
190	5.34	6.61	7.84	10.05	12.45	14.98	16.69
191	5.43	7.00	8.55	10.47	12.26	14.60	16.63
192	5.30	6.38	7.30	9.07	11.14	13.01	14.39
193	3.77	6.50	7.74	9.53	11.07	13.15	15.39
194	5.21	7.61	8.81	9.90	12.00	14.78	16.44
195	5.33	7.54	11.24	12.57	13.93	15.33	17.04
196	4.56	6.23	7.74	9.50	12.16	13.75	15.10
197	8.14	10.17	11.73	13.50	15.68	17.29	19.14
198	5.75	8.54	10.20	12.97	14.44	15.72	17.10
199	12.67	14.04	15.17	17.04	18.06	21.07	22.45
200	7.56	8.80	10.11	12.21	14.56	15.61	19.00
201	5.81	7.73	10.03	12.08	14.24	15.75	17.32
202	8.20	9.81	11.76	13.08	14.82	16.07	19.53
203	5.19	7.35	9.49	11.34	12.75	13.92	16.78
204	5.44	6.90	8.91	10.26	11.98	14.11	15.59
205	4.97	6.07	7.50	8.93	11.14	12.42	13.85
206	4.77	5.98	8.14	10.77	13.67	15.48	16.92
207	5.47	7.43	8.82	10.98	12.97	15.04	17.49
208	6.47	7.52	9.70	11.85	13.63	14.98	16.24
209	6.33	7.40	8.94	10.60	12.12	13.70	15.00
210	6.34	7.82	10.07	11.74	13.49	14.95	16.50
211	6.35	7.93	9.06	11.30	12.88	15.06	16.23
212	7.18	9.08	10.85	13.55	15.40	16.72	18.20
213	6.74	8.30	9.70	11.47	12.97	14.71	16.78
214	5.17	8.30	9.48	12.03	14.09	16.00	17.29
215	5.52	8.14	9.84	11.64	13.04	14.67	16.57
216	6.73	8.10	9.92	12.52	13.57	15.51	17.38
217	6.20	8.57	10.91	12.11	14.25	17.00	18.34
218	4.95	7.44	9.72	12.27	14.01	15.17	16.77
219	6.94	8.96	10.84	12.07	13.94	16.72	18.04
220	7.54	9.17	10.90	12.88	14.30	16.00	18.22
221	5.20	8.20	10.34	11.65	13.13	14.99	17.07
222	6.47	8.04	10.29	12.40	13.74	15.45	17.58
223	5.24	7.41	10.23	11.99	13.30	15.23	16.74
224	7.61	9.27	11.34	13.10	14.87	16.44	19.74
225	6.40	8.49	9.84	11.21	12.37	14.50	16.07
226	6.07	7.41	9.36	10.75	12.76	14.52	15.89
227	6.87	8.17	9.77	11.75	13.12	15.61	17.26
228	6.15	7.73	9.41	11.05	12.97	14.98	16.24
229	8.26	9.67	12.57	15.08	17.07	18.51	20.97
230	5.02	6.60	8.69	11.35	12.64	14.12	15.54
231	6.35	7.97	9.51	11.21	12.70	14.30	15.70

vehicle	1	2	3	4	5	6	7
cycle	+3.0%						
232	6.40	8.54	10.63	11.85	13.45	14.90	17.07
233	5.73	8.04	10.73	12.20	13.51	15.49	17.72
234	4.57	6.15	8.25	9.60	11.52	13.87	15.94
235	5.83	8.64	9.80	11.74	13.53	15.54	18.20
236	4.74	6.71	8.44	10.33	11.80	13.50	15.27
237	5.27	6.79	9.05	11.10	14.42	16.47	18.20
238	4.91	7.60	9.27	11.43	12.84	15.34	17.14
239	6.90	8.54	9.99	12.14	14.34	15.75	16.53
240	6.20	7.81	9.24	11.28	13.16	15.29	16.57
241	7.15	8.46	9.89	12.42	13.56	15.40	17.52
242	8.98	9.97	11.40	13.03	15.69	17.23	18.86
243	6.81	8.24	9.89	12.74	14.33	16.16	17.40
244	5.91	7.51	9.94	12.04	14.12	17.04	18.47
245	6.20	8.71	10.65	12.92	14.81	15.97	17.91
246	5.94	7.94	10.23	11.67	12.84	14.88	15.80
247	6.29	7.40	10.03	11.69	13.29	15.11	16.31
248	6.19	8.19	9.53	11.50	13.94	16.04	18.01

vehicle	1	2	3	4	5	6	7
no. of cycles	248	248	248	248	248	247	247
mean elapsed time	6.01	7.93	9.86	11.72	13.51	15.32	17.17

vehicle	8	9	10	11	12	13	14
cycle							
1	18.82	20.90	22.56				
2	18.01	21.12	23.76				
3	19.42	20.78	21.86	23.86	26.32	27.36	29.00
4	21.69	24.13	26.27				
5	16.51	17.71	20.04	21.94	22.37	24.20	28.14
6	18.21	19.55	20.63	21.49	24.55	26.64	27.67
7	22.05	23.28	24.90	25.83	27.10	28.61	29.78
8	17.64	20.70	21.95	24.48	26.29	27.59	28.51
9	19.67	21.26	23.78	25.13	26.77	27.91	29.36
10	18.35	21.10	22.35	24.22	25.59	26.90	28.40
11	17.82	20.10	21.43	24.00	26.10	27.34	29.04
12	17.14	19.51	22.10	23.52	24.89	25.96	27.95
13	19.64	20.89	23.03	24.79	26.03	27.70	30.17
14	19.55	21.17	22.14	23.94			
15	27.39	23.34	25.61	27.31	28.94	31.02	32.64

vehicle	8	9	10	11	12	13	14
cycle							
16	18.59	19.71	21.75	23.07	25.10	27.76	29.51
17	15.70	17.84	21.78	23.00	24.17	25.87	27.30
18	18.39	20.99	23.01	24.80	27.07	28.37	29.60
19	19.38	21.44	23.61	24.88	26.27	27.90	29.88
20	18.10	19.64	21.50	22.56	24.80	26.45	28.29
21	19.89	21.74	22.87	24.76	25.74	29.04	30.77
22	17.24	18.74	20.35	22.00	24.88	26.43	
23	18.73	20.16					
24	20.34	21.90	23.91	26.03	28.02	29.34	31.47
25	20.88	23.42	24.60	25.84	27.26	28.69	29.87
26	17.87	19.90	22.58	23.94			
27	16.32	17.90	19.63	21.08	22.07	24.41	26.60
28	15.08	17.00					
29	20.03	21.22	22.91	26.21	27.67	29.37	30.78
30	21.47	22.70	24.85	27.07	28.50	29.73	32.84
31	21.79	22.92	26.15	27.58	29.30	31.96	
32	19.20	21.57	23.20	25.29	26.91	28.81	
33	19.27	20.54	21.68	23.36	24.72	27.36	28.82
34	16.86	18.40	20.67	22.05	24.27		
35	22.27	24.84	27.03	29.77	31.24	33.35	35.47
36	19.45	20.96	22.04	23.88	25.36	27.72	28.67
37	20.09	21.70	23.74	24.94	26.39	27.64	28.70
38	16.33	17.69	19.14	21.32	22.76	24.87	28.21
39	19.36	21.11	23.26	24.79	26.27	27.54	28.70
40	17.24	18.69	21.52	23.00	25.00	26.88	28.57
41	18.19	21.12	21.96	23.12	24.81	26.44	27.86
42	20.30	21.57	23.53	24.99	29.94	32.72	
43	18.12	19.10	20.19	22.67	24.88	26.38	28.36
44	19.06	20.94	22.89	24.28	25.89	27.60	29.27
45	17.98	19.56	21.29	22.46	25.34	26.74	28.80
46	16.94	20.07	23.27	25.18	27.56	28.91	30.57
47	17.12	18.91	20.66	22.71	24.20	25.14	28.31
48	17.86	19.24	20.80	22.62	24.27	25.68	27.74
49	21.63	23.32	24.73	25.97	27.54	28.45	30.29
50	20.34	22.02	23.76	24.94	26.65	28.07	29.26
51	17.82	19.14	20.27	23.00	24.40	25.92	27.70
52	17.94	19.08	20.35	22.04	23.44	25.26	26.92
53	18.03	20.40	21.86	24.07	25.85	27.19	28.30
54	18.07	22.17					
55	16.57	18.43	20.50	23.14	24.90	27.72	28.70
56	17.10	19.66	20.87	22.25	23.80	25.90	28.75
57	20.88	22.31	23.84	27.37	28.94	30.25	31.84
58	18.90	20.27	22.34	23.85	25.50	27.22	28.98
59	24.03	25.51	27.27	28.50	31.78	33.47	35.47
60	18.65	21.08	22.84	24.80			
61	18.24	19.83	21.22	23.79	26.10	27.88	30.16
62	18.10	20.52	22.05	23.40	25.56	28.84	30.36
63	19.44	21.03	23.51	25.17	26.83	28.78	30.38
64	20.34	22.57	23.93	25.40	27.04	28.64	31.52

vehicle	8	9	10	11	12	13	14
cycle							
65	20.24	21.80	23.07	24.32	25.38	27.09	29.47
66	18.88	20.30	22.16	24.03	25.16	26.63	28.27
67	19.58	21.09	23.73	25.28	27.44	28.99	31.90
68	20.47	22.17	23.14	25.92	27.20	28.97	30.35
69	20.19	21.86	23.44	25.36	26.59	28.17	29.83
70	18.44	19.85	23.10	25.13	27.50	28.46	30.17
71	17.35	18.90	20.50	21.65	23.23	25.23	26.34
72	22.01	23.75	26.05	27.51	28.74	29.93	32.86
73	17.85	19.36	20.97	21.81	25.00	26.46	28.01
74	16.63	18.09	20.21	21.36	23.30	25.41	26.83
75	18.00	19.00	20.45	21.84	24.00		
76							
77	16.25	18.02	20.98	22.68	25.10	27.14	28.45
78	18.94	20.30	21.94	24.07	26.16	27.59	30.54
79	21.94	24.21	25.37	27.27	29.24	30.83	32.02
80	17.74	19.07	20.42				
81	23.09	26.50					
82	20.10	21.72					
83							
84							
85	20.84	21.86	24.13	26.47	28.60	31.84	34.87
86	18.27	20.28	22.18	23.58	24.85	26.34	27.44
87	21.60	24.17	28.15	29.85	31.30	32.89	34.03
88	18.83	20.46	22.63	23.87	26.02	27.31	29.19
89	18.54	20.54	21.70	23.68	25.10	27.14	28.30
90	20.11	21.85	24.24	26.42	28.09	29.90	31.90
91	19.37	23.94	26.85				
92	17.48	18.36	19.47	20.92	22.63	26.19	
93	19.18	20.35	21.94	23.68	27.00	29.07	31.65
94	18.35	21.44	23.18	24.22	26.50	29.05	31.04
95	18.95	21.04	22.39	24.23	26.13	27.56	28.97
96	19.75	20.97	22.13	24.33	25.97	27.82	30.54
97	22.82	25.34	26.76	28.30			
98	18.24	19.36	21.30	23.20	24.73	26.52	27.99
99	19.50	21.95	23.14	25.43	26.46	28.76	30.16
100	19.20	21.04	23.03	24.70	26.71	29.04	30.54
101	18.50	20.65	22.08	23.60	24.97	26.50	28.66
102	18.59	21.34	25.30	28.32			
103	18.07	20.06	21.56	23.17	24.85	26.36	27.77
104	17.45	18.53	20.04	21.76	24.14	25.22	28.07
105	18.17	19.70	20.82	22.57	23.84	24.78	26.60
106	16.99	19.74	21.50				
107	18.71	20.75					
108	20.80	22.73	24.57				
109	20.03	21.54	22.83	24.74	26.89	28.06	29.54
110	17.11	18.46	20.41	21.93	22.96	24.31	25.71
111	19.99	21.86	24.27	26.60	27.94		
112	17.94	19.89	21.62	23.24	25.17	27.86	29.37
113	15.54	17.33	18.99	20.80	23.12	24.20	25.90

vehicle	8	9	10	11	12	13	14
cycle							
163	20.08	21.78	23.45	26.40	27.89	29.41	31.00
164	16.56	17.95	21.58	23.50	24.64	27.44	29.36
165	20.42	21.89	24.51				
166	17.95	19.71	20.70	21.95	23.27	25.72	27.67
167	19.67	21.05	23.74	25.07			
168	19.60	20.95	23.35	25.45			
169	19.66	21.30	22.81	23.94	25.62	26.71	29.46
170	17.83	19.89	22.00	24.17	25.60	26.96	28.27
171	17.22	18.69	20.07	21.24	22.31	23.84	25.04
172	17.61	18.62	19.74	21.73	23.81	25.55	27.39
173	18.49	20.10	21.15	23.55	24.61	26.74	28.28
174	17.21	18.62	19.91	21.19	22.42	23.80	26.47
175	19.55	21.11	23.15	24.94	26.24	28.27	29.72
176	17.03	19.20	22.49	25.00	27.86	29.34	31.23
177	21.57	24.08	25.28	26.81	29.07	31.29	
178	17.51	19.86	23.02	24.28	26.36	28.87	30.61
179	18.79	19.80	22.57	25.00	26.98	29.38	31.12
180	17.14	19.02	20.42	23.04	24.60	26.57	27.87
181	18.09	20.03	21.34	23.31	25.24	26.16	27.60
182	20.08	21.45	22.85	25.18	27.24		
183	21.27	23.39	25.03	26.96	28.67	29.96	32.92
184	18.92	21.61	22.74				
185	18.84	20.74	22.42	24.16	29.50		
186	19.24	20.63	23.34	26.73	27.88	29.89	31.96
187	20.46	21.97	23.25				
188							
189	24.71	26.26	27.58	28.99			
190	18.97	21.06	24.66	27.36	28.92	30.20	31.40
191	19.35	22.81	24.03	25.44	27.05	28.72	29.82
192	16.65	18.11	19.28	20.70	22.82	25.27	27.05
193	16.77	18.16	20.73	23.28			
194	18.40						
195	18.72						
196	16.22	18.59	21.26	22.60			
197	20.40	21.84	23.26	25.86	28.60	30.08	31.97
198	18.43	19.87	21.21	24.06	25.59	27.53	29.41
199	24.34	25.38	27.41	29.49	31.32	32.64	35.01
200	20.62	22.47	23.64	25.06	26.16	28.01	29.89
201	18.78	19.96	21.61	23.15	25.27	26.41	
202	22.59	23.65	25.00	26.76	28.00	29.64	31.44
203	18.45	21.16	23.08	24.78	26.24	27.97	28.85
204	17.50	19.17	20.40	22.62	23.61	24.84	27.03
205	15.04	16.95	19.15	20.80	22.65	24.16	26.81
206	18.30						
207	19.98	21.37	22.76	24.04	25.84	26.85	28.50
208	17.97	19.72	21.36	22.86	24.80	25.97	27.64
209	16.65	20.04					
210	19.02	20.68	22.10	24.67	26.37		
211	17.54	19.00	20.14	21.07	22.63	24.03	27.60

vehicle	8	9	10	11	12	13	14
cycle							
114	19.88	22.76	24.48	26.14	27.80	30.75	33.07
115	17.27	18.42	20.51	21.97	23.23	24.38	25.50
116	18.42	20.72	21.73	22.86	24.42	26.06	27.20
117	17.57	19.27	20.65	21.84	22.77	24.00	25.44
118	17.95	19.28	20.44	22.39	23.66	25.23	26.72
119	16.61	18.54	21.94	24.47	25.65	27.47	28.36
120	20.62	23.59	26.00	28.48	30.85	32.84	34.84
121	17.99	19.67	21.14	22.95	25.44	27.34	29.83
122	17.36	18.54	20.33	21.72	23.73	26.34	27.79
123	15.89	17.50	20.69	21.80	23.66	25.62	27.55
124	18.59	20.17	21.74	23.01	24.90	26.07	28.12
125							
126	18.44	19.49	21.05	22.31	23.54		
127	17.15	18.20	20.34	22.78	25.34		
128	17.09	20.09	22.08	23.82	25.24	26.75	28.18
129	19.57	21.74	23.44	24.95	25.85	27.04	28.44
130	19.35	21.60	23.81	25.14	26.65	27.81	29.02
131	18.95	20.52	21.75	23.18	25.43	26.35	28.14
132	17.93	19.94	21.80	23.08	24.78	26.70	28.96
133	19.80	21.03	22.96	24.41	26.53	28.10	30.10
134	16.99	19.17	20.49	21.77	23.58	24.72	26.05
135	16.59	18.16	19.50	20.94	22.84	24.17	26.66
136	16.89	18.30	20.19				
137	19.29	22.20	24.42				
138	17.18	18.87					
139	19.64	21.17	22.36	24.83			
140	15.71	17.42	20.28	22.34	23.66	25.09	26.42
141	18.53	20.72	22.87	24.54	25.98		
142	17.50	19.61	21.42	23.48	25.66	27.41	28.80
143	17.49	19.17	20.97	22.42	25.00	26.93	28.52
144	16.91	18.23	20.03	21.04	23.26		
145	18.49	19.96	21.44	22.64	24.95	26.85	28.78
146	22.40	23.73	25.56	27.03	28.24	30.13	32.17
147	23.17	24.70	26.29	29.09	30.64	32.95	
148	21.81	23.10	24.65	25.60	26.79	28.04	30.17
149	26.85	29.49	31.54	34.85	36.00	38.05	39.56
150	19.04	20.27	21.97	23.27	24.65	26.17	27.32
151	17.37	19.07	20.61	22.76	24.17	25.93	
152	18.97	20.75	22.60	25.82	27.79	29.68	
153	19.97	22.53	24.07	25.25	27.61	29.10	30.67
154	19.17	20.34	22.02	23.47	25.10	26.94	28.37
155	16.74	20.34	21.47	23.54	25.57	26.95	28.66
156	17.64	19.47	21.65	24.53			
157	16.57	18.16	20.36	21.50	22.88	24.53	26.07
158	19.38	20.93	22.96	24.69	26.61		
159	18.40	19.73	21.29	25.03	27.79	29.65	31.65
160	19.42	21.02	22.13	23.67	25.81	27.80	31.18
161	19.42	21.02	22.13	23.67	25.81	27.80	29.77
162	19.51	21.55	23.24	24.72	26.13	27.35	

vehicle	8	9	10	11	12	13	14
cycle							
212	19.45	22.15	24.56	25.88	27.30	28.74	29.80
213	18.44	19.70	21.88	23.70	25.07	26.60	28.14
214	18.82	19.89	20.99	22.78	24.10	26.75	28.77
215	18.70	20.25	22.50	23.83	24.94	27.10	
216	19.44	21.26	23.53	25.85			
217	19.46	21.54	23.52	25.20	24.49	31.22	32.62
218	18.54	20.31	22.09	23.99	25.17	26.50	
219	19.90						
220	19.84	21.36	24.32				
221	18.79						
222	18.66	20.35	22.00	24.07	26.64	28.79	30.40
223	17.19	19.06	20.88	21.00			
224	20.84	22.71	24.60				
225	17.70	19.83	21.30	23.57	24.67	25.19	27.84
226	17.66	18.92	20.60	22.17	24.53	25.62	27.03
227	18.50	20.35	21.89	23.14	24.69	26.57	29.51
228	17.76	19.20	20.60	22.00	23.00	24.19	25.58
229	23.91	25.51	29.02				
230	16.91	18.54	21.49	24.32	25.83	27.48	28.56
231	17.09	18.75	20.62	23.04	24.52	25.66	26.52
232	18.71	20.50	22.06	24.04	25.87	27.60	29.42
233	18.61	20.19	21.41	23.33	24.78	26.68	27.60
234	17.47	18.99	21.32	23.04	24.24	26.04	27.55
235	19.19	21.30	22.67	24.43	28.79	27.53	29.35
236	16.65	19.50	21.66	23.30	24.50	26.34	28.77
237	19.42	22.85	24.24	26.47	28.60	29.77	31.32
238	18.81	21.21	22.62	23.97	25.54	27.56	29.45
239	17.65	20.84	22.62	24.03	26.74	28.50	30.08
240	18.63	20.83	22.13	24.37	25.61	27.88	
241	19.40	20.99	22.60	23.17	25.19	26.54	27.30
242	20.00	22.14	23.71	25.16	28.81		
243	18.86	20.94	23.17	25.41	26.71	28.23	29.38
244	20.20	21.60	23.53	24.78	26.71	29.27	30.95
245	19.73	20.82	22.10	23.90			
246	17.14	20.41	22.09	23.08	24.38	25.20	26.92
247	17.87	19.86	22.17	23.72			
248	19.67	22.57	25.21				

vehicle	8	9	10	11	12	13	14
no. of cycles	243	238	230	214	198	186	172
mean elapsed time	18.87	20.68	22.51	24.17	25.88	27.60	29.28

vehicle	15	16	17	18	19	20	21
cycle	+3.0%						
1							
2							
3	30.37	31.50	32.69	34.08	35.54	36.60	38.07
4							
5	30.60	32.23					
6							
7	32.50	33.73	35.38	36.33			
8	30.21						
9	31.07	32.60	33.46				
10	30.47	32.67	34.48	36.09	38.40	40.12	
11	30.04	31.58	33.03	34.83	36.37	37.92	39.67
12	31.37	32.67	34.04	36.40	37.71		
13	32.39	34.70	36.27				
14							
15							
16	31.08	33.00	34.14	36.57	38.53	40.36	41.62
17	28.42	29.56	30.68	31.98	33.17	34.43	
18							
19							
20	29.75	31.25	32.50	33.57	35.59	37.67	39.58
21	32.44						
22							
23							
24							
25	31.46	33.33	35.10	37.48	40.62	41.59	43.84
26							
27	28.64						
28							
29	32.13	33.81	35.40	37.40	38.03	40.75	42.05
30							
31							
32							
33	30.74	33.97	35.35	37.04	38.54		
34							
35							
36	30.19	33.05	34.56	36.26	38.14		
37	30.80	31.62	33.64	34.98	36.54	37.87	39.84
38	29.46	31.03	32.62				
39	30.97	33.04	34.56	36.74	37.99	39.47	
40	30.07	31.64	33.19	34.47	36.06		
41	32.76	35.52					
42							
43	29.66						
44	32.46						
45	30.81	32.90	34.12	35.84	37.95		
46	32.71	35.00	37.11				

vehicle	15	16	17	18	19	20	21
cycle	+3.0%						
47	29.45	30.96	33.16	35.36	36.62	37.68	38.67
48	30.17	32.97	34.60	37.15	37.99	39.23	40.77
49							
50	30.90	32.82	35.12	36.39	37.66	39.00	40.06
51	28.82	29.91	31.59	34.25	36.25	38.27	39.81
52	27.64	29.04	31.12	32.98	34.50	35.60	37.24
53	31.87	32.92					
54							
55	30.43						
56	30.36	31.74	33.44	36.40	38.07	39.78	41.30
57	33.39	36.02	37.56	39.04	40.07	41.70	45.16
58	30.34	32.04	33.21	35.14	36.64	38.67	40.20
59	36.92	39.23	41.11	42.84	44.58	45.82	47.67
60							
61	32.55	33.63	35.30	38.62	40.07	42.45	46.00
62	32.06	33.87	35.20	36.27	38.88	40.02	41.64
63	31.54						
64							
65	31.10	32.70	34.03	36.04	37.94		
66	29.94	31.71	33.79	36.00	37.54		
67	33.90	35.74	37.30	39.01	40.46	42.23	43.86
68	32.17						
69	30.99	33.10	34.57	35.88	37.48	39.20	41.50
70	36.29	37.58	40.01	42.44	44.17	47.45	
71							
72							
73	29.44	32.04	33.49				
74							
75							
76							
77	29.80	31.55	33.75	35.44	36.89	38.17	
78							
79	35.20	38.45					
80							
81							
82							
83							
84							
85	36.50						
86	28.79	30.74	32.04				
87	36.00	37.79	39.14	41.64	43.36	46.44	49.20
88							
89	31.00	32.66					
90	33.73	35.15	36.80	38.31	40.00	41.84	43.10
91							
92							
93							
94	33.50						
95	30.44	33.25	34.75	37.56	39.40		

vehicle	15	16	17	18	19	20	21
cycle	+3.0%						
96	31.71	33.20	34.84	36.20	38.11	39.61	40.94
97							
98	29.95	31.11	32.43	33.87	35.47	37.70	38.64
99	32.22	33.95	35.90	38.14	39.57		
100							
101	30.49	32.20	33.89	34.27	36.73	38.07	40.57
102							
103	28.99	29.06	31.47				
104	30.41						
105	29.72	30.63	33.74	34.72	35.84		
106							
107							
108							
109	31.55	33.20	34.30	35.96	37.24	39.00	41.72
110	26.80	28.66	30.07	31.94	33.04	34.46	36.65
111							
112	32.04	33.56	35.19	37.14	38.79	40.30	41.97
113	27.14	29.60	31.64				
114	34.59	35.97	37.21	39.25	40.60	42.25	43.94
115	28.00	30.45	31.60	34.53	35.53	36.89	38.17
116	28.29	30.29	31.29	32.87	34.26	35.57	
117	26.32						
118	29.21	31.14					
119	29.82						
120							
121	31.70						
122	29.44	30.92	32.50	34.52	36.42		
123	29.09	30.90	31.78	34.24	35.40	37.74	39.84
124	30.75						
125							
126							
127							
128	30.24	31.67	33.43	35.66			
129	29.99	31.51	34.34	36.22	38.59	39.91	41.32
130	31.30	32.52	34.66				
131	30.34	32.20	33.63	35.97	37.94	39.76	41.77
132	31.01	32.47	33.98				
133	32.19	33.91					
134	27.31	28.95	30.96	34.81	36.34	37.69	
135	28.94						
136							
137							
138							
139							
140	29.16						
141							
142	30.05	31.21	32.59	33.04	35.76	36.59	38.00
143							
144							

vehicle	15	16	17	18	19	20	21
cycle	+3.0%						
145	31.92						
146	33.92						
147							
148	31.78	33.70	35.79	37.07	38.53		
149	41.03						
150	29.00	30.54					
151							
152							
153	31.92	33.30	35.16	36.64	38.60	39.60	40.97
154	29.91	32.18					
155	29.98						
156							
157	28.13	29.60	31.90	33.14			
158							
159	33.95	35.36	37.48				
160	33.09						
161							
162							
163	32.32	33.40	34.60				
164	31.00	32.54	34.62	35.70	37.27		
165							
166	29.84	31.27	32.19	33.97	36.23	38.29	40.00
167							
168							
169	31.60	33.01					
170							
171	26.59	28.05	30.06				
172	28.58	30.43	31.72	33.13	34.97	36.24	37.05
173	29.54	30.42	32.01	33.77	35.23	36.69	
174	29.77	31.29					
175	31.85	33.25	35.89	37.17	38.74	40.14	41.90
176	33.67	35.56					
177							
178	32.53	34.18	35.74				
179	32.75	34.20					
180	29.56	30.35	31.42	34.14	35.78	37.28	39.13
181	29.76	32.03					
182							
183	34.28	36.33	38.54				
184							
185							
186	33.44	35.48	37.26	38.81	40.00	41.86	43.45
187							
188							
189							
190							
191	31.10	33.06	35.71				
192	28.03	30.70	31.87	33.64	35.12		
193							

vehicle	15	16	17	18	19	20	21
cycle	+3.0%						
194							
195							
196							
197	34.00						
198	31.61	34.36	36.66	39.21	42.26		
199	36.45	38.45	39.66	41.07	42.53	44.17	45.44
200	32.45	33.89					
201							
202	32.74	35.21	37.22				
203	30.68	32.14	34.35	36.35	38.01	39.10	41.80
204	31.10	32.57	33.78	35.19	37.08	38.28	39.40
205	28.32	29.36	31.50	32.78	35.13		
206							
207	29.88	30.94	32.39	33.84	35.24		
208	29.54	31.68					
209							
210							
211	29.22	30.47	31.42	32.67	35.07	37.17	
212							
213							
214							
215							
216							
217	33.74	35.06	36.82	37.90	39.22	41.07	42.39
218							
219							
220							
221							
222	31.67	33.11	35.98				
223							
224							
225	29.77	30.74	33.82	35.07	36.29	37.50	38.91
226	28.55	30.68	32.64	34.29	35.38	37.57	39.59
227	30.57	32.08	33.72				
228	26.94						
229							
230	30.10	31.28	33.78	35.67			
231	27.73	29.76					
232							
233	29.31	31.00	32.75				
234	29.21	30.81					
235							
236							
237							
238							
239	31.47	33.62					
240							
241	29.56	31.04	32.46	34.07	35.88	37.17	38.89
242							

vehicle	15	16	17	18	19	20	21
cycle	+3.0%						
243	30.98	32.56	33.79	35.52	37.60	39.74	41.24
244	32.08	34.19					
245							
246							
247							
248							

vehicle	15	16	17	18	19	20	21
no. of cycles	142	118	98	78	74	57	48
mean elapsed time	30.96	32.56	34.18	35.91	37.62	39.26	41.14

vehicle	22	23	24	25	26	27	28
cycle	+3.0%						
1							
2							
3	39.35	40.99	42.21	44.90	45.96	47.17	48.48
4							
5							
6							
7							
8							
9							
10							
11	41.14	42.97	44.87	46.40	47.66	49.70	51.33
12							
13							
14							
15							
16	43.32	45.03	46.27				
17							
18							
19							
20	41.31	42.56	43.84	45.38	46.80	48.16	51.54
21							
22							
23							
24							
25							
26							
27							
28							

vehicle	22	23	24	25	26	27	28
cycle		+3.0%					
29							
30							
31							
32							
33							
34							
35							
36							
37	40.09	42.40	44.08				
38							
39							
40							
41							
42							
43							
44							
45							
46							
47							
48	42.55						
49							
50	41.59						
51	41.00	43.27					
52	39.90						
53							
54							
55							
56	42.79	44.67	46.44	48.10	49.50	51.47	53.00
57	46.47	47.57	49.44	51.47	53.49	54.56	56.21
58	41.78	43.75	46.69				
59	49.54	51.14	52.65	55.24	57.10	58.71	
60							
61	47.20	48.84	50.75				
62							
63							
64							
65							
66							
67	45.25	47.74	49.04	51.36			
68							
69							
70							
71							
72							
73							
74							
75							
76							
77							

vehicle	22	23	24	25	26	27	28
cycle		+3.0%					
78							
79							
80							
81							
82							
83							
84							
85							
86							
87	50.40	51.98					
88							
89							
90	45.02	47.59					
91							
92							
93							
94							
95							
96	42.11	43.60	44.71	46.01			
97							
98	41.42	43.01	44.74	46.15			
99							
100							
101	42.20	43.87					
102							
103							
104							
105							
106							
107							
108							
109							
110							
111							
112	43.61						
113							
114	45.10	46.81	49.33				
115	42.53	44.01	45.87	47.15	48.90	50.34	52.22
116							
117							
118							
119							
120							
121							
122							
123							
124							
125							
126							

vehicle	22	23	24	25	26	27	28
cycle		+3.0%					
127							
128							
129							
130							
131	43.48	45.74	47.34	49.87	51.16	53.68	
132							
133							
134							
135							
136							
137							
138							
139							
140							
141							
142	39.18	40.72	42.16	45.57	47.44	48.59	50.35
143							
144							
145							
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172	38.21	40.77	42.11	43.84	45.91	46.50	
173							
174							
175	43.12	44.57	45.45	47.07	48.01	49.94	52.10

vehicle	22	23	24	25	26	27	28
cycle		+3.0%					
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199	48.00	50.19	51.90	53.23	56.03	57.77	58.92
200							
201							
202							
203	42.90	44.14	46.72	48.56	50.33	51.72	54.92
204	40.84	44.04	46.54				
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217	43.70	45.33	46.71	47.67	49.62	50.17	53.01
218							
219							
220							
221							
222							
223							
224							

vehicle	22	23	24	25	26	27	28
cycle		+3.0%					
225							
226	41.07	43.00					
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							
241	40.45	42.61					
242							
243	42.47	44.64	46.26	48.03			
244							
245							
246							
247							
248							

vehicle	22	23	24	25	26	27	28
no. of cycles	34	30	24	18	14	14	11
mean elapsed time	42.91	44.92	46.51	48.11	49.85	51.32	52.92

-3.0%

vehicle	1	2	3	4	5	6	7
cycle							
1	5.46	7.89	9.78	11.21	15.26	17.62	20.06
2	4.54	7.76	8.93	11.50	13.20	15.97	
3	3.47	7.16	9.32	10.60	12.58	15.87	19.35
4	6.97	8.25	10.94	12.52	16.09	18.57	20.09
5	6.44	8.24	9.60	10.96			
6	6.29	8.87	10.57	12.03	14.53		
7	5.17	6.48	9.56	11.87	13.71	16.14	19.15
8	5.17	7.60	9.75	11.25	13.41	15.13	17.02

-3.0% vehicle	1	2	3	4	5	6	7
cycle							
9	6.63	8.07	10.67	12.74	13.86	16.50	18.66
10	6.73	8.97	10.57	12.63	14.93	17.46	19.56
11	2.52	5.24	7.80	9.38	10.94	12.34	14.16
12	5.14	6.13	7.85	9.07	11.00	12.60	14.13
13	4.66	6.50	9.17	12.16	13.82	15.47	17.13
14	6.05	7.54	11.00	12.21	14.72	16.51	18.24
15	4.51	6.41	8.91	10.76	12.37	14.57	16.46
16	5.24	8.07	10.83	12.16	14.16	16.02	17.32
17	6.30	9.03	11.48	13.21	14.83	16.44	17.90
18	3.66	6.40	8.24	9.55	10.94	12.50	14.04
19	6.48	8.00	10.09	12.32	13.53	14.99	17.09
20	5.82	7.44	9.54	11.08	12.57	14.82	16.37
21	5.85	8.08	10.34	12.08	14.68	16.28	17.45
22	6.64	8.80	10.20	11.81	13.42	15.04	16.75
23	3.35	4.60	7.24	8.83	11.80	13.74	15.92
24	6.88	8.19	9.79	11.17	13.58	15.42	17.55
25	4.25	8.01	9.83	12.54	14.45	16.15	17.57
26	6.87	8.67	10.23	11.69	13.40	15.27	16.70
27	5.47	8.60	10.64	12.10	13.72	15.54	16.84
28	4.89	7.77	10.09	12.02	13.71	15.69	17.20
29	5.64	7.47	9.34	10.94	12.54	14.50	15.96
30	5.14	7.20	8.81	10.55	13.49	15.49	17.18
31	5.19	7.07	8.87	10.44	12.63	14.47	16.07
32	5.04	8.43	10.71	12.43	14.45	16.87	18.74
33	5.15	7.43	8.99	10.53	12.42	13.89	16.14
34	5.37	7.10	8.99	10.05	12.16	13.89	15.38
35	4.54	7.61	9.07	11.59	13.55	15.83	17.71
36	7.93	10.16	12.00	13.74	15.50	18.33	20.83
37	5.47	7.46	9.44	12.37	14.24	17.09	19.64
38	5.40	6.81	8.60	10.89	13.20	14.96	16.51
39	4.08	5.46	7.43	10.07	12.40	14.12	16.06
40	6.04	7.62	9.14	11.72	13.71	15.61	17.77
41	5.47	6.80	10.21	11.42	13.63	15.44	17.40
42	4.07	6.46	7.99	11.47			
43	5.26	7.06	9.43	11.28			
44	5.10	6.28	8.67	10.21	11.86		
45	5.79	7.20	9.24	10.46	11.89	14.88	16.17
46	5.77	7.74	12.77				
47	5.22	7.93	9.98				
48	4.83	7.30	9.21	12.50			
49	5.24	6.87	8.81	10.49	12.27	13.95	15.36
50	3.73	5.87	7.70	8.90	10.76	13.09	14.30
51	6.78	8.92	10.97	13.77	14.94	16.43	18.13
52	7.71	9.15	11.48	13.42	15.31	16.86	18.40
53	4.96	6.91	8.59	10.24	11.91	13.34	15.10
54	4.84	7.17	8.81	11.01	12.00	13.89	15.72
55	3.93	5.14	7.60	9.18	11.45	13.44	15.81
56	5.32	7.42	9.01	11.95	13.79	15.50	17.50

-3.0%

vehicle	1	2	3	4	5	6	7
cycle							
57	4.38	5.44	6.41	10.70	12.70	14.00	15.84
58	6.17	8.09	9.67	10.97	12.97	14.38	15.65
59	4.09	6.74	7.73	9.31	11.37	12.63	14.48
60	5.80	7.66	9.86	11.24	13.24	14.61	16.48
61	5.68	7.28	8.77	11.17	13.41	14.60	15.67
62	4.32	7.10	9.52	11.10	12.30	14.42	16.08
63	6.04	8.77	11.07	12.95	14.19	15.93	17.47
64	5.76	7.64	9.97	11.59	13.38	15.61	17.17
65	4.74	6.84	8.58	10.52	12.15	14.14	16.09
66	5.47	7.44	8.88	10.52	12.38	14.09	16.39
67	3.68	5.09	6.26	9.52	11.16	13.06	15.11
68	4.62	5.61	7.42	9.60	11.27	13.04	14.96
69	6.42	7.91	9.54	11.01	12.96	14.84	16.06
70	6.46	8.41	10.12	11.74	13.50	14.87	16.18
71	3.96	5.49	6.93	9.10	11.04	12.56	14.44
72	4.28	5.94	8.24	11.15	12.05	13.72	14.82
73	5.30	6.88	8.54	10.53	11.71	13.89	15.21
74	4.72	7.08	8.58	11.06	12.73	14.26	15.70
75	4.41	5.77	7.45	9.52	11.42	13.36	14.85
76	5.59	7.32	9.19	11.09	12.68	14.2	15.33
77	4.77	6.87	9.20	10.67	14.17	16.24	17.76
78	5.29	7.88	9.39	10.56	12.70	14.90	16.07
79	4.72	6.63	7.86	9.81	11.94	13.84	15.69
80	5.44	6.82	8.90	10.99	13.17	15.05	18.04
81	5.44	8.61	10.14	11.67	12.98	19.41	20.54
82	3.55	6.46	7.93	10.26			
83	4.99	6.76	8.84				
84	5.96	7.70	9.94	11.72	13.83	16.96	18.87
85	5.67	7.69	9.77	13.42	16.35	19.38	22.40
86	5.14	7.30	9.92	12.50			
87	5.20	6.33	8.52	9.94	11.69	13.78	15.39
88	5.07	6.35	7.77	10.17	12.15	13.69	15.81
89	5.73	8.32	11.17	14.06	16.08	17.47	19.34
90	5.30	7.23	8.83	11.02	13.11	15.25	17.11
91	5.82	8.17	9.37	10.60	13.16	15.60	16.94
92	5.47	6.99	8.57	10.16	12.72	14.04	16.88
93	4.99	6.67	9.66	10.83	12.75	14.48	16.42
94	5.52	7.14	8.61	10.17	12.14	13.79	15.15
95	5.64	7.32	8.90	10.70	12.40	14.34	16.67
96	8.14	9.87	11.91	13.70	15.14	18.04	19.71
97	4.54	7.24	9.09	12.21	14.17	15.69	18.11
98	5.67	6.86	8.96	10.87	12.83	14.41	16.28
99	5.06	8.04	10.31	12.06	16.61	19.76	22.10
100	5.24	7.03	9.17	10.30	11.73	13.58	15.14
101	4.17	6.83	8.61	10.06	12.25	14.58	16.21
102	6.83	8.35	10.20	12.03	13.79	15.47	17.62
103	6.21	7.97	9.29	11.07	12.84	14.17	16.20
104	6.40	8.79	10.57	12.38	13.79	15.55	18.28

-3.0%

vehicle	1	2	3	4	5	6	7
cycle							
105	4.83	6.14	8.34	10.34	12.34	14.85	16.90
106	4.36	6.78	7.91	10.87	12.06	13.15	14.58
107	6.04	10.40	13.94	16.34	17.74	18.91	20.23
108	5.22	6.74	8.36	13.05	14.50	15.59	17.20
109	5.51	8.04	9.85	11.57	12.92	14.74	16.57
110	5.03	6.90	8.36	10.99	12.80	14.62	16.29
111	4.63	7.16	8.64	9.95	12.50	13.63	15.30
112	5.57	7.32	9.53	10.76	12.88	14.71	16.05
113	5.25	6.74	9.17	10.95	12.27	13.79	15.70
114	6.21	7.38	9.07	11.98	13.54	15.61	17.81
115	5.94	8.40	9.59	11.17	14.34	15.84	17.03
116	4.64	6.42	8.14	10.70	12.56	14.05	15.48
117	5.28	7.77	9.44	11.13	13.44	15.56	17.13
118	5.08	6.73	8.36	9.46	11.22	12.33	13.89
119	5.42	6.47	8.47	10.19	11.97	13.87	16.32
120	5.14	6.66	8.36				
121	5.86	9.63					
122	4.24	5.70	8.42	9.93	11.60	14.07	15.90
123	3.89	5.29	7.26	8.78	10.97	12.97	14.65
124	5.85	7.57	9.54	11.85	13.24	15.14	17.09
125	4.20	7.01	8.18	9.60	11.13	12.75	14.00
126	5.60	6.83	8.60	9.55	14.51	16.82	18.22
127	5.21	6.44	7.79	9.04	11.59	13.28	16.89
128	5.14	7.54	9.30	11.33	13.30	14.97	16.92
129	4.94	6.36	8.02	9.59	11.06	12.92	14.40
130	5.57	6.62	9.14	11.02	12.91	14.40	17.67
131	5.88	7.17	8.78	10.78	12.46	15.07	17.97
132	7.40	9.57	11.32	12.97	14.40	16.46	17.87
133	4.81	6.50	7.87	9.64	13.54	15.18	17.30
134	5.71	6.88	8.55	10.56	12.77	14.10	15.61
135	6.00	7.20	9.74	11.21	12.82	15.47	17.24
136	5.98	7.76	9.71	10.97	11.94	12.95	14.34
137	4.84	7.00	8.70	10.68	11.94	13.55	15.41
138	5.24	7.62	9.61	11.04	12.91	14.29	16.43
139	5.46	8.35	9.97	11.81	13.17	14.72	16.22
140	5.04	6.32	7.90	9.87	11.55	13.50	15.33
141	5.20	7.39	9.30	11.38	14.88	16.51	17.64
142	4.86	6.67	7.97	11.14	13.11	15.51	17.68
143	4.29	6.92	8.58	10.63	13.03	14.50	17.23
144	5.45	7.07	9.29	10.83	13.21	14.64	15.78
145	5.19	6.98	9.12	10.62	12.44	15.75	17.15
146	4.00	5.70	7.75	9.54	10.59	12.34	13.75
147	4.17	5.88	7.70	9.44	11.37	13.13	14.73
148	4.27	5.74	8.64	10.44	12.06	13.74	15.36
149	7.98	9.27	10.39	11.80	13.04	14.70	16.98
150	4.30	6.19	9.08	10.89	12.30	13.83	15.43
151	5.74	7.21	8.71	10.40	12.23	13.41	15.05
152	4.32	5.93	7.91	9.47	11.13	12.83	15.47

-3.0%

vehicle	1	2	3	4	5	6	7
cycle							
153	5.18	7.55	10.05	12.21	14.25	15.91	17.32
154	5.30	7.47	8.97	10.44	12.34	14.37	16.43
155	6.47	8.70	9.85	11.00	12.55	14.30	15.80
156	5.30	6.97	8.67	10.46	11.98	14.44	15.74
157	5.08	7.80	9.87	11.70	14.94	17.93	20.64
158	3.36	5.55	10.91	13.30	14.54	16.27	18.17
159	4.76	7.83	10.34	12.26	13.51	15.78	17.39
160	3.80	5.83	7.42	9.21	11.30	12.96	14.61
161	6.88	8.49	10.41	11.89	12.93	14.12	15.58
162	5.07	7.84	10.17	11.40	13.01	14.60	16.04
163	5.13	7.39	4.67	11.29	12.64	14.13	17.94
164	5.98	7.60	9.20	11.50	13.20	14.19	16.73
165	5.90	7.58	9.46	12.79	14.36	15.97	17.18
166	5.60	9.88	11.31	14.48	15.65	16.87	17.93
167	4.02	6.64	9.58	11.87	13.32	15.06	16.83
168	4.03	5.78	7.50	9.51	12.09	14.34	16.07
169	6.68	8.61	10.99	12.42	13.88	15.41	17.03
170	4.44	6.67	8.91	10.80	12.17	13.57	15.68
171	6.51	7.33	10.47	12.01	13.53	15.37	16.92
172	6.40	7.98	9.23	11.03	13.95	15.71	19.24
173	6.15	8.71	11.24	12.95	14.00	16.41	19.68
174	4.87	6.33	8.37	9.54	11.74	13.14	14.91
175	6.18	8.34	9.60	11.08	12.34	14.70	16.49
176	4.66	6.50	8.21	10.05	11.36	14.27	15.67
177	3.73	5.54	10.70	12.42	13.95	15.68	17.86
178	4.93	7.57	9.53	11.73	13.86	15.53	17.20
179	4.99	6.19	7.80	9.03	11.10	12.70	15.02
180	4.51	6.98	8.64	9.69	11.18	12.90	14.43
181	6.91	8.20	9.73	11.76	13.72	14.97	16.30
182	5.73	7.27	8.91	10.89	12.54	14.05	15.74
183	4.07	5.74	8.15	9.96	12.30	13.77	15.49
184	5.09	6.74	9.00	10.76	13.77	15.24	16.55
185	4.83	6.75	8.42	9.93	11.64	13.92	15.50
186	6.24	9.04	11.54	14.02	15.69	17.18	19.30
187	4.76	6.25	8.07	9.69	12.10	14.03	16.02
188	4.87	6.21	9.00	10.55	12.55	14.10	15.91
189	5.09	6.74	10.02	11.54	13.72	15.80	17.45
190	3.44	7.47	9.94	12.27	14.32	16.51	18.03
191	5.40	6.59	8.04	9.51	11.37	12.87	15.36
192	3.89	7.09	8.64	9.75	11.70	13.32	
193	2.33	4.24	6.97	8.80	11.77		
194	6.56	8.60	10.83	13.00	14.02	15.35	16.79
195	5.94	7.26	8.39	11.11	12.64	14.47	16.18
196	4.96	6.59	8.30	10.40	11.89	13.56	15.87
197	5.65	7.00	8.72	10.40	12.01	14.14	16.68
198	2.98	5.42	7.44	8.96	10.10	12.57	14.54
199	4.17	6.88	9.27	10.43	12.25	13.55	14.95
200	4.04	6.34	8.60	10.58	12.27	13.60	15.69

-3.0% vehicle	1	2	3	4	5	6	7
cycle							
201	5.47	6.84	9.12	10.66	12.90	15.27	16.31
202	4.30	5.47	6.72	8.18	10.17	13.82	15.14
203	5.44	7.34	8.72	11.34	12.90	14.38	15.84
204	4.47	7.67	9.97	13.47	16.67	17.95	20.19
205	5.63	8.04	9.62	11.30	12.34	13.55	15.34
206	5.55	7.45	9.90	11.69	13.30	17.12	19.14
207	5.60	7.18	9.08	10.89	12.10	13.33	16.04
208	7.28	8.72	9.87	11.71	13.97	15.48	17.46
209	5.27	7.48	8.94	10.21	11.78	12.87	15.80
210	6.88	8.16	9.60	11.57	12.68	14.32	16.13
211	4.71	7.13	9.15	11.04	[illegible]	13.89	15.54
212	5.07	7.80	9.82	11.30	12.56	13.85	15.58
213	5.99	7.46	8.97	10.67	12.23	13.55	14.96
214	5.67	7.32	9.61	11.60	13.27	14.70	16.54
215	4.60	6.57	8.24	10.44	12.05	13.86	15.34
216	3.95	5.04	8.21	9.51	10.61	12.10	13.64
217	3.97	5.67	8.29	9.60	11.14	12.38	14.22
218	5.95	7.46	9.23	10.89	12.07	13.85	15.14
219	5.57	7.34	9.81	11.41	13.27	15.02	16.94
220	6.27	8.80	10.50	11.90	13.20	14.63	17.04
221	5.40	7.76	9.27	14.35	16.13		
222	5.17	7.75	9.39	11.20	13.10	15.97	18.45
223	5.45	7.13	8.44	10.21	12.21	14.63	16.73
224	4.17	6.23	8.56	10.23	12.78	14.65	
225	6.27	7.67	9.31	11.88	13.07	14.79	16.21
226	5.41	9.26	11.64	13.26	15.63	17.19	19.54
227	5.80	7.47	8.94	11.01	12.86	15.32	17.43
228	6.70	8.48	10.41	11.59	13.40	15.83	17.90
229	4.52	6.92	10.25	11.87	13.23	15.10	17.10
230	5.27	7.17	9.47	10.79	12.27	14.11	15.87
231	4.71	7.94	10.29	12.07	13.43	15.15	
232	6.40	7.99	9.30	10.74	12.35	13.72	15.27
233	4.99	7.23	9.88	11.26	12.63	14.88	16.67
234	6.45	8.29	9.44	10.62	11.73	13.30	14.68
235	5.08	6.52	8.81	10.67	12.17	13.70	15.82
236	5.17	8.30	9.87	11.74	13.79	14.94	17.61
237	5.57	8.72	11.14	12.71	14.53	16.13	17.65
238	4.24	6.54	8.51	10.07	11.52	13.17	15.40
239	5.05	7.07	9.66	12.38	14.66	17.91	20.38
240	5.24	6.70	9.11	10.85	13.04	13.97	15.79
241	5.23	7.50	8.88	10.46	12.21	13.49	14.82
242	3.44	5.24	6.62	8.21	10.23	11.64	13.07
243	3.77	6.05	7.71	9.61	11.07	12.69	14.70
244	5.02	6.80	8.82	10.73	12.40	13.82	15.27
245	4.86	6.27	7.81	10.74	11.97	13.16	14.52
246	3.39	5.33	7.04	9.04	10.97	13.20	14.61
247	4.46	6.27	8.57	10.00	11.62	12.99	16.05
248	5.48	8.79	10.17	11.57	12.91	13.98	16.74

-3.0%

vehicle	1	2	3	4	5	6	7
cycle 249	5.04	6.48	8.34	9.61	11.43	14.73	16.26

vehicle	1	2	3	4	5	6	7
no. of cycles	249	249	248	244	238	234	230
mean elapsed time	5.23	7.23	9.18	11.06	12.91	14.75	16.59

-3.0%

vehicle	8	9	10	11	12	13	14
cycle							
1	21.24	22.87	25.65				
2							
3	21.30	23.24	24.59	26.93	29.93		
4	21.66	23.02	24.34	26.25	28.09	31.35	33.02
5							
6							
7	21.16	23.64	25.94				
8	18.19	19.70	22.44	24.59	26.47	27.90	29.40
9	20.58	21.94	23.14	25.50	27.72	29.29	30.82
10	21.69	22.70	24.56	26.42	29.14	30.61	31.91
11	16.31	19.70	21.22	22.55	24.16	26.07	28.33
12	16.30	17.70	19.09	20.26	21.67	23.16	25.07
13	18.81	20.58	22.73	25.84	28.72	30.31	32.30
14	20.02	21.87	23.51	25.76	27.07	28.96	30.04
15	18.39	20.23	22.52	25.34	28.07		
16	18.92	20.71	23.34	25.00	26.80	29.14	32.39
17	19.44	21.20	22.74	25.60	27.57	29.27	31.78
18	15.52	17.37	18.43	21.50	23.55	25.84	27.53
19	19.70	21.67	23.90	26.46			
20	17.65	19.25	21.18	22.80	24.57		
21	19.66	21.55	23.40	24.97	26.73	30.07	33.34
22	17.98	19.49	21.46	23.43	26.50	28.60	30.00
23	17.34	19.48	21.27	23.42	25.44		
24	20.60	22.55	24.21	25.93	27.68	30.07	32.69
25	18.94	20.65	21.94	23.91	26.74	28.35	29.96
26	19.51	21.17	23.62	25.54	27.46	29.46	31.03
27	17.96	19.63	21.10	23.23	25.17	26.96	28.66
28	19.08	20.55	23.34	25.79	27.51	28.88	30.45
29	18.05	19.80	22.07	23.60	24.84	26.65	27.24
30	18.49	19.81	23.40	25.03	26.84		
31	18.01	20.94	22.57	24.20	25.88	27.46	29.36

-3.0%

vehicle	8	9	10	11	12	13	14
cycle							
32	20.44	22.47	23.99	25.97	28.10	29.44	31.60
33	18.33	20.21	22.64	24.12	25.36	27.27	29.60
34	17.25	19.31	20.89	22.68	25.97	27.99	29.74
35	19.68	21.19	22.90	24.70	27.41		
36	22.91	24.21	25.44	27.74	28.93	30.59	32.40
37	20.67	22.29	24.20	25.74	27.21	28.58	30.96
38	18.54	20.63	22.67	24.36	26.47	29.10	30.69
39	17.55	19.14	21.78	23.56	25.25	27.18	28.66
40	20.07						
41	19.10	21.14	23.15	24.40			
42							
43							
44							
45	17.54	19.32	20.29	21.39	22.76		
46							
47							
48							
49	16.57	18.18	19.52	21.35	22.80	23.99	25.81
50	15.41						
51	19.94	21.26	23.57	26.27	27.80	28.97	
52	19.67	21.82	23.62	25.60	27.03	28.11	
53	16.21	17.80	20.04	20.99	22.57	24.58	25.89
54	17.21	19.31	21.02	23.30	24.54	26.43	27.75
55	17.73	19.63	21.61	23.13	24.61	27.07	28.38
56	19.02	20.87	23.15	16.00	28.12	29.57	31.63
57	17.31	18.94	20.46	22.60	24.54	26.02	28.37
58	17.49	18.96	20.50	22.86	25.44	27.29	29.43
59	16.72	18.50	19.99	21.29	23.31	24.68	26.75
60	18.43	19.89	22.01	24.18	27.27		
61	16.84	18.07	19.48	21.34	23.06	25.31	26.73
62	18.27	19.27	20.44	21.93	22.93	24.11	25.94
63	18.93	20.25	21.41	22.48	23.98	25.27	26.81
64	19.40	21.40	22.84	25.03	26.80	29.07	30.80
65	18.19	19.22	20.92	22.20	23.57	24.90	27.05
66	17.82	18.84	20.71	22.55	24.30	26.11	
67	16.79	18.00	19.18	21.53	23.65		
68	16.87	18.54	20.79				
69	17.97	19.74	21.11	22.79	24.91		
70	18.02	19.87	21.33	22.70	24.96	26.78	29.17
71	16.39	17.46	21.37	23.28	25.71	27.33	29.27
72	16.24	18.29	20.23	21.74	23.01	24.41	26.50
73	16.32	18.01	19.49	21.01	22.13	23.37	24.64
74	17.20	18.62	20.21	21.78	24.20	25.73	27.57
75	16.27	17.73	19.55	21.08	22.37	23.50	25.11
76	18.68	20.06	22.03	24.07	25.69	28.1	29.68
77	19.17	21.43	23.02	25.56	27.44	29.96	30.24
78	18.59	19.79	22.22	23.55	25.84	27.67	29.74
79	17.99	20.96	22.44	23.47	25.17	27.58	29.63

-3.0%

vehicle	8	9	10	11	12	13	14
cycle							
80	20.47	22.64	24.28	25.51	26.81	28.04	29.44
81	22.07	23.45	25.51	27.38	30.33		
82							
83							
84	20.93	23.05					
85	24.27	25.93	27.27				
86							
87	17.93	19.67					
88	18.34	20.06					
89	21.39	23.10	24.24				
90	19.40	21.61	24.23	26.30	28.04	30.27	31.96
91	20.07	21.57					
92	18.33	20.21	21.54	23.87	24.94	26.17	27.98
93	18.35	20.31	22.05	23.65	25.44	26.89	
94	16.34	17.94	19.53	20.72	23.73	25.72	28.57
95	18.34	20.50	22.72	24.34	25.51	26.78	27.95
96	21.00	22.82	24.87	26.94	28.92	30.50	31.82
97	20.81	22.14	23.71	25.50	27.21	28.75	30.64
98	17.76	20.66	21.90	23.10	24.53	25.67	27.06
99	23.67	25.42	26.77	28.28	30.00	31.50	33.40
100	17.10	18.56	21.30	22.85	24.02	26.25	28.21
101	17.94	19.48	20.50	22.07	23.85	25.51	26.71
102	21.68	23.25	25.04	27.37	29.27	30.45	31.73
103	17.34	19.62	21.34	24.00	25.81	27.90	29.98
104	19.48	22.16	24.36	26.70	28.78	30.91	33.42
105	18.41	19.72	21.34	23.00	24.74	26.87	
106	16.38	18.81	21.24	22.86	24.35	26.27	27.30
107	21.69	22.92	24.83	27.36			
108	18.78	19.98	21.46	23.29	27.17	28.50	29.85
109	18.17	19.81	22.29	24.57	26.12	27.90	29.56
110	17.91	19.14	21.83	23.87	25.40	27.30	28.54
111	17.69	19.52	21.47	22.90	24.06	26.03	28.78
112	17.07	18.17	19.13	21.81	23.16	24.50	25.94
113	18.07	20.30	21.88	24.23	26.40	27.94	29.71
114	19.71	22.35	24.66	27.24	29.36	31.68	33.14
115	18.64	19.28	20.83	22.06	23.20	25.97	28.49
116	16.54	18.52	20.76	22.73			
117	18.32	19.90	22.00	23.44	24.80	26.99	29.40
118	16.20	18.20	19.96	21.69	23.41	24.70	27.42
119	17.65	19.08	21.31	23.67	25.10	26.86	
120							
121							
122	18.34						
123							
124	18.90	21.80					
125	16.55	18.55	20.53	22.70	24.90		
126	19.80	21.05	22.67	27.50	29.74	32.85	34.14
127	18.50	20.71					

-3.0%

vehicle	8	9	10	11	12	13	14
cycle							
128	18.33	20.07	21.57	23.14	24.85	27.30	29.76
129	16.14	17.97	19.73	21.45	23.94	25.88	27.56
130	18.96	20.23	21.47	23.87	24.95	26.86	28.83
131	19.20	20.97	22.68	23.68	26.16	28.21	
132	19.25	21.10	22.57	23.94	26.39	29.14	
133	18.86	20.44	22.62	24.77	26.92	28.57	30.02
134	17.64	19.05	21.24	23.10	24.72	27.21	28.55
135	19.25	21.08	22.71	25.57	27.28	29.38	30.40
136	15.35	17.51	20.01	22.91	24.34	27.46	28.56
137	17.61	19.54	20.99	22.55	23.55	26.94	30.20
138	17.74	19.34	20.00	22.35	23.80	25.69	26.94
139	17.39	19.49	21.59	24.60	26.10	27.64	30.00
140	16.50	18.70	20.27	21.83	24.24	26.04	28.25
141	19.42	21.06	22.14	23.77	25.84	27.26	
142	18.91	22.10	23.49	24.94	30.14		
143	18.70	20.31	22.25	23.65	25.00	27.31	29.31
144	17.17	18.87	20.25				
145	18.50	20.05	21.53	22.70	24.19	25.45	27.43
146	15.49	17.05	18.60	21.46	22.37	23.67	26.52
147	18.06	19.87	21.50	23.87	25.52	26.92	28.12
148	16.84	18.25	19.73	21.47	22.73	24.13	25.76
149	19.74	21.73	23.54	24.86	27.17	28.64	29.87
150	17.64	19.48	21.24	23.54	26.89	28.22	29.67
151	16.85	17.88	19.96	21.52	23.11	24.47	25.95
152	17.89	19.35	20.85	22.58	23.88	25.37	28.07
153	18.91	20.41	21.61	23.19	25.27	26.64	28.94
154	18.27	19.27	20.38	22.19	23.91	25.70	28.11
155	17.01	18.90	20.52	22.28	23.56	25.53	26.91
156							
157							
158	19.92	21.40					
159	20.06						
160	16.70	18.44	20.52				
161	17.28	19.95	21.96	23.20	25.85	29.22	31.84
162	18.16	20.30	22.48	24.50	26.61	28.52	30.73
163	19.04	21.27	23.40	25.20	27.75	29.87	31.99
164	18.24	20.31	22.61	24.34	26.06	27.86	30.21
165	18.42	19.40	22.30	24.05	25.30	26.64	28.66
166	19.87	23.38	25.29	27.16	28.68	30.29	31.94
167	19.20	21.93	23.61	25.60	27.08	28.07	31.37
168	17.62	19.21	20.98	24.35	25.82	28.91	31.14
169	18.35	19.87	21.27	22.65	24.14	25.79	28.27
170	17.74	19.83	22.19	26.75	29.00	31.54	
171	18.67	20.12	22.60	24.21	25.53	27.44	29.85
172	21.59	23.72	25.65	29.03	33.72	35.54	37.20
173	22.44	24.52	27.43	29.94	31.69	33.18	25.96
174	16.[illegible]	18.55	19.97	22.45	24.22	26.06	29.16
175	19.04	20.89	22.20				

-3.0%

vehicle / cycle	8	9	10	11	12	13	14
176	18.59	20.10	22.24				
177							
178	18.71	21.22	22.40	24.97	27.47	29.01	30.95
179	16.71	19.25	21.20	22.42	23.81	25.63	29.55
180	15.96	18.24	20.24	22.10	27.71	29.76	
181	18.35	20.02	21.94	23.49	25.97	28.03	30.67
182	17.42	19.81	22.08	23.65	24.99	26.06	27.85
183	18.34	19.93	21.00	23.11	25.24	26.63	28.84
184	17.86	19.80	22.52	24.22	26.84	32.37	35.60
185	18.51	20.74	22.62	25.80	27.60	30.00	32.07
186	20.84	24.01	26.14	28.34	31.62	34.61	35.59
187	19.50	20.87	22.44	25.80	27.44	30.03	31.95
188	17.70	19.67	21.37	23.01	24.57	25.95	28.01
189	19.34	20.64	23.50	26.03	28.17	29.74	32.74
190	20.45	22.55	25.70	28.03	29.60	30.70	32.35
191	17.56	20.86	23.10	25.93	27.95	29.86	32.27
192							
193							
194	18.90	21.05	22.86	24.17	26.67	29.02	31.28
195	19.78						
196	17.97	19.49	21.47	24.27	26.05		
197	17.87	19.86	22.79	25.02	26.37	27.87	30.87
198	16.27	17.46	19.17	21.06	23.20	24.31	26.61
199	16.55	17.90	19.17	21.04	22.26	23.51	25.60
200	16.71						
201	17.86	19.90	21.52	22.87	25.70	28.35	
202	16.30	17.38	18.83	21.24	23.54	25.18	28.47
203	17.02	19.54	22.00	24.50	26.71	28.17	29.87
204	21.25	23.65	26.42				
205	16.90	18.31	20.06	21.94	23.32	25.84	27.94
206	20.72	21.94	24.78	28.44	30.52	32.58	34.14
207	17.80	20.04	21.62	24.32	26.05	28.34	29.90
208	19.03	20.36	21.68				
209	17.19						
210	17.67	19.92	21.27	23.41	25.51	27.51	29.22
211	16.87	18.40	20.03	21.47	23.00	24.57	26.55
212	16.74	19.04	22.30	24.27	26.50	29.27	
213	16.31	17.21	20.17	21.83	23.90	25.89	28.31
214	18.05	19.84	21.40	22.49	23.61	25.84	27.31
215	17.07	18.85	20.24	21.54	24.48	26.01	27.44
216	16.20	17.98	21.00	22.72	24.11	26.12	27.58
217	15.90	17.82	19.67	21.04	23.33		
218	16.64	18.80	20.26	21.80	23.24	24.70	26.47
219	18.35	19.65	21.41				
220	19.72						
221							
222	22.05						
223	18.22						

-3.0%

vehicle	8	9	10	11	12	13	14
cycle							
224							
225	18.16	19.39	21.07	22.90			
226	20.87	22.45	24.07	25.51	28.30	29.73	30.96
227	19.24	20.61	21.61	23.19	25.12	26.77	28.72
228	19.74	21.61	23.21	24.60	26.34	28.82	
229	17.92	20.05	22.13	23.91	26.05	28.60	30.43
230	17.24	18.94	19.97	21.07	22.74	24.08	26.41
231							
232	16.51	18.45	21.33	23.18	24.90	26.64	28.15
233	18.53	21.07	24.47	25.65			
234	16.26	18.77	20.70				
235	17.17	18.56	20.14	21.84	25.39	27.88	31.38
236	19.54	23.16	24.67	25.90	27.10	29.09	31.51
237	19.79	22.01					
238							
239	22.71	24.20	27.98	29.97	31.65	34.60	37.91
240	17.24						
241	17.91	20.51	23.67				
242	14.55	16.76					
243	16.64	18.31	20.50	22.02			
244	16.65	19.12	20.34	22.60			
245	16.06	17.54	18.72	19.91	21.86	23.70	26.37
246	16.27	17.74	19.32	20.97	23.18	25.63	26.92
247	17.25	18.47	19.87	21.71	26.28	28.44	30.97
248	18.70	21.44	22.44	23.88	25.58	27.74	
249	17.99						

vehicle	8	9	10	11	12	13	14
no. of cycles	225	213	204	190	182	167	152
mean elapsed time	18.38	20.19	22.03	23.83	25.82	27.65	29.48

-3.0%

vehicle	15	16	17	18	19	20	21
cycle							
1							
2							
3							
4	35.97	37.11	39.46	43.68	44.99	46.55	49.30
5							
6							
7							

-3.0% vehicle	15	16	17	18	19	20	21
cycle							
8	30.33	32.28	33.76	34.87	36.40	38.81	40.68
9	32.63	33.84	35.44	37.34	42.69	45.63	47.94
10	33.16	35.00	36.80	37.85	39.70	41.18	42.69
11							
12	26.75	29.00	30.11	33.09	35.27	38.97	40.44
13	34.14	35.47	37.60	40.04	41.37	45.18	47.38
14	31.50	33.33	35.96	39.07	40.91	43.45	45.24
15							
16							
17	33.61	35.03	37.75	40.11	43.32	45.44	47.86
18							
19							
20							
21	36.29	39.00	41.06	42.83	44.92	47.15	49.50
22							
23							
24	35.21	37.67	39.30	42.40	45.34		
25	31.67	33.47	35.40	36.14	38.10	39.95	41.65
26	33.36	35.31	37.17	39.28	40.97	42.13	43.89
27	30.51	31.78	34.37	35.97	38.00	39.87	42.94
28	34.30						
29	28.30						
30							
31	30.40	32.54	35.31	37.17	39.89	42.14	44.62
32	32.46	34.54	36.22	38.72	41.38	43.87	46.46
33	32.32	34.57	37.12	39.32	41.19	43.60	46.21
34	33.80	35.18	37.01	39.27	40.60	42.20	43.54
35							
36	35.73	37.50	40.27	41.68	43.61	46.33	48.46
37	33.35	35.97	37.80	40.22	42.93	44.84	46.72
38	32.00	33.86	36.84	38.57	41.37	43.21	45.64
39	32.04	34.14	235.87	38.75	41.26	42.82	44.66
40							
41							
42							
43							
44							
45							
46							
47							
48							
49							
50							
51							
52							
53	27.47	29.15	30.88	32.55	34.04	36.29	38.24
54	29.41	30.97	32.39	34.27	36.99	38.40	40.81
55	29.85	31.26	33.54	35.20	36.50	37.94	39.71

-3.0%

vehicle	15	16	17	18	19	20	21
cycle							
56	33.10						
57	29.80	32.07	34.60	37.21	40.47	43.35	46.29
58	31.32						
59	29.07	30.86	33.24	34.08	36.64	38.37	41.65
60							
61	28.34	29.65					
62	27.88	29.94	31.47	33.41			
63							
64	33.46						
65	28.45	31.32					
66							
67							
68							
69							
70	30.75	32.94	34.63				
71	31.88	33.53	34.72	37.27	39.07	41.09	
72	28.72						
73	25.90	27.20	29.17	30.49	32.02	33.24	
74	29.50						
75	27.26	28.57	29.84	33.17	35.97	38.27	39.75
76	32.1	34.3	36.08	37.42	38.65	40.5	
77	31.50	32.88	34.07				
78	31.31	33.09	34.85	37.47	39.18		
79							
80	30.79	32.06	34.55	35.87	37.78	40.04	41.60
81							
82							
83							
84							
85							
86							
87							
88							
89							
90							
91							
92	29.73	31.40	33.84	35.68	37.94	40.53	42.79
93							
94	30.08	32.84	35.80				
95	29.82	31.13	32.55	34.54	36.24	37.78	40.38
96	36.22	37.93	40.22	42.34	45.09	47.40	49.81
97	33.14	35.69	38.22				
98	29.76						
99	34.95	37.39					
100	30.17	33.84	35.54	37.09	38.31	39.90	41.57
101	27.82	29.29					
102	34.17						
103							

-3.0%

vehicle	15	16	17	18	19	20	21
cycle							
104							
105							
106	28.39	30.61	33.04				
107							
108	31.37	32.70	34.71	37.74	39.55	41.22	42.94
109	30.90	32.62	34.20	35.94	38.60	40.34	41.45
110	30.85	32.78					
111							
112	27.84	29.40	31.12	33.64	35.35	37.67	
113	31.64	33.51	35.92	37.63	38.73	39.83	41.70
114	35.17	37.07	39.67	41.75	43.66	46.29	48.37
115	29.98	32.47	35.51	37.07	39.34	41.24	43.38
116							
117	30.83	33.71	35.14	37.24	38.99		
118	28.97	31.97	33.57	35.37	36.54		
119							
120							
121							
122							
123							
124							
125							
126	37.70	39.37					
127							
128	32.07	33.90	36.12	39.30			
129	30.90	33.39	35.20	37.70	40.00	43.27	46.81
130	30.99						
131							
132							
133	31.51	33.51	34.85	36.86	38.67	39.90	42.58
134	31.16	32.93	35.07	38.18	40.30	41.93	43.80
135	31.44	32.89	34.14	35.22			
136	30.27	32.22	33.64	36.19			
137	33.01	34.77	36.27	37.76	39.61	41.50	43.33
138	28.43	31.17	32.43	33.74	35.01	37.64	
139	31.62	33.42	34.91	36.66			
140	29.54						
141							
142							
143	30.70						
144							
145	28.65	29.64	31.73				
146	27.67	29.71	31.57	34.30	35.52	37.56	43.64
147	29.62	32.20	34.33	37.49	39.57	41.28	43.45
148	27.64	29.94	31.88	33.30	34.94		
149	31.73	33.38	35.70	37.98	40.01	41.88	44.04
150	30.90	32.61	34.39	36.65	38.34	41.94	44.06
151	27.16	29.16	31.71	33.30	35.08	36.74	38.24

-3.0%

vehicle	15	16	17	18	19	20	21
cycle							
200							
201							
202	30.49	31.78	34.81	36.05	37.70	40.12	41.92
203	32.03	34.04	36.30	39.11			
204							
205							
206							
207	31.70	33.73	35.72	37.85	39.41	41.94	44.74
208							
209							
210	30.68	32.36	34.52	35.94	38.50		
211	28.80	30.54	32.87	34.93	37.17	38.20	40.49
212							
213	30.38	32.04	34.50	35.75	37.32	39.49	43.20
214	29.79	31.19	33.03	34.32	36.11	37.74	40.30
215	29.11	30.71	32.21	35.09	37.11	38.50	41.22
216	28.72	21.95	24.98	37.13	38.71	40.52	42.14
217							
218	28.62	31.47					
219							
220							
221							
222							
223							
224							
225							
226	33.05	34.91	36.10	37.87	38.94	40.93	44.61
227	30.15	31.88	33.41	34.73	36.34	38.72	40.70
228							
229	32.27	34.62	36.48	38.08	39.61	42.83	44.30
230	27.65	30.02	32.62	34.27	37.14	38.67	40.44
231							
232	31.28	34.01	35.57				
233							
234							
235	33.88	36.54	38.61	40.00	41.36		
236	33.72	35.70	36.84	38.13	39.82	41.96	44.03
237							
238							
239	40.04	42.82					
240							
241							
242							
243							
244							
245	27.60	28.97	30.25	31.73	34.75	37.34	39.97
246							
247	32.08	33.78	36.47	38.20	39.47	40.91	42.95

-3.0% vehicle	15	16	17	18	19	20	21
cycle							
152	29.64	32.95	34.50				
153	30.21	31.39	33.09	36.36	37.88	38.40	40.60
154	29.67	31.07	33.64	35.34	37.57	40.01	41.39
155	28.67	30.20	31.69	33.87	35.87	37.09	38.36
156							
157							
158							
159							
160							
161							
162	32.75	35.33	37.33	39.07	40.84	42.85	44.10
163	35.47	37.08	38.78	41.08	43.84	45.47	47.69
164	32.54	34.83	37.11	39.02	40.49	42.19	45.78
165	29.92	31.68	32.89	36.10	38.22	40.12	41.45
166	33.89	36.73	39.14	41.34	44.15	46.65	48.46
167	33.24	34.96	36.46	38.07	41.20	43.34	46.00
168	32.99	34.67	37.86	39.40	41.37	43.37	45.10
169	30.27	32.39	34.42	36.07	37.34	40.34	41.90
170							
171	33.90	33.20	35.65	36.86	38.35	39.79	42.30
172	38.87						
173	38.09	39.76	43.01	44.34	45.65		
174	31.78	33.84	37.46	40.60	42.89	44.20	46.84
175							
176							
177							
178	32.64	35.05	36.54	37.66	39.36	41.20	42.38
179	31.90	33.72	37.07	38.61	40.74	42.63	44.53
180							
181	32.99	35.39	37.16	39.21	40.86	43.02	45.75
182	29.41	30.93	32.38	33.94	35.22	37.47	39.70
183	30.24	32.60	34.02	36.70			
184	37.10	39.00					
185	33.35	35.43	37.40				
186	37.17	38.64	41.40	42.49	45.06		
187	33.70	35.90	37.67	39.67	41.66	43.67	46.99
188	31.14	32.60	34.17	35.92	38.14	39.82	
189	34.90	36.47	37.85	39.26	40.61	43.21	
190	33.64	34.90	37.36	39.26	42.90		
191							
192							
193							
194	33.37	35.29	36.54	38.52	40.21		
195							
196							
197	33.02	34.76	35.97	38.44	40.82	42.55	45.60
198	29.19						
199							

-3.0% vehicle	15	16	17	18	19	20	21
cycle							
248							
249							

vehicle	15	16	17	18	19	20	21
no. of cycles	135	121	112	103	96	85	78
mean elapsed time	31.46	33.31	36.98	37.30	39.34	41.20	43.62

-3.0% vehicle	22	23	24	25	26	27	28
cycle							
1							
2							
3							
4	51.07	52.26	54.35	56.14	59.33	61.02	
5							
6							
7							
8	42.74	44.64	46.15	48.10	50.00	51.47	
9	49.76	51.44	52.70	54.95	56.87	58.49	59.88
10	44.07	46.14	49.18	50.21	53.00	54.18	56.42
11							
12	44.61	46.21	47.86	50.56	53.04	55.27	57.17
13	48.81	50.72	52.34	54.28	56.81	59.14	
14	47.18	48.81	50.55	52.07	53.58	55.57	57.53
15							
16							
17	50.70	54.32	56.03	57.87	59.25		
18							
19							
20							
21	51.23	52.49	53.82	56.27			
22							
23							
24							
25	43.85	46.73	50.60	51.67	53.20	55.27	56.87
26	45.80	47.34	49.10	50.88	52.13	53.60	55.44
27	44.74	46.34	48.12	51.01	52.67	54.64	58.04
28							
29							
30							
31	47.47	50.67	52.97	54.47	56.90	59.15	60.56

-3.0%

vehicle	22	23	24	25	26	27	28
cycle							
32	48.90	51.97	54.87	57.02			
33	47.69	51.16	52.83	54.20	55.46	56.84	58.07
34	45.42	47.47	49.19	50.95	53.10	54.98	56.26
35							
36	50.43	52.79	56.23	58.17	60.30		
37	48.35	51.44	53.34	54.90	57.93	60.07	
38	47.35	49.09	51.94	53.44	55.76	59.83	
39	46.60	48.13	50.91	52.81	54.53	5C.14	59.16
40							
41							
42							
43							
44							
45							
46							
47							
48							
49							
50							
51							
52							
53	41.07	42.78	45.18	47.30	48.80	51.43	52.89
54	43.08	44.80	45.74	47.49	48.94	50.82	52.43
55	41.05	43.57	45.95	47.66	49.20	50.62	53.15
56							
57	48.72	50.64	51.83	54.49	57.03	59.05	
58							
)							
60							
61							
62							
63							
64							
65							
66							
67							
68							
69							
70							
71							
72							
73							
74							
75							
76							
77							
78							
79							

-3.0%

vehicle	22	23	24	25	26	27	28
cycle							
80							
81							
82							
83							
84							
85							
86							
87							
88							
89							
90							
91							
92	44.77	47.40	49.54	51.39	54.62	56.40	57.97
93							
94							
95	42.26						
96	51.94	54.76	56.47	57.67	58.93		
97							
98							
99							
100	43.53	45.87	49.12	50.81	52.28	55.19	56.59
101							
102							
103							
104							
105							
106							
107							
108	46.06	47.46	49.05	51.02	53.46	55.56	56.94
109	43.24	44.54	47.32	49.82	53.27	54.78	56.17
110							
111							
112							
113	42.62	44.33	47.09	49.49			
114	50.48	51.57	53.99	56.87	58.57	60.21	
115	44.57	47.68	49.44	52.07	53.49	57.53	58.97
116							
117							
118							
119							
120							
121							
122							
123							
124							
125							
126							
127							

-3.0% vehicle	22	23	24	25	26	27	28
cycle							
128							
129							
130							
131							
132							
133	44.19	45.96	47.51	48.87	51.39	53.88	55.40
134	45.59	48.48	49.64	51.63	53.92	56.17	58.69
135							
136							
137							
138							
139							
140							
141							
142							
143							
144							
145							
146	45.16	47.07	48.39	49.07	51.23	53.74	56.04
147	44.95	46.35	48.32	50.33	52.13	53.68	56.20
148							
149	45.98	47.85	49.15	51.66	53.44	54.65	55.92
150	46.00	47.45					
151	40.09	42.00	43.72	45.17	46.94	48.28	50.10
152							
153	44.57	47.19	49.91	51.85	54.84	57.27	58.75
154	43.00	44.61	46.06	47.85	49.54	50.47	51.67
155	40.23	41.60	44.28	45.84	47.20	49.79	52.00
156							
157							
158							
159							
160							
161							
162	45.47	47.32					
163	49.14	50.75	52.46	54.25	56.99		
164	47.85	49.64	51.66	53.71	56.54	58.22	
165	42.84	44.84	47.20	49.58	52.30		
166	50.85	53.57	56.74	58.80			
167	47.38	48.69	52.53	56.04	58.87	60.70	
168	47.29	49.49	50.61	52.09	53.79	55.59	58.53
169	44.42	47.36	48.79	52.02	53.67	56.70	58.54
170							
171							
172							
173							
174	48.52	50.24	52.27	54.10	56.87	59.70	
175							

-3.0%

vehicle	22	23	24	25	26	27	28
cycle							
176							
177							
178	43.93	46.24	48.26	51.56	54.55	57.03	58.49
179	46.49	47.56	49.67	51.38			
180							
181	47.80	49.37	51.12	54.46	56.98	59.24	
182	42.17	43.93	45.62	47.60	49.52		
183							
184							
185							
186							
187	48.58	50.40	52.57	54.64	56.75	58.83	60.92
188							
189							
190							
191							
192							
193							
194							
195							
196							
197	47.54	49.73	52.70	54.08	56.11	57.96	60.44
198							
199							
200							
201							
202	43.24	45.07	46.64	48.98	50.65	52.85	55.10
203							
204							
205							
206							
207	46.02	47.54	51.28	52.75	56.36	57.82	59.68
208							
209							
210							
211							
212							
213	45.32	47.57	49.39	52.14	54.20	56.48	58.42
214	43.86	45.12	46.99				
215	42.36	44.67	46.04	48.23	49.04	52.56	
216	43.60	45.52	48.11	50.17	52.45	54.09	56.04
217							
218							
219							
220							
221							
222							
223							

-3.0%

vehicle	22	23	24	25	26	27	28
cycle							
224							
225							
226	46.02	47.49	49.94	51.19	52.81	54.88	
227	42.52	44.00	46.73	48.64	50.47	52.48	55.95
228							
229	45.91	47.50	50.46	51.97	53.52	56.74	
230	42.82	44.43	45.70	47.63	49.92		
231							
232							
233							
234							
235							
236	46.28	48.40	50.44	51.74			
237							
238							
239							
240							
241							
242							
243							
244							
245	41.17	43.05	44.71	46.35	47.79	49.80	51.72
246							
247	44.67						
248							
249							

vehicle	22	23	24	25	26	27	28
no. of cycles	71	69	67	66	60	53	39
mean elapsed time	45.69	47.73	49.84	51.85	53.72	55.60	56.64

-3.0%

vehicle	29	30	31	32	33	count
cycle						
1						10
2						6
3						12
4						27
5						4
6						5
7						10

-3.0%

vehicle cycle	29	30	31	32	33	count
8						27
9						28
10	58.40	60.07				30
11						14
12	59.30	61.77				30
13						27
14	59.37	60.89				30
15						12
16						14
17						26
18						14
19						11
20						12
21						25
22						14
23						12
24						19
25	58.86	60.54				30
26	57.34	58.74	60.67			31
27	59.60					29
28						15
29						15
30						12
31						28
32						25
33	59.39					29
34	58.87	61.67				30
35						12
36						26
37						27
38						27
39						28
40						8
41						11
42						4
43						4
44						5
45						12
46						3
47						3
48						4
49						14
50						8
51						13
52						13
53	54.09	55.88	57.46	59.27		32
54	54.04	56.10	59.76			31
55	54.60	55.97	57.40	58.94		32

-3.0%

vehicle	29	30	31	32	33	count
cycle						
56						15
57						27
58						15
59						21
60						12
61						16
62						18
63						14
64						15
65						16
66						13
67						12
68						10
69						12
70						17
71						20
72						15
73						20
74						15
75						21
76						20
77						17
78						19
79						14
80						21
81						12
82						4
83						3
84						9
85						10
86						4
87						9
88						9
89						10
90						14
91						9
92						28
93						13
94						17
95						22
96						26
97						17
98						15
99						16
100	58.64					29
101						16
102						15
103						14

-3.0%

vehicle	29	30	31	32	33	count
cycle						
104						14
105						13
106						17
107						11
108	58.47					29
109	59.47	60.97				30
110						16
111						14
112						20
113						25
114						27
115	60.22					29
116						11
117						19
118						19
119						13
120						3
121						2
122						8
123						7
124						9
125						12
126						16
127						9
128						18
129						21
130						15
131						13
132						13
133	57.60	59.60	60.17	61.77		32
134						28
135						18
136						18
137						21
138						20
139						18
140						15
141						13
142						12
143						15
144						10
145						17
146	58.96	60.78				30
147	57.91	60.12				30
148						19
149	57.34	58.87	60.30			31
150						23
151	52.20	53.43	56.91	58.27	59.52	33

-3.0%

vehicle	29	30	31	32	33	count
cycle						
152						17
153	60.46					29
154	54.92	56.71	58.36			31
155	53.62	55.04	58.08	59.86		32
156						7
157						7
158						9
159						8
160						10
161						14
162						23
163						26
164						27
165						26
166						25
167						27
168	60.64					29
169	59.70					29
170						13
171						21
172						15
173						19
174						27
175						10
176						10
177						7
178						28
179						25
180						13
181						27
182						26
183						18
184						16
185						17
186						19
187						28
188						20
189						20
190						19
191						14
192						6
193						5
194						19
195						8
196						12
197						28
198						15
199						14

-3.0%

vehicle	29	30	31	32	33	count
cycle						
200						8
201						13
202	56.42	57.76	59.21			31
203						18
204						10
205						14
206						14
207	60.96					29
208						10
209						8
210						19
211						21
212						13
213	59.84					29
214						24
215						27
216	57.64	59.30				30
217						12
218						16
219						10
220						8
221						5
222						8
223						8
224						6
225						11
226						27
227	57.93	60.01				30
228						13
229						27
230						26
231						6
232						17
233						11
234						10
235						19
236						25
237						9
238						7
239						16
240						8
241						10
242						9
243						11
244						11
245	52.92	54.34	56.00	57.54	59.90	33
246						14
247						22

-3.0%

vehicle	29	30	31	32	33	count
cycle						
248						13
249						8

vehicle	29	30	31	32	33
no. of cycles	31	21	11	6	2
mean elapsed time	57.73	58.50	58.57	59.28	59.71

Appendix C

Adjustment of heavy vehicle headways

This Appendix contains an example of the calculations used to compute the passenger car equivalencies of heavy vehicles.

As noted in the text, the Transport and Road Research Laboratory method of calculating passenger car equivalents of trucks uses the formula:

$$PCU = (H_c - H_{avg} + H_t) \ / \ H_{avg}$$

where H_c is the headway of the vehicle preceding the slower moving vehicle

H_{avg} is the average headway for vehicles in the position in the queue of the preceding car

H_t is the headway of the slower vehicle.

Following is an example of the calculations used to compute the passenger car equivalencies of heavy vehicles. For a graphical representation of the terms used in the above equation, the reader is referred to Figure 24.

H_c	H_{avg}	H_t	PCU
3.65s	1.95s	1.96s	1.87

$$PCU = (3.65s - 1.95s + 1.96s) \ / \ 1.95s$$
$$= 1.87$$

Appendix D

Headway data

This Appendix contains the database of headways that resulted from the manipulation and adjustment of the database of recorded elapsed times

+7.2% HEADWAYS

cycle	1	2	3	4	5	6	7
vehicle							
1	4.33	1.57	3.06	2.97	1.84	1.25	2.21
2	1.22	2.05	2.90	2.35	1.53	1.80	3.11
3	1.56	1.55	1.29	1.74	2.14	2.10	2.35
4	1.88	1.78	1.94	1.81	1.88	0.20	1.91
5	1.55	1.97	1.71	1.11	2.22	2.02	2.21
6	1.24		1.06	1.24	1.45	1.92	2.59
7	1.77		1.11	3.54	1.53	2.36	1.27
8	1.16		2.06	2.06	1.34	1.82	1.88
9	2.39		1.40	2.12	1.19	2.03	1.55
10					1.33	2.26	1.99
11					1.76		1.69
12					1.90		2.51
13					1.84		
14							
15							
16							
17							
18							
19							
no. of cars per cycle	9	5	9	9	13	10	12

+7.2% cycle	8	9	10	11	12	13	14
vehicle							
1	1.98	1.42	1.43	2.16	2.04	1.68	1.23
2	2.85	1.69	2.59	1.60	1.84	1.85	1.22
3	1.93	1.36	2.70	2.33	1.44	1.30	1.06
4	1.17	1.50	1.67	2.61	1.16	1.50	2.28
5	2.15	2.13	1.39	1.30	1.65	1.39	1.69
6	1.34	1.50	2.44	2.18	3.97	1.20	1.09
7	1.54	1.48	1.24	2.13	1.64	1.76	1.69
8	1.24	2.48	1.32	2.13	1.87	1.49	1.69
9	1.65	1.29	1.47	1.77	1.73	1.38	1.49
10	1.63	2.25	3.21	1.72	1.83	1.01	1.71
11	1.41	1.67	1.29	1.49	2.91	2.00	2.20
12	1.77	2.50	1.46	2.41	1.57	1.65	1.77
13	2.73	2.04	1.97	1.93	1.89	2.02	
14	1.70		1.22		2.69	2.02	
15			1.57		1.55	0.98	
16						1.58	
17						1.89	
18							
19							
no. of cars per cycle	14	13	15	13	15	17	12

+7.2%							
cycle	15	16	17	18	19	20	21
vehicle							
1	2.91	1.41	1.48	1.20	2.47	2.37	2.72
2	1.55	1.30	2.88	2.31	1.90	1.59	1.34
3	1.54	1.61	1.84	1.85	3.32	1.31	1.12
4	2.14	1.93	1.95	1.81	2.38	1.62	1.76
5	0.88	1.51	2.91	1.29	1.22	1.12	1.37
6	2.36	1.52	1.24	1.64	1.63	1.90	3.89
7	1.23	2.05	1.75	1.28	1.47	2.16	2.19
8	1.83	1.86	1.61	2.16		1.52	1.09
9	2.09	1.03	1.30	1.21		2.37	1.32
10	2.59	1.57	1.93	1.37		1.77	1.37
11	1.47	2.50	1.10	2.10		2.40	1.29
12	1.72	1.15	2.37	1.49		2.14	1.97
13	1.46	1.60	1.71	1.29			1.50
14	2.35	0.98					1.76
15		1.20					
16		1.45					
17		1.84					
18							
19							
no. of cars per cycle	14	17	13	13	7	12	14

+7.2%							
cycle	22	23	24	25	26	27	28
vehicle							
1	2.08	1.88	2.10	1.69	2.32	1.72	3.84
2	1.44	1.39	2.60	2.84	1.86	1.48	1.27
3	2.35	1.79	1.76	1.88	1.53	1.77	1.69
4	2.26	1.44	1.13	1.21	1.92	1.02	1.54
5	3.06	1.24	1.94	2.02	1.93	1.69	1.70
6	1.38	2.12	1.77	1.29	2.11	1.64	1.36
7	1.45	1.20	1.30	1.36	1.19	1.34	1.44
8	1.55	2.42	1.70	1.27	1.34	1.11	1.68
9	1.56	1.75	3.26	1.45	1.35	1.39	1.30
10	1.49	1.46	2.74	1.24	1.84	1.97	2.80
11	2.11	3.37	1.40	2.22	1.43	2.10	1.98
12	1.57	2.90	3.10	1.54	1.28	1.68	1.82
13	1.30			1.16	2.19	1.43	1.69
14	1.75				1.62	2.05	2.12
15	1.58				2.08	1.37	1.29
16						1.58	
17							
18							
19							
no. of cars per cycle	15	12	12	13	15	16	15

+7.2%							
cycle	29	30	31	32	33	34	35
vehicle							
1	1.14	2.47	1.64	1.18	2.33	1.63	2.03
2	1.38	2.16	1.28	1.18	2.15	1.24	1.25
3	2.09	1.45	1.54	1.78	1.75	1.40	2.35
4	2.69	2.55	1.30	1.96	3.15	2.08	1.76
5	2.21	2.13	1.71	1.77	1.32	1.24	1.41
6	1.08	1.75	1.80	3.01		1.36	0.97
7	1.30	1.88	2.00	1.65		1.37	1.54
8	2.16	2.54	2.23			1.02	
9	1.93	2.45	2.30			2.32	
10	1.72	2.07	1.27				
11	1.58						
12	1.58						
13	1.41						
14	2.10						
15	1.04						
16							
17							
18							
19							
no. of cars per cycle	15	10	10	7	5	9	

+7.2%

cycle	36	37	38	39	40	41	42
vehicle							
1	1.33	2.40	2.65	1.35	2.27	1.91	1.88
2	1.79	1.65	1.88	2.12	1.04	2.16	2.75
3	2.95	1.36	2.23	1.89	1.79	1.09	1.94
4	1.18	2.14	2.50	2.41	1.44	1.97	1.26
5	1.52	1.52	1.15	1.89	1.26	2.77	1.92
6	1.70	1.83	1.74	1.46	2.03	1.94	1.56
7	2.12	1.18		1.66	2.20	1.58	1.91
8	2.20	1.73		1.72	2.62	1.75	1.22
9	3.28	1.25		2.52	1.88	1.70	1.21
10				2.81	3.25		2.62
11				1.47			1.52
12				1.20			0.59
13				2.08			1.34
14							1.68
15							0.99
16							1.87
17							1.45
18							
19							
no. of cars per cycle	9	9	6	13	10	9	17

+7.2%

cycle	42	43	44	45	46	47	48
vehicle							
1	1.88	1.90	3.23	1.92	2.04	1.98	3.40
2	2.75	2.77	2.25	2.36	2.07	1.90	1.46
3	1.94	1.93	3.44	1.31	1.21	1.88	2.41
4	1.26	1.34	1.94	1.24	1.40	1.41	3.07
5	1.92	1.51	1.19	1.65	1.65	1.42	1.52
6	1.56	1.25	1.27	1.35	1.11	1.85	1.30
7	1.91	1.23	1.73	0.82	1.55	1.39	1.32
8	1.22	1.79		2.26	1.84	1.17	1.38
9	1.21	1.47		1.72	1.41	1.32	2.94
10	2.62	1.71		1.01	1.37	1.25	2.23
11	1.52	1.33		1.47	1.83	2.16	1.13
12	0.59	1.27		1.27	1.21	2.35	1.14
13	1.34	2.52		1.54	2.52	2.10	2.64
14	1.68	1.26		2.52	1.07	1.47	1.22
15	0.99			1.34	2.50		1.47
16	1.87			1.47			
17	1.45			1.66			
18							
19							
no. of cars per cycle	17	14	7	17	15	14	15

+7.2%							
cycle	49	50	51	52	53	54	55
vehicle							
1	2.38	2.65	1.75	2.12	1.73	2.41	1.22
2	1.58	1.22	1.27	2.10	1.15	3.27	2.43
3	2.76	1.04	1.32	2.37	3.06	1.20	1.96
4	1.36	1.04	4.24	1.24	2.80	1.52	2.45
5	1.90	0.96	1.54	1.99	1.17	1.47	1.77
6	1.20	1.37	3.18	1.21	1.34	1.52	1.43
7	1.90	1.73	1.39	1.73	2.15	1.26	1.98
8	1.54	1.73	2.91	1.08	1.37	1.58	2.29
9	2.00	1.43	1.59	1.51	1.55	2.11	1.83
10	1.72	1.39	1.71	1.36	0.84	2.33	3.41
11	1.87	2.37	1.95	3.07	1.93	2.20	2.12
12	1.79		1.30	1.26	1.34	1.35	1.01
13	1.36		1.44	2.88	1.36	1.70	1.38
14	1.52		1.30	1.41	1.17		
15	1.46		1.66	1.45	3.01		
16							
17							
18							
19							
no. of cars per cycle	15	11	15	15	15	13	13

+7.2%

cycle	56	57	58	59	60	61	62
vehicle							
1	1.60	2.57	2.08	1.73	1.50	1.06	1.56
2	1.71	1.30	1.60	1.40	1.01	1.29	1.86
3	1.35	2.66	1.37	1.43	1.00	1.36	1.06
4	1.49	1.88	1.98	3.56	2.13	2.67	1.85
5	1.80	1.13	1.26	1.38	2.10	1.60	1.95
6	1.06	2.17	1.17	1.56	1.90	2.01	1.38
7	2.52	2.28	2.53	1.29	1.16	1.68	1.47
8	1.41	1.90	1.59	1.29	1.87	1.46	1.31
9	2.11	1.50	1.96	1.20	2.10	2.35	1.67
10	1.94	1.64	2.52	1.59	1.43	2.08	1.22
11	1.39	2.71	1.79	1.37	1.90	1.51	1.17
12		1.01	3.21	2.23	1.28	1.10	1.63
13		1.28	1.23	1.83	1.69	1.35	1.78
14		1.64	2.20	2.33	1.20	1.82	1.39
15		1.19			1.24	1.99	1.82
16					1.64		1.35
17					1.42		1.20
18							
19							
no. of cars per cycle	11	15	14	14	17	15	17

+7.2%							
cycle	63	64	65	66	67	68	69
vehicle							
1	2.04	1.44	1.48	1.86	2.48	2.37	1.41
2	2.99	2.03	1.46	1.96	1.49	2.52	1.47
3	1.35	1.32	1.66	1.98	1.37	2.67	1.93
4	1.35	1.45	2.53	1.81	1.56	1.97	1.63
5	1.19	2.30	1.56	1.62	1.18	2.41	1.56
6	1.63	1.99	1.48	2.37	1.71	2.23	1.91
7	2.19	1.48	2.61	2.70	1.22	1.24	1.43
8	3.21	1.69	1.84	1.40	3.03	1.86	1.03
9	1.15	1.28	1.65	1.56	2.52	2.55	1.64
10	1.64	1.52	2.49	1.29	1.61		1.06
11	1.45	1.50	1.50	1.36	1.57		1.23
12	2.99	1.24	1.92	2.10	1.42		1.19
13	1.91	0.99	1.27	1.91			2.25
14	1.50	1.81	1.17				2.13
15	1.76	1.59	2.21				1.50
16		1.15	1.16				
17		1.24					
18		1.20					
19							
no. of cars per cycle	15	18	16	13	12	9	15

+7.2%

cycle	70	71	72	73	74	75	76
vehicle							
1	1.63	2.47	1.84	1.97	1.67	1.92	0.30
2	0.73	1.47	2.60	2.71	1.46	1.45	2.91
3	2.07	1.10	2.20	1.17	1.38	1.38	2.24
4	1.98	1.50	2.03	1.82	2.74	1.09	1.82
5	1.33	1.43	1.55	1.81	0.62	2.30	1.13
6	1.81	1.70	1.95	1.51	2.04	3.17	2.16
7		1.72	1.33	2.61	1.99	3.13	2.20
8		1.69	1.47		2.23	1.47	1.39
9		1.88	1.43		2.06	1.00	1.49
10		1.60	1.34			2.06	
11		2.04	1.33			1.02	
12		1.25	1.27				
13		1.65	1.65				
14		1.44	1.33				
15							
16							
17							
18							
19							
no. of cars per cycle	6	14	14	7	9	11	

+7.2%							
cycle	77	78	79	8Ø	81	82	83
vehicle							
1	2.73	2.Ø3	2.7Ø	2.56	1.43	4.Ø2	2.76
2	1.18	1.56	2.Ø8	2.54	2.61	2.33	1.73
3	2.4Ø	2.98	1.97	1.83	1.5Ø	1.77	2.45
4	1.86	Ø.96	1.7Ø	2.74	1.86	1.Ø3	1.4Ø
5	2.51	5.47	1.71	1.16	2.71	1.41	Ø.93
6	1.31	1.4Ø	2.74	2.35	1.52	2.Ø3	3.36
7	1.51	3.49	1.59	2.39	2.34	1.75	1.75
8	1.86	1.93	2.9Ø	2.29	2.85	2.41	1.79
9	2.Ø2	1.53	2.8Ø	Ø.89	1.2Ø	1.4Ø	2.89
1Ø	2.51	1.92	1.94		1.77	2.51	1.83
11	1.17	1.56			2.59	1.78	1.62
12	2.19				1.78	2.95	2.32
13	1.51				1.42	Ø.67	1.99
14	1.97					2.76	1.15
15	1.81						
16							
17							
18							
19							
no. of cars per cycle	15	11	1Ø	9	13	14	14

+7.2%							
cycle	84	85	86	87	88	89	90
vehicle							
1	2.83	1.86	1.20	3.29	2.56	1.39	3.37
2	2.02	1.35	1.66	1.30	1.69	3.48	1.78
3	1.32	1.45	2.47	1.19	1.61	1.80	2.00
4	3.51	1.95	2.08	1.78	1.70	2.27	2.88
5	2.07	1.42	1.12	2.23	2.37	1.78	1.29
6	1.21	2.74	3.46	1.27	2.00	1.91	2.76
7	1.24	1.52	1.47	1.68	1.33	2.00	1.77
8	1.06	1.69	1.19	1.92	1.48	2.22	2.44
9	1.81	2.04	4.95	2.17	1.47	0.84	2.17
10	1.39	2.53	1.20	1.41	3.87	1.67	2.45
11	1.32	2.02	1.44	2.51	2.52	2.37	2.19
12	1.43		2.17	2.97	2.75	1.75	1.41
13	1.90		0.09	1.94	2.14	1.74	
14				1.18		1.66	
15				1.85			
16							
17							
18							
19							
no. of cars per cycle	13	11	13	15	13	14	12

+7.2% cycle	91	92	93	94	95	96	97
vehicle							
1	1.94	1.22	1.43	1.87	1.88	1.48	1.90
2	1.34	2.74	1.77	1.04	1.69	3.74	1.25
3	2.04	2.13	1.60	1.63	2.41	2.76	1.34
4	3.39	3.29	1.78	2.30	1.87	1.20	1.93
5	1.66	1.70	1.28	1.80	1.88	1.23	2.25
6	1.35	0.63	1.94	1.27	1.79	2.43	2.78
7	1.42	1.91	1.37	2.04	2.56	1.55	1.28
8	1.98	2.27	1.40	1.09	1.57	2.11	1.39
9	1.51	1.27	2.33	1.35	2.08	3.21	1.53
10	1.83	1.61	1.71	1.50	2.53	1.93	1.67
11	2.41	1.71	2.19	1.93	2.59	1.78	1.48
12	1.32	1.64	1.03	1.38	2.05	1.79	
13	2.31	1.52	1.11	1.44		1.59	
14	1.28	1.32	1.79	1.06		2.36	
15	1.28	1.63	1.57	2.13			
16			1.16				
17							
18							
19							
no. of cars per cycle	15	15	16	15	12	14	11

+7.2%							
cycle	98	99	100	101	102	103	104
vehicle							
1	2.19	2.04	2.01	1.58	2.31	2.17	1.43
2	1.25	1.28	1.55	1.86	1.44	2.22	1.72
3	2.36	2.40	2.17	1.41	2.09	2.12	1.95
4	2.23	2.59	3.01	1.48	1.39	2.20	2.16
5	2.29	2.64	1.19	2.03	2.05	1.58	1.88
6	2.21	1.67	1.67	2.42	1.92	1.92	1.65
7	1.27	2.26	2.27	2.16	1.66	1.82	2.00
8	2.11	2.27	1.80	1.67	1.74	1.46	1.91
9	1.72	1.14	1.68	1.46	2.48	2.82	1.64
10	1.44	1.43	1.61	1.90	2.27	1.31	1.48
11	2.20	1.97	1.70	1.61	2.74	2.45	1.78
12	2.84	1.64	1.82	2.62	2.58	1.89	1.94
13		0.42	1.43	1.62	1.30	1.45	2.80
14		2.57	1.09	2.01		1.40	1.93
15			1.64				1.86
16							
17							
18							
19							
no. of cars per cycle	12	14	15	14	13	14	15

+7.2%							
cycle	105	106	107	108	109	110	111
vehicle							
1	2.34	2.16	2.02	2.89	2.55	1.97	1.97
2	1.82	1.40	3.11	1.28	2.29	2.83	1.88
3	2.07	1.72	1.64	1.71	1.63	1.63	1.98
4	1.86	1.90	2.04	2.64	1.85	2.35	1.94
5	1.27	1.46	2.69	1.29	1.66	2.90	1.64
6	1.76	1.51	1.99	1.60	2.98	3.24	2.20
7	1.56	1.10	1.79	1.50	1.38	2.36	0.90
8	1.58	2.26	1.15	2.38	1.62		
9	1.89	1.50	2.10	1.25	1.53		
10	1.55	1.55	1.56	1.55	2.11		
11	1.63	1.46	1.89	2.93	2.02		
12	1.53	2.41	2.08	1.81			
13	1.43	2.05	1.70	1.81			
14	1.94	1.38		1.40			
15	1.67	1.92		1.54			
16	1.58						
17							
18							
19							
no. of cars per cycle	16	15	13	15	11	7	

+7.2%							
cycle	112	113	114	115	116	117	118
vehicle							
1	1.88	1.72	1.33	3.08	1.21	1.27	1.78
2	1.85	2.61	1.42	2.38	1.87	1.44	1.72
3	2.95	1.58	2.34	2.58	2.23	1.73	2.08
4	1.59	2.31	2.16	1.98	2.48	2.74	1.95
5	1.64	1.82	1.47	0.58	1.54	2.09	1.82
6	1.80	1.05	1.60	1.90	1.28		1.67
7	1.30	1.01	2.96	1.98	2.25		1.75
8	1.59	2.21	2.43	1.61	1.73		2.98
9	3.08	1.99	1.60	1.43	3.30		2.53
10	2.14	2.15	3.08	2.80	1.72		1.28
11	1.99	2.25			1.59		2.74
12	2.24	1.82			2.97		2.40
13					1.50		
14							
15							
16							
17							
18							
19							
no. of cars per cycle	12	12	10	10	13	5	12

+7.2%

cycle	119	120	121	122	123	124	125
vehicle							
1	2.03	2.29	1.65	2.19	1.32	2.35	2.71
2	2.12	2.38	1.79	3.58	1.73	2.06	1.42
3	1.62	2.09	1.60	1.90	2.15	1.78	1.92
4	2.10	2.32	2.06	1.51	1.23	2.32	1.20
5		3.17	1.27	1.66	2.47	2.16	1.72
6		1.90	3.72	2.05	1.45	2.65	1.24
7		1.62	1.62	1.29	1.74	1.80	2.17
8				1.63	1.39	1.41	2.17
9				3.11	2.18	2.58	1.51
10				1.57	1.29	1.44	1.95
11				1.87	3.85	2.10	2.54
12					1.39	2.24	1.13
13					2.19		
14					1.50		
15					1.53		
16							
17							
18							
19							
no. of cars per cycle	4	7	7	11	15	12	12

+7.2%

cycle	126	127	128	129	130	131	132
vehicle							
1	3.20	2.40	2.33	2.05	2.24	1.91	1.72
2	3.00	1.48	2.74	1.49	2.88	1.50	2.09
3	1.41	1.90	2.33	2.13	1.30	2.61	1.96
4	2.09	2.29	3.09	2.02	1.93	2.73	1.32
5	1.97	2.17	1.89	2.08	2.91	1.30	2.23
6	1.48	1.72	1.74	1.88	2.73	2.30	1.54
7	1.56	1.64	1.47	1.29	3.18	1.46	1.90
8	2.30	1.73	1.99	1.33	1.35	1.95	1.27
9	2.06	1.63	2.42	2.27	2.15	1.39	2.16
10	1.19	1.61	2.88	1.28	1.80	1.08	4.27
11	2.93	1.43	1.94	1.95	2.15	1.30	1.53
12	1.84	2.20		1.06	1.90	2.62	
13	2.37	1.70			1.09	1.63	
14	1.49	1.16				2.30	
15		1.54					
16							
17							
18							
19							
no. of cars per cycle	14	15	11	12	13	14	11

+7.2%							
cycle	132	133	134	135	136	137	138
vehicle							
1	1.72	1.07	1.75	3.26	2.67	3.00	2.47
2	2.09	1.57	3.39	1.68	1.95	3.07	3.37
3	1.96		1.16	2.29	1.65	2.36	1.15
4	1.32		1.97	1.16	1.12	1.31	1.62
5	2.23		1.35	2.26	1.25	1.71	2.15
6	1.54		2.86	1.98	1.64	1.63	2.75
7	1.90		1.34	1.36	1.81	3.18	1.48
8	1.27		1.48	2.41	2.83	1.02	1.66
9	2.16		2.30	1.84	2.31	1.95	1.81
10	4.27		1.46	1.29	1.33	2.33	2.43
11	1.53		1.68	2.97	1.43	2.59	2.11
12			1.31	1.32	1.66	1.73	2.31
13			2.16	1.56	1.82	0.90	2.04
14			2.69		1.86	1.96	2.09
15					1.81		
16							
17							
18							
19							
no. of cars per cycle	11	2	14	13	15	14	14

+7.2%

cycle	139	140	141	142	143	144	145
vehicle							
1	1.84	1.38	2.54	4.07	2.89	3.50	1.70
2	3.16	1.97	1.22	1.81	1.31	1.42	1.94
3	1.95	2.33	2.58	1.43	2.26	1.99	2.03
4	1.71	1.73	1.52	2.07	1.54	2.44	1.87
5	3.64	2.16	1.54	1.46	2.29	1.84	1.66
6	1.57	1.87	1.23	1.79	1.81	1.96	1.66
7	1.42	1.89	1.66	2.53	2.66	1.06	2.08
8	1.47	2.51	2.17	1.04	1.33	2.02	2.07
9	2.62	1.98	2.05	1.55	1.67	1.75	1.64
10		1.65	0.92	1.25	1.07	1.44	1.46
11		2.15	2.57	2.59	2.20	1.42	2.12
12		1.92	2.30	1.30	1.37	1.98	1.79
13		1.68	2.40	2.66	1.31	2.16	1.52
14		1.28		1.96	2.41	2.23	1.95
15					1.08	0.79	1.55
16							
17							
18							
19							
no. of cars per cycle	9	14	13	14	15	15	15

+7.2%							
cycle	146	147	148	149	150	151	152
vehicle							
1	3.01	1.95	1.67	1.85	2.91	2.74	1.29
2	2.06	3.10	1.24	2.00	1.53	1.77	2.34
3	1.27	3.15	3.19	3.14	1.59	1.10	2.36
4	1.92	1.48	1.14	1.13	1.63	1.97	1.83
5	1.64	2.20	1.77	1.73	1.96	2.67	1.37
6	1.58	2.17	1.21	2.90	2.02		1.13
7	1.90	3.13	3.09	2.40	2.50		1.29
8	2.09	3.08	2.00	1.46	1.72		1.94
9	2.20	2.39	2.32	1.11	1.65		1.23
10	2.05	2.53	1.38	1.37	1.90		2.75
11	1.65	1.97	1.93	2.03	2.23		2.34
12	2.35		2.12	2.69	2.18		1.73
13	1.82		1.89	1.97	2.02		2.02
14	2.06		1.78	1.60			1.85
15				1.45			
16							
17							
18							
19							
no. of cars per cycle	14	11	14	15	13	5	14

+7.2% cycle	153	154	155	156	157	158	159
vehicle							
1	2.73	2.66	1.78	1.20	3.64	2.31	2.85
2	1.90	2.33	2.89	2.61	2.88	2.97	1.74
3	1.44	2.84	2.47	2.03	1.27	1.52	2.75
4	1.33	1.52	2.25	2.52	3.53		1.76
5	1.03	1.57	1.51	2.10	3.48		1.71
6	1.68	1.78	1.29	3.38	1.61		1.41
7	1.12	1.26	1.58	3.04	1.43		0.93
8	1.44	1.86	1.93	1.75	1.73		2.19
9	1.59	1.78	3.15	3.26	1.85		1.21
10		3.41	2.20	2.55			1.42
11			1.45	0.92			1.73
12			1.84				2.49
13							1.69
14							2.61
15							
16							
17							
18							
19							
no. of cars per cycle	9	10	12	11	9	3	14

+7.2%

cycle	160	161	162	163	164	165	166
vehicle							
1	1.90	1.83	2.58	1.32	2.49	1.53	1.23
2	1.26	1.32	1.41	1.70	1.32	2.50	2.27
3	2.74	1.49	1.09	1.57	1.06	1.36	2.09
4	1.35	1.88	0.99	1.72	1.86	1.26	1.31
5	3.40	3.11	1.22	2.10	2.10	1.66	1.35
6	1.23	1.78	1.61	1.11	1.66	2.54	3.62
7	1.90	2.18	0.98	1.30	2.74	1.32	1.54
8	1.54	1.43	1.85	1.68	1.40	1.27	2.28
9	1.71	2.27	1.87	1.19	1.42	1.48	1.69
10	1.66	2.66	1.63	2.34	1.31	0.94	1.95
11	1.02	1.56	1.37	2.02	0.96	2.08	2.56
12	1.79	4.01	2.84	1.22	2.12	1.98	1.36
13	0.32	1.97	1.42	1.93	2.12	1.35	2.87
14	3.99		0.99	1.11	2.83	1.74	1.56
15			2.18	1.75	1.42	2.76	
16			1.14	1.25		1.42	
17						1.16	
18							
19							
no. of cars per cycle	14	13	16	16	15	17	14

+7.2%							
cycle	174	175	176	177	178	179	180
vehicle							
1	1.59	1.66	1.77	1.98	2.26	2.45	1.51
2	1.10	2.47	1.65	1.63	1.51	1.20	1.56
3	4.16	1.86	1.73	2.36	2.13	1.81	1.99
4	1.40	3.44	2.09	1.74	2.07	2.67	2.97
5	1.72	1.25	1.75	1.98	1.11	1.96	1.74
6	1.99	1.58	1.33	1.03	2.49	1.52	3.00
7	2.21	2.46	1.70	1.59	1.77	2.36	2.05
8	2.90	1.70	1.26	2.05	2.36	0.96	1.97
9	1.33	1.54	1.66	1.53	2.00	1.50	1.18
10	2.13	1.10	1.55	1.13	1.50	1.14	1.21
11	1.40	3.35	2.94	2.30	2.17	1.38	1.69
12	1.46	2.45	1.31	2.55	1.21	1.21	1.27
13	1.21		2.30	1.95	2.11	1.98	1.79
14	2.30		1.12	2.55	0.85	1.94	1.58
15	1.57		1.41	1.27		1.40	1.64
16							
17							
18							
19							
no. of cars per cycle	15	12	15	15	14	15	15

+7.2% cycle	167	168	169	170	171	172	173
vehicle							
1	2.08	6.51	1.39	2.83	1.64	2.16	1.61
2	1.45	3.18	2.53	1.60	1.73	1.97	1.87
3	1.37	2.75	1.61	2.13	1.11	1.77	2.15
4	1.94	2.57	1.76	1.91	3.40	1.35	1.09
5	2.28	2.66	1.21	2.42	1.14	1.23	2.04
6	1.95	1.77	1.24	1.28	1.49	1.25	1.11
7	1.53	3.20	1.78	2.40	2.33	2.63	1.57
8	1.93	2.52	3.28	1.33	2.08	1.06	1.03
9	1.21	2.38	0.84	1.31	1.19	1.33	2.17
10	1.33		1.25		1.75	3.02	1.06
11	1.48		1.27		1.34	2.27	3.15
12	1.22		1.92		2.12	1.07	1.91
13	2.64		1.02		1.33	3.62	
14	2.16				1.22	2.11	
15	2.30				0.98		
16							
17							
18							
19							
no. of cars per cycle	15	9	13	9	15	14	12

+7.2%

cycle	181	182	183	184	185	186	187
vehicle							
1	1.77	3.01	1.23	1.90	2.53	2.47	1.84
2	1.50	3.14	2.18	0.94	1.86	1.77	1.59
3	1.81	1.59	2.84	1.13	3.35	2.81	2.04
4	2.20	1.85	1.73	1.17	1.63	2.04	1.12
5	1.36	2.21	1.39	1.93	1.84	1.60	2.07
6	1.27	1.68	1.40	1.63	1.25	1.81	2.23
7	1.76	2.08	0.99	1.13	4.62	1.40	2.19
8	1.80	1.72	2.46	1.21		1.62	3.07
9	1.79	1.24	1.64	3.74			1.51
10	2.87	1.96	1.53	2.19			2.24
11	2.01	2.09	1.39	1.14			2.76
12	2.02	2.52	1.25	1.47			
13	1.93	2.00		1.46			
14	2.26			1.59			
15	2.23			1.55			
16				1.19			
17							
18							
19							
no. of cars per cycle	15	13	12	16	7	8	11

+7.2%							
cycle	188	189	190	191	192	193	194
vehicle							
1	2.30	1.61	1.68	1.95	2.10	1.97	1.60
2	1.95	1.27	1.99	2.37	1.93	1.96	1.05
3	1.72	1.96	2.37	1.53	3.71	1.97	3.05
4	3.11	1.16	4.14	1.54	1.47	3.20	1.45
5	1.91	1.49	2.78	3.27	1.67	2.05	1.60
6	1.63	2.02	1.45		1.57	0.89	1.61
7	2.85	2.64	3.04		2.43	1.56	2.76
8		2.58	1.66		1.41	2.86	0.94
9		3.24	1.52			1.34	2.27
10		2.61				1.18	1.61
11		1.98				2.32	0.95
12						1.62	
13							
14							
15							
16							
17							
18							
19							
no. of cars per cycle	7	11	9	5	8	12	11

+7.2%

cycle	195	196	197	198	199	200	201
vehicle							
1	1.94	2.42	3.00	2.99	2.93	1.19	1.81
2	2.29	2.28	1.26	1.55	1.62	1.91	1.64
3	1.42	1.22	1.66	1.77	1.25	1.78	2.95
4	1.16	2.40	1.51	1.67	1.47	1.62	2.16
5	1.17	1.42	1.18	5.36	1.40	2.41	2.04
6	3.03	1.34	1.64	1.87	1.30	1.30	1.81
7	1.37	1.14	1.59	2.25	1.58	1.44	2.03
8	1.95	1.79	1.30	1.33	1.58	2.20	1.30
9	0.96	1.47	2.24	1.22	1.68	2.22	2.21
10	1.94	1.80	1.47	2.22	1.80	1.52	1.50
11	1.73		2.95	2.05	1.46	1.18	1.03
12	1.72		1.52	1.96	2.33	1.17	2.67
13	1.77		1.46	1.64	2.40	1.30	2.06
14	2.59		1.98		1.83	1.06	
15	1.06		2.66		2.37	1.39	
16						1.22	
17						1.19	
18							
19							
no. of cars per cycle	15	10	15	13	15	17	13

+7.2%							
cycle	202	203	204	205	206	207	208
vehicle							
1	1.34	2.00	1.41	1.54	1.69	1.32	2.10
2	1.43	2.00	1.54	2.69	1.93	2.22	1.86
3	2.06	2.12	1.70	2.16	1.32	1.37	2.46
4	2.23	1.61	1.86	1.58	1.14	1.27	1.67
5	1.67	1.63	1.79	1.82	1.24	2.17	1.35
6	2.14	2.75	1.95	1.17	1.24	1.63	2.63
7	1.41	1.36	1.79	1.64	2.67	1.04	1.91
8	2.67	1.41	2.03	1.91	1.82	1.44	1.68
9	1.55	1.90	2.10	1.89	1.04	1.74	2.28
10	2.37	1.26	1.24	1.95	1.80	1.62	2.48
11	2.13	1.26	1.50	2.18	1.76	1.10	1.22
12	1.05	1.14	0.94	1.15	2.47	1.02	1.24
13	3.14	1.48	2.20	1.69		2.61	1.19
14	1.48	1.69	1.20	1.77		1.14	1.03
15			1.91				2.02
16			1.38				
17							
18							
19							
no. of cars per cycle	14	14	16	14	12	14	15

+7.2%							
cycle	209	210	211	212	213	214	215
vehicle							
1	1.46	1.18	1.68	1.55	2.02	8.82	1.47
2	2.03	2.22	3.02	3.06	1.10	4.15	1.75
3	2.23	2.66	1.36	1.44	2.01	2.68	2.01
4	1.83	2.09	1.34	1.31	1.87	3.58	2.21
5	1.91	1.62	2.22	1.56	1.10	2.51	1.72
6	1.23	1.52	1.77	1.22	1.38	2.19	1.60
7	1.36	2.05	1.62	1.92	3.23	2.29	1.47
8	2.51	1.84	1.41	1.53	2.33		2.84
9	1.51	1.49	1.61	1.46	1.48		1.34
10	2.09	1.27	1.47	1.79	1.28		1.65
11	1.16	1.61	1.32	2.01	1.42		1.71
12	1.50	1.27	1.93	1.32	1.67		1.52
13	1.15	2.73	1.63	2.72	1.44		1.73
14	1.85	0.77	2.82	1.30	1.73		2.08
15	1.56	1.30	1.76	2.80	1.90		1.50
16	1.68						
17							
18							
19							
no. of cars per cycle	16	15	15	15	15	7	15

+7.2%

cycle	216	217	218	219	220	221	222
vehicle							
1	2.26	1.65	1.33	1.67	2.28	3.26	2.69
2	1.91	1.98	1.40	2.52	2.33	1.51	1.50
3	1.35	1.83	3.34	2.32	2.97	1.36	2.24
4	2.14	1.36	1.37	1.36	1.25	2.05	1.20
5	2.87	1.49	1.56	1.37	1.34	1.67	1.02
6	1.53	1.88	1.77	1.36	2.31	1.35	1.45
7	2.72	1.26	1.54	1.35	2.53	1.61	2.05
8	0.99	2.12	1.64	2.63		2.28	
9	1.52	1.45	1.57	1.88			
10	2.54	1.69	1.31	1.67			
11	1.21	1.65	1.31	1.83			
12	1.56	1.65	1.29	1.28			
13	1.39	1.76	2.61	1.33			
14	1.53	0.96	1.22	1.88			
15	2.38	2.83	1.32	1.08			
16		1.67					
17		1.79					
18							
19							
no. of cars per cycle	15	17	15	15	7	8	

+7.2%							
cycle	223	224	225	226	227	228	229
vehicle							
1	2.33	2.37	1.16	0.44	2.30	1.69	2.53
2	1.83	1.04	1.64	2.41	1.97	2.26	1.15
3	1.24	1.73	2.44	2.02	1.61	1.41	3.50
4	1.52	1.65	2.53	1.03	2.70	2.06	1.07
5	1.01	1.66	1.36	1.56	1.80	1.81	1.66
6	0.79	1.36	1.33	1.35	1.48	1.80	2.79
7		3.52	1.21	2.07	1.08	1.73	1.73
8		1.20	2.97	1.87	1.13	2.11	1.68
9		1.14	1.34	1.55	1.34	2.07	2.06
10		1.26	1.82	1.41	1.47	1.91	2.24
11			2.65	1.42	2.79	2.52	2.44
12				1.61	2.78	1.74	
13				1.17	2.87	2.48	
14				1.26	1.73		
15				1.45	1.53		
16				1.33			
17				1.78			
18				1.67			
19				1.53			
no. of cars per cycle	6	10	11	19	15	13	11

+7.2%							
cycle	230	231	232	233	234	235	236
vehicle							
1	1.39	2.61	1.16	3.01	1.02	2.88	2.17
2	5.22	1.49	2.23	1.24	1.87	1.97	2.00
3	1.45	2.37	1.67	1.38	1.53	1.58	2.26
4	4.58	1.03	1.82	1.41	1.17	1.85	2.44
5	2.36	1.84	1.63	1.70	2.51	1.50	1.17
6	1.83	1.34	1.11	2.70	2.05	1.45	1.88
7	1.32	2.24	1.54	1.83	1.26	1.66	1.48
8	1.79	1.08	1.84	2.34	1.21	1.58	2.03
9	2.38	1.56	2.30	1.63	1.07	1.99	1.82
10	1.66	1.14	1.78	1.26	1.54	0.82	1.28
11	1.88	2.35	2.50		2.18		1.59
12	1.62	1.91	3.21		2.85		1.67
13		1.85			2.66		1.74
14		2.30			2.15		3.06
15		1.31					1.18
16		2.19					
17							
18							
19							
no. of cars per cycle	12	16	12	10	14	10	15

+7.2%							
cycle	237	238	239	240	241	242	243
vehicle							
1	2.86	1.27	1.56	2.30	1.67	2.75	1.57
2	1.47	2.35	1.79	1.82	2.20	2.96	1.37
3	1.73	0.93	1.56	2.74	2.85	2.06	2.62
4	4.11	1.24	1.48	1.34	1.55	1.46	1.77
5	1.86	2.30	2.78	1.91	1.87	1.59	1.27
6	2.20	1.68	1.30	2.46	1.35	1.22	1.32
7	1.28	2.31	2.25	1.71	1.98	1.83	1.46
8	1.62	1.77	1.76	1.69	1.36	1.76	1.59
9	1.50	2.45	1.72	1.55	1.24	1.57	1.77
10	1.56	1.94	1.19	2.89	2.42	1.10	1.69
11	1.82	3.63	1.51	1.26	2.00	1.64	1.27
12	1.92	2.51	2.69	2.27	2.51	2.36	2.69
13	1.48	2.12	1.62	1.20	2.27	1.88	2.25
14	1.17		2.14		1.03	1.82	1.49
15			2.36			3.26	2.54
16							
17							
18							
19							
no. of cars per cycle	14	13	15	13	14	15	15

+7.2%

cycle	243	244	245	246	247	248	249
vehicle							
1	1.57	2.46	2.34	1.47	1.91	2.25	1.43
2	1.37	1.81	1.79	1.36	2.07	1.72	1.99
3	2.62	1.39	1.57	3.46	2.83	1.42	1.64
4	1.77	2.06	1.73	1.28	1.34	2.33	2.89
5	1.27	2.91	3.16	1.75	1.06	1.34	1.40
6	1.32	1.43	2.34	1.79	1.29	1.71	1.75
7	1.46	2.13	1.67	2.42	1.79	1.74	1.49
8	1.59	1.61	1.29	1.34	3.18	1.41	1.55
9	1.77	2.10	1.39	2.47	1.32	1.90	2.56
10	1.69	1.92	2.12	1.68	1.42	1.55	1.83
11	1.27	1.64	2.90	2.09	2.09	1.27	2.27
12	2.69	2.11	1.41	1.33	1.68	1.20	1.75
13	2.25	1.58	1.85		1.58	2.27	1.74
14	1.49	2.21			1.11	1.81	1.45
15	2.54				1.06	1.92	1.41
16						1.80	
17						1.47	
18							
19							
no. of cars per cycle	15	14	13	12	15	17	15

+7.2% cycle	250	no. of cycles	mean headway (secs)	+7.2% stand dev	HEADWAYS min head	max head
vehicle						
1	1.42	250	2.09	0.82	0.30	8.82
2	0.43	250	1.94	0.64	0.43	5.22
3	2.18	249	1.93	0.59	0.93	4.16
4	0.65	248	1.90	0.66	0.20	4.58
5	3.55	247	1.81	0.63	0.58	5.47
6	1.62	242	1.79	0.59	0.63	3.97
7	2.06	239	1.82	0.58	0.82	4.62
8	1.81	225	1.81	0.51	0.94	3.28
9	2.36	222	1.82	0.57	0.84	4.95
10		204	1.80	0.57	0.82	4.27
11		192	1.90	0.56	0.92	3.85
12		175	1.83	0.58	0.59	4.01
13		151	1.79	0.53	0.09	3.62
14		121	1.74	0.54	0.77	3.99
15		82	1.69	0.51	0.79	3.26
16		22	1.47	0.27	1.14	2.19
17		12	1.51	0.26	1.16	1.89
18		2	1.44	0.24	1.20	1.67
19		1	1.53	0.00	1.53	1.53

no. of cars per cycle 9

-7.2% HEADWAY

cycle	1	2	3	4	5	6	7
vehicle							
1	1.98	1.30	1.64	1.76	1.87	1.46	1.96
2	1.99	1.39	2.13	1.45	1.89	2.22	2.14
3	1.80	3.50	2.37	1.82	3.27	2.16	1.36
4	1.60	1.76	1.23	2.00	1.04	1.85	1.10
5	1.09	1.52	1.21	1.91	2.50	1.97	2.04
6	2.07	1.57	1.62	1.77	1.81	1.31	1.78
7	2.94	1.22	1.37	1.74	1.40	1.78	2.03
8	1.59	2.42	2.56	1.88	1.82	1.52	1.48
9	2.24	1.58	3.47	1.34	1.27	2.81	1.46
10	1.30	1.94		2.13	1.64	1.31	2.14
11		1.91		2.75	2.09	2.18	1.84
12				1.85	1.81	3.16	1.53
13				1.54	3.70	1.04	2.08
14					1.11	1.66	1.07
15					1.82	1.12	2.50
16							
17							
18							
no. of cars per cycle	10	11	9	13	15	15	15

-7.2%							
cycle	8	9	10	11	12	13	14
vehicle							
1	1.23	2.43	1.67	2.21	2.30	1.65	1.91
2	1.91	1.87	1.76	5.83	1.57	1.59	2.07
3	1.39	1.96	3.50	1.11	2.82	1.73	2.04
4	2.00	1.93	2.40	2.50	1.17	1.80	1.80
5	2.18	2.00	1.70	1.20	2.01	2.55	2.45
6	1.79	1.92	1.46	1.32	1.08	1.48	1.58
7	2.27	2.47	1.44	1.25	1.66	2.42	1.26
8	2.13	1.46	2.01	1.58	1.93	1.54	1.98
9	1.77	2.01	2.07	2.81	2.56		2.50
10	1.39	3.36	3.26	1.79	1.63		1.68
11	1.95	2.66	2.85	2.04	2.17		
12	0.97	1.39	2.12		2.11		
13	1.61	1.45	1.66		0.69		
14	2.14	1.06			2.03		
15	1.57						
16							
17							
18							
no. of cars per cycle	15	14	13	11	14	8	10

-7.2%

cycle	15	16	17	18	19	20	21
vehicle							
1	1.35	1.47	2.37	2.53	2.30	2.12	1.47
2	1.75	1.76	4.05	1.53	1.61	2.22	2.05
3	1.58	1.63	1.56	3.04	1.97	2.07	1.04
4	1.70	2.74	1.44	4.01	1.95	1.59	2.70
5	3.60	1.88	2.92		1.21	1.62	1.16
6	1.83	1.51	2.65		3.28	1.88	2.34
7	1.82	1.34	1.60		1.70	2.56	1.30
8	2.88	2.20	1.76		1.42	1.83	1.36
9	2.04	4.67	1.34		1.43	1.84	0.97
10	2.07				2.65	1.70	1.89
11					1.80	2.94	1.65
12					1.71	1.95	1.79
13					1.49	2.54	1.56
14					1.37		1.58
15					1.19		3.47
16					2.06		
17							
18							
no. of cars per cycle	10	9	9	4	16	13	15

-7.2%

cycle	22	23	24	25	26	27	28
vehicle							
1	2.37	1.21	3.18	1.89	4.43	2.43	2.88
2	1.50	3.42	1.94	1.32	1.60	2.44	3.10
3	0.34	1.47	2.01	1.48	1.31	2.24	2.59
4	2.23	1.68	2.51	1.71	0.61	1.83	2.24
5	2.29	1.01	1.24	1.25	1.42	3.17	1.72
6	2.03	4.30	1.73	1.92	1.64	1.73	1.91
7	1.57	1.17	1.29	2.43	1.80	2.76	1.67
8	2.97	1.95	1.62	1.90	2.47	1.37	1.43
9	1.90	1.29	1.17	1.99	2.72	1.51	1.11
10	2.35	1.51	2.17	2.26	1.70	2.07	2.17
11	1.65	3.06	1.38	1.21	2.13		1.52
12	1.72	0.90	1.48	2.18	2.48		1.84
13	3.15	1.51	2.87	1.69	2.34		1.82
14	1.21	1.23	1.73	1.45			
15	1.09	1.69	1.60	2.21			
16							
17							
18							
no. of cars per cycle	15	15	15	15	13	10	13

-7.2%							
cycle	29	30	31	32	33	34	35
vehicle							
1	1.66	1.23	2.60	1.60	1.22	1.85	1.49
2	1.79	2.38	2.82	2.67	1.89	1.99	1.31
3	2.84	1.58	1.63	1.70	2.89	1.61	2.00
4	1.81	1.83	1.26	3.41	1.01	1.61	1.72
5	2.56	1.42	1.19	1.84	1.53	1.88	2.97
6	2.49	1.21	3.11	3.11	2.65	2.08	0.67
7	2.02	0.99	1.99	1.14	2.81	1.20	
8		1.54	1.24	2.50	2.30	1.22	
9		1.91	4.30	3.69	1.67	1.93	
10		1.00	1.11	2.05	2.27	1.91	
11		1.53	2.19		1.90	2.84	
12		2.71	1.35		2.59	1.48	
13		2.53	2.29		1.66	1.92	
14		2.03	1.69		1.80	2.85	
15		2.39			1.21	1.58	
16							
17							
18							
no. of cars per cycle	7	15	14	10	15	15	

6

-7.2%							
cycle	36	37	38	39	40	41	42
vehicle							
1	1.49	3.24	1.92	1.54	1.50	1.98	0.78
2	3.08	1.34	1.52	2.54	1.20	1.76	1.93
3	1.84	2.56	2.51	1.00	1.31	2.40	3.12
4	1.88	3.16	2.94	1.22	1.84	2.62	1.41
5	2.52	1.24	0.70	3.06	2.04	2.05	1.59
6	1.41	1.66	1.96	1.41	3.21	1.32	2.30
7	1.80	1.64	1.74	1.30	1.79	1.50	2.38
8	1.64	1.52	1.92	2.88		1.95	1.11
9	1.47		2.01	1.60		2.33	2.44
10	1.26		0.99	2.75		1.05	2.51
11	1.23		2.20	2.60		2.60	1.66
12	2.81		1.47	2.19		2.92	
13	1.63		1.41	1.29		1.46	
14	1.23		1.34	3.12			
15	1.44						
16							
17							
18							
no. of cars per cycle	15	8	14	14	7	13	11

-7.2%							
cycle	43	44	45	46	47	48	49
vehicle							
1	1.14	2.72	2.50	2.73	1.67	1.82	1.72
2	1.42	2.18	1.90	1.08	3.14	1.23	2.16
3	1.68	1.33	2.26	1.88	1.16	1.34	2.85
4	0.71	1.48	2.00	1.86	1.25	2.81	1.02
5	2.55	1.46	2.51	3.29	1.21	1.40	3.39
6	1.28	1.04	1.48	1.50	1.21	1.93	1.42
7	1.37	1.93	2.07	1.21	1.75	1.25	3.39
8	3.93	2.37	2.41	1.60	2.06	0.93	1.52
9	2.11	1.02	1.50	1.49	1.75	2.25	1.07
10		1.30	1.22	1.82	1.21	2.23	2.20
11		1.59	3.79	1.39	1.24	1.15	0.95
12		2.24	2.51	1.46	3.37		1.46
13		1.93	1.00	1.96			2.11
14		0.83	1.26				1.02
15		2.48					
16		1.70					
17							
18							
no. of cars per cycle	9	16	14	13	12	11	14

-7.2%

cycle	50	51	52	53	54	55	56
vehicle							
1	1.79	2.23	1.51	1.59	2.18	1.54	1.30
2	1.38	1.77	1.73	2.88	1.98	2.23	1.50
3	1.80	2.18	1.14	2.28	1.44	1.45	1.25
4	1.33	1.88	3.45	1.64	1.53	1.39	2.08
5	2.04	1.07	1.65	1.54	1.06	3.11	2.09
6	2.19	2.06	1.87	3.40	1.57	1.40	1.08
7	1.56	2.90	1.96	2.66	1.79	1.65	2.05
8	1.58	1.26	1.77	1.65	2.96	1.83	1.08
9	1.43	1.84	1.85	2.20	2.37	2.72	2.61
10	1.32	1.87	2.00	1.51	1.63	2.59	1.53
11	2.26	3.10	1.90	1.63	1.59	2.92	2.44
12	1.32	1.07	1.62	1.46	2.09	2.12	1.58
13	2.17	2.03	1.42	1.93	2.21	1.16	1.94
14	1.52	2.56	1.54	1.95	0.86		2.12
15	2.74				2.36		
16							
17							
18							
no. of cars per cycle	15	14	14	14	15	13	14

-7.2% cycle	57	58	59	60	61	62	63
vehicle							
1	1.32	1.72	2.04	1.83	1.74	1.44	2.37
2	2.83	1.54	2.00	1.67	1.83	1.70	2.01
3	2.29	3.04	1.64	1.30	2.76	1.93	2.19
4	1.38	1.35	2.57	1.41	1.28	2.45	3.04
5	1.52	1.13	3.62	0.54	3.05	2.07	2.36
6	1.31	2.12	1.41	2.13	2.01	1.18	1.30
7	1.68	1.61	0.94	1.84	1.62	1.44	1.48
8	2.20	1.77	1.97	1.63	2.10	1.17	1.25
9	1.50	2.42	2.14	1.56	3.17	1.70	1.38
10	1.44	2.48	1.61	2.73	1.54	2.17	0.86
11	1.26	1.97	1.68	1.76	1.84		2.64
12	3.22	2.05	1.55	1.62			1.29
13	2.74	2.58	2.87	2.55			1.56
14			1.59	2.75			
15							
16							
17							
18							
no. of cars per cycle	13	13	14	14	11	10	13

-7.2%							
cycle	64	65	66	67	68	69	70
vehicle							
1	3.28	1.50	1.87	2.07	1.68	1.63	1.55
2	1.68	1.86	2.18	1.54	0.70	1.18	2.13
3	2.06	1.78	1.35	1.73	3.46	2.69	1.70
4	1.99	1.40	4.03	1.37	1.65	1.86	2.50
5	1.35	1.90	0.91	2.05	2.99	1.44	1.62
6	2.40	1.92	2.04	3.16	2.00	1.88	1.38
7	0.71	1.82	2.18	2.05	2.79	3.74	1.58
8	1.57	1.66	1.96	1.61	1.51	2.20	2.43
9	1.45	1.93	1.43	1.16	2.81	2.38	1.54
10	1.27	3.34	3.11	1.84		3.11	
11	4.23	1.06	2.13	3.12		1.99	
12	1.32	2.26		2.03		1.35	
13	1.80	2.06				2.04	
14		1.36				1.75	
15							
16							
17							
18							
no. of cars per cycle	13	14	11	12	9	14	9

-7.2%							
cycle	71	72	73	74	75	76	77
vehicle							
1	2.42	0.61	1.40	2.22	1.37	1.28	1.08
2	1.98	1.33	1.28	2.75	1.77	1.30	2.37
3	1.12	3.14	1.86	1.54	1.32	1.12	1.43
4	2.36	0.78	3.36	2.59	1.86	2.30	1.99
5	2.32	2.03	2.26	1.41	3.03	1.43	1.95
6	1.42	1.35	1.33	1.77	1.65	2.80	2.06
7	1.67	1.57	1.89	2.38	2.24	1.77	1.28
8	2.53	1.27	1.30	2.00	2.77	1.80	2.58
9	2.60	2.15	2.74	1.47	2.16	1.11	1.20
10	1.59	1.85	1.29	2.72	2.60	1.92	3.95
11	1.88	1.19	0.83		0.97	1.54	1.65
12	1.72	2.90	4.17		2.11	2.08	1.55
13	1.49	1.67	2.35		1.73	0.90	2.22
14	2.90	1.24			1.33	2.31	1.36
15		2.29				3.12	1.53
16							
17							
18							
no. of cars per cycle	14	15	13	10	14	15	15

-7.2%							
cycle	78	79	80	81	82	83	84
vehicle							
1	1.36	3.49	1.76	1.84	0.74	1.53	1.87
2	2.37	1.16	3.34	1.88	1.70	1.93	2.07
3	2.93	2.11	2.97	2.40	1.64	1.86	2.43
4	1.73	1.50	1.85	2.07	1.59	2.18	1.53
5	0.80	2.94	1.61	2.13	1.57	1.63	2.18
6	1.52	1.76	1.94	2.17	2.51	2.25	2.19
7	1.81	1.16	2.52	2.94	2.49	2.60	2.23
8	2.63	1.40	2.12	1.35	1.36	5.35	3.32
9	1.67	2.24	1.62	1.69	1.41	1.18	2.31
10	1.45	3.27	1.46	1.34	2.02	1.74	1.47
11	1.89	1.03	2.11	1.45	2.71	2.11	1.21
12	2.43	1.65	1.78	2.01	1.74	1.89	3.33
13	1.86	1.89	1.69	1.37	1.69	1.68	
14	1.51			2.55		1.81	
15	1.5[illegible]						
16							
17							
18							
no. of cars per cycle	15	13	13	14	13	14	12

-7.2%

cycle	85	86	87	88	89	90	91
vehicle							
1	1.16	1.81	2.11	1.80	2.26	1.79	1.22
2	2.53	1.03	2.29	2.62	2.56	3.22	1.66
3	1.43	1.81	0.77	1.37	2.24	1.67	2.26
4	2.17	1.49	1.99	1.58	1.39	1.94	1.95
5	2.43	2.02	1.01	1.74	1.02	2.40	1.93
6	1.18	1.12	2.57	5.27	1.82	3.54	2.07
7	1.63	2.02	4.27		2.15	1.73	2.48
8	1.83	1.56	1.85		1.01	2.79	2.41
9	1.47	2.25	1.11		2.50	1.47	1.41
10	2.34	1.77	1.64		1.04	1.38	1.08
11	2.31	1.04	1.42		2.10	2.50	1.52
12	2.08	1.30	2.99			2.36	2.48
13	1.72	1.71	1.92			2.43	1.60
14	1.71	2.65	2.63				1.76
15	1.93	2.71					1.99
16							
17							
18							
no. of cars per cycle	15	15	14	6	11	13	15

-7.2%

cycle	92	93	94	95	96	97	98
vehicle							
1	1.22	1.68	1.92	1.95	1.95	3.19	1.57
2	2.62	1.55	1.02	2.39	1.25	1.81	1.51
3	1.35	2.24	2.49	2.03	1.41	1.90	1.10
4	1.48	1.59	1.65	1.86	1.80	2.06	3.79
5	2.98	3.66		1.03	1.75	1.48	1.68
6	1.83	2.32		2.78	1.41	2.64	1.09
7	1.83	1.34		1.34	1.20	2.13	1.69
8	3.56	2.91		2.97	1.37	1.49	4.82
9	1.67	1.83		2.11	1.60	2.32	1.29
10	1.63	1.19		1.40	1.37	1.66	1.56
11	2.39	1.26		2.81	3.18	1.38	1.65
12		2.58		1.13	1.72	5.42	1.76
13		2.61		1.89	2.40		
14		1.07			1.15		
15							
16							
17							
18							
no. of cars per cycle	11	14	4	13	14	12	12

-7.2%

cycle	99	100	101	102	103	104	105
vehicle							
1	1.81	1.50	1.51	0.96	1.55	1.63	1.13
2	1.97	0.94	1.91	1.27	1.70	1.63	1.33
3	2.72	2.42	1.33	0.98	1.73	1.52	2.37
4	1.64	2.59	3.44	4.18	1.39	2.04	1.64
5	2.00	1.56	3.40	2.06	1.12	3.09	2.11
6	2.51	1.41	1.77	1.27	1.83	1.62	3.58
7	1.51	2.24	1.76	1.81	1.74	2.47	1.45
8	1.93	2.31	1.37	2.00	3.10	2.82	1.79
9	1.56	2.34	1.15	1.03	2.09	2.11	2.37
10	1.37	1.35	1.57	1.16	2.20	1.62	2.05
11	2.71	1.39	1.54		1.87	3.18	1.21
12	1.29	3.47	2.07		3.89	1.67	1.15
13	2.96	1.41	2.10		1.38		1.68
14	1.44	1.77	1.23		1.57		1.41
15			1.04				0.55
16							
17							
18							
no. of cars per cycle	14	14	15	10	14	12	15

-7.2%							
cycle	113	114	115	116	117	118	119
vehicle							
1	1.40	1.92	1.50	2.68	1.41	1.48	1.48
2	3.53	1.35	1.61	1.30	1.78	2.05	2.19
3	3.08	1.65	1.27	1.66	1.89	2.01	2.21
4	2.38	1.93	2.41	1.69	1.76	1.73	1.99
5	2.65	1.54	1.94	2.03	1.51	2.20	1.23
6	1.19	3.06	1.28	1.38	1.66	1.65	1.44
7	2.30	2.32	2.01	1.46	1.97	1.57	1.47
8	1.95	1.97	1.06	1.18	2.33	1.34	3.06
9		1.97	2.06	0.92	3.24	1.21	1.16
10			3.12	2.22	1.60		
11				2.47	2.44		
12				3.07			
13							
14							
15							
16							
17							
18							
no. of cars per cycle	8	9	10	12	11	9	9

-7.2%

cycle	106	107	108	109	110	111	112
vehicle							
1	1.12	1.54	2.78	2.28	1.57	1.34	1.62
2	2.51	3.33	3.25	2.63	2.09	3.41	2.49
3	0.97	2.83	1.22	3.17	2.24	2.33	2.12
4	1.62	2.51	3.08	1.02	1.14	1.29	1.62
5	1.39	2.24	1.83	1.61	1.89	1.83	1.24
6	1.37	1.98	1.13	2.30	1.65	1.79	2.41
7	3.05	1.62	1.57	1.44	1.81	1.46	2.59
8	1.30	1.95	2.30	2.26	2.12	1.41	3.11
9	2.31	3.18	2.16	2.34	1.59	1.22	1.93
10	1.87	1.87	1.27	1.33	1.70	2.62	
11	3.96			3.09	1.00	2.74	
12	1.83			1.49	1.35	1.73	
13	1.60			1.08	1.75		
14	1.73			2.41	3.03		
15							
16							
17							
18							
no. of cars per cycle	14	10	10	14	14	12	

9

-7.2%

cycle	120	121	122	123	124	125	126
vehicle							
1	1.25	1.25	1.90	2.50	1.73	2.00	1.67
2	2.91	2.91	1.34	1.52	1.95	1.65	2.10
3	1.39	1.43	2.33	2.05	1.87	2.07	1.19
4	2.44	2.37	1.82	1.16	1.57	1.91	1.78
5	2.78	1.30	1.94	1.73	1.54	1.23	2.04
6	1.25	1.34	3.25	1.26	2.77	1.97	1.98
7	2.96	1.81	1.73	2.58	3.79	2.71	1.37
8	2.04	2.09	3.90	2.44	3.74	2.99	2.23
9	2.52	1.52	3.06	1.77	2.81	1.83	1.71
10	3.24	2.01	1.46	1.64	1.60	2.05	1.51
11	1.54	2.58	1.34	2.19	1.37	1.44	1.23
12	1.71	1.49	3.04	1.76	3.12	2.51	1.86
13		3.16		1.69	1.54	2.54	1.00
14		1.62					2.14
15							2.03
16							1.23
17							
18							
no. of cars per cycle	12	14	12	13	13	13	16

-7.2%

cycle	127	128	129	130	131	132	133
vehicle							
1	1.80	1.64	1.24	2.44	1.10	1.35	1.70
2	3.97	1.62	2.30	3.85	2.24	2.04	2.19
3	2.23	1.74	2.35	1.71	2.91	1.26	1.41
4	1.57	2.59	1.42	2.05	2.70	1.33	2.00
5	1.73	2.31	1.68	2.15	1.11	2.47	1.28
6	1.52	2.55	2.70	2.30	2.62	1.94	1.08
7	1.79	1.17	2.21	2.68	2.58	2.02	2.78
8	1.45	2.38	2.81	3.40	1.20	1.41	2.26
9	1.17	2.19	1.97	2.56		2.04	1.85
10	1.28	1.69	2.40	1.93		2.00	2.47
11	3.04	1.86	1.93	1.43		4.32	1.56
12	2.26	1.82	2.28			1.09	1.79
13	1.89	2.32	1.61			2.91	2.29
14	1.30	1.56				1.17	
15	1.95						
16							
17							
18							
no. of cars per cycle	15	14	13	11	8	14	13

-7.2%							
cycle	134	135	136	137	138	139	140
vehicle							
1	1.90	2.38	2.43	1.35	3.04	2.20	2.37
2	1.31	1.30	1.80	1.15	1.85	1.45	1.30
3	1.57	2.16	0.58	2.63	1.30	2.55	1.70
4	2.10	1.85	1.30	2.04	1.81	1.76	2.45
5	1.88	2.14	2.02	1.40	1.44	1.16	1.50
6	2.48	1.91	1.64	2.40	1.79	1.28	1.82
7	1.28	2.41	1.07	1.27	1.66	2.56	1.24
8	2.28	1.44	1.90	1.06	1.17	1.68	
9	1.05	1.79	1.54	2.02	1.50	1.49	
10	1.11	1.54	1.89	2.20	2.41	3.02	
11	1.25	1.04	1.58	2.25	0.99	2.04	
12	2.45	2.00	1.59	1.82	2.64	2.73	
13	2.12	2.33	1.69	1.60	2.88		
14	1.52	1.73	2.77	2.56	1.34		
15	1.84	1.70	1.61	2.77	2.81		
16		0.74					
17							
18							
no. of cars per cycle	15	16	15	15	15	12	

7

-7.2%							
cycle	141	142	143	144	145	146	147
vehicle							
1	2.00	2.47	2.12	1.57	1.63	1.69	1.44
2	2.14	1.26	1.56	3.62	2.09	3.65	1.98
3	1.22	2.22	1.80	1.83	1.43	2.43	1.81
4	1.37	1.03	1.25		1.33	1.35	1.95
5	2.79	1.66	2.29		1.88	1.81	2.24
6	2.11	1.55	2.37		1.40	2.16	1.66
7	1.80	1.63	1.16		1.65	3.51	2.19
8	2.29	1.36	1.33		2.52	1.89	2.55
9	2.57	2.05	1.63		1.90	0.99	1.85
10	2.98		2.30		3.14	1.40	1.89
11	1.70		1.91		1.39	2.24	2.29
12						2.17	2.16
13						1.39	2.07
14						1.32	1.90
15							
16							
17							
18							
no. of cars per cycle	11	9	11	3	11	14	14

-7.2%							
cycle	148	149	150	151	152	153	154
vehicle							
1	2.87	2.40	2.91	1.79	1.42	1.43	1.76
2	1.62	1.08	1.21	1.11	4.94	3.14	1.38
3	1.92	1.38	1.51	1.15	1.87	1.08	1.12
4	1.56	1.52	3.58	1.94	2.87	2.01	1.29
5	2.23	1.77	1.11	2.12	1.38	1.42	1.34
6	1.80	1.25	1.23	2.73	1.99	1.14	2.74
7	0.94	1.59	1.53	1.19	1.66	3.03	1.43
8	2.20	1.19	1.93	1.56	2.11	1.48	1.49
9	2.04	1.48	1.85	2.10	1.65	1.06	1.68
10	1.42	2.72	1.42	1.55	1.58	2.11	2.50
11	1.99	4.0[illegible]	2.37	1.22	1.90	2.95	2.41
12	3.05	1.8[illegible]	1.45	1.50	1.38	2.05	0.75
13	1.56	2.43	2.43	1.80	1.98	1.56	1.23
14		2.50	1.54	1.54	2.83	1.50	2.20
15		1.18	1.72	3.21		1.66	2.14
16							2.25
17							1.74
18							
no. of cars per cycle	13	15	15	15	14	15	17

-7.2%							
cycle	155	156	157	158	159	160	161
vehicle							
1	2.01	2.05	2.44	3.14	1.28	2.41	2.73
2	2.36	2.06	1.31	1.70	3.12	1.75	1.41
3	1.90	0.96	2.08	1.32	1.52	2.04	1.65
4	1.86	0.87	1.94	2.11	1.80	4.42	1.99
5	2.30	2.76	4.02	1.75	1.73	2.39	1.51
6	1.54	1.53	1.90	1.90	1.73	1.86	1.65
7	1.85	2.32	1.29	1.12	2.04	1.79	1.65
8	1.55	2.10	3.38	1.05	1.72	0.93	1.57
9	1.55	1.33	4.12	2.98	1.17	1.67	1.92
10	1.55	1.41	1.27	1.94	1.94	1.41	1.32
11	1.47	1.90	2.50	2.22	1.52	0.86	2.18
12	1.55	1.53	1.46	0.81	2.17	0.86	1.30
13	2.18	1.80	1.65	1.36	1.31	1.63	2.06
14	1.79	1.47		1.97	2.47	2.28	2.00
15	2.07	1.90		1.76	1.86	2.33	2.42
16							
17							
18							
no. of cars per cycle	15	15	13	15	15	15	15

-7.2% cycle	162	163	164	165	166	167	168
vehicle							
1	1.24	2.34	1.30	1.45	1.60	1.30	2.44
2	1.68	1.41	1.61	2.59	1.89	1.66	1.31
3	1.75	1.69	2.03	2.22	1.86	2.56	1.83
4	1.81	2.13	1.13	1.26	0.90	2.14	2.36
5	1.32	1.77	1.44	1.41	2.90	1.22	1.37
6	2.22	2.16	1.71	2.37	2.18	2.84	0.97
7	1.52	1.15	1.70	1.51	1.34	1.52	1.03
8	1.50	2.31	2.42	1.62	2.14	3.18	1.62
9	1.66	1.64	1.56	2.65	2.50	1.96	2.36
10	2.00	1.41	1.40	2.80	2.09	2.03	1.87
11	1.59	2.30	1.66	1.42	2.66	2.00	3.78
12	1.40	0.98	2.49	1.48	1.38	1.76	2.17
13	1.21	2.19	1.45	2.04	2.18	1.51	2.90
14	1.17	1.14	1.66	1.84	1.42		
15	2.63	1.62	1.44				
16	1.87		1.71				
17			1.38				
18							
no. of cars per cycle	16	15	17	14	14	13	13

-7.2%

cycle	169	170	171	172	173	174	175
vehicle							
1	2.09	2.25	2.66	1.24	1.91	1.87	2.41
2	1.03	1.98	2.22	3.15	2.02	2.14	2.04
3	1.13	1.73	1.95		1.74	1.41	1.61
4	1.32	2.12	1.23		1.33	1.69	2.15
5	1.33	1.12	1.65		1.07	1.48	1.99
6	2.03	2.53	1.97		1.64	1.11	2.64
7	1.89	1.71	1.76		1.59	2.06	1.46
8	2.50	2.23	1.38		2.38	2.26	2.77
9	4.03	2.11	1.94		1.54	2.90	2.18
10		2.99	1.71		1.45	1.83	1.52
11			1.45		1.99	1.80	1.30
12					1.84	1.12	1.68
13					2.66	1.23	1.60
14					1.46	2.56	
15					1.68	1.04	
16					1.98		
17							
18							
no. of cars per cycle	9	10	11	2	16	15	13

-7.2%

cycle	176	177	178	179	180	181	182
vehicle							
1	2.14	2.08	1.78	1.90	1.42	1.74	1.36
2	1.48	1.46	1.96	1.90	1.38	1.70	2.27
3	1.61	2.35	2.11	1.20	1.41	2.55	1.67
4	2.15	1.67	1.48	1.46	1.39	2.10	2.39
5	1.96	1.42	1.37	1.77	1.37	2.27	2.07
6	1.03	1.62	1.87	1.40	2.88	2.01	1.63
7	2.39	1.92	2.06	1.17	1.59	1.78	2.04
8	2.86	1.86	1.60	1.66	1.17	1.42	1.54
9	2.24	1.59	1.23	1.56	1.44	2.24	1.91
10	1.83	1.41	1.62	1.82	1.79	3.16	1.29
11		2.95	3.19	1.29	1.77	1.07	1.05
12		2.12	2.19	2.00	2.23	1.07	2.01
13		1.70	1.73	3.31	1.68	2.85	1.49
14		1.73	2.14	2.41	1.43		2.78
15				1.82	1.62		
16					1.28		
17							
18							
no. of cars per cycle	10	14	14	15	16	13	14

-7.2%

cycle	183	184	185	186	187	188	189
vehicle							
1	1.23	1.56	2.44	1.16	2.57	1.88	1.88
2	2.95	1.70	2.29	2.21	2.16	1.46	2.21
3	1.87	1.81	1.98	1.59	1.70	1.71	2.59
4	1.12	1.59	1.26	1.41	2.25	1.80	2.83
5	1.89	1.73	1.52	1.25	1.35	2.74	1.62
6	2.43	1.53	1.08	1.31	1.65	1.14	1.80
7	2.84	1.54	1.27	1.75	1.32	1.42	1.67
8	1.99	1.60	1.94	1.46	1.13	1.90	1.64
9	1.54	2.61	2.29	2.44	1.58	1.69	1.36
10	1.39	2.28	1.21	2.36	1.72	1.40	1.26
11	1.06	1.06	2.26	2.17	1.49	1.44	2.19
12	2.24	1.77	2.23	2.96	2.48	1.26	1.62
13	0.97	1.16	1.37	1.52	2.44	1.40	1.77
14	1.97	0.99	2.89	1.58	1.86	2.34	1.65
15	1.02	2.72	0.87			2.20	1.39
16	2.02	1.54				3.41	
17							
18							
no. of cars per cycle	16	16	15	14	14	16	15

-7.2%

cycle	190	191	192	193	194	195	196
vehicle							
1	2.32	1.63	2.11	1.37	1.43	2.73	1.08
2	1.61	2.76	1.35	1.54	2.05	1.64	1.19
3	1.35	1.90	1.31	0.97	1.83	1.61	1.29
4	0.97	1.05	1.56	2.61	1.41	2.45	1.93
5	1.03	1.57	3.13	1.90	0.89	1.02	2.97
6	2.51	2.59	1.34	2.43	2.47	1.90	2.91
7	1.21	1.48	1.97	2.46	1.94	1.51	2.47
8	2.44	2.32	1.61	3.79	2.21	2.78	2.40
9	1.38	2.73	2.01	1.72	2.59	3.11	1.52
10	1.75	2.43	2.57	1.76	2.72	1.53	1.77
11	1.84	2.71	1.51	2.12	1.17	1.55	
12	1.20	1.86	2.82	1.98	2.00	2.46	
13	2.12	1.35		1.35	1.56	2.06	
14	1.61				1.62		
15	2.33				1.89		
16	1.62						
17							
18							
no. of cars per cycle	16	13	12	13	15	13	10

-7.2%

cycle	197	198	199	200	201	202	203
vehicle							
1	1.26	1.06	1.07	3.37	1.69	1.98	1.50
2	1.70	1.84	1.57	1.82	2.35	2.09	1.33
3	1.97	2.64	1.62	1.55	1.16	1.63	3.26
4	1.63	1.88	2.00	1.63	2.58	1.64	0.81
5	1.07	2.70	0.89	1.77	2.01	3.16	1.73
6	2.62	1.53	1.51	3.04	1.53	3.07	2.51
7	1.02	2.27	1.59	1.81	1.67	2.38	2.36
8	3.33	1.44	1.57	1.21	1.84	1.61	1.37
9	2.88	1.40	1.06	1.72	1.51	2.38	1.95
10	2.19	1.70	1.58	1.05	2.47	1.18	3.64
11	2.41	1.55	1.07	2.27	1.97	1.81	3.35
12	2.94	1.37	2.94	2.88	2.70	0.86	
13		1.11	1.20	1.38	1.28	2.64	
14			1.63	2.17	1.05	2.14	
15			1.28			1.10	
16			1.30				
17			1.80				
18			1.49				
no. of cars per cycle	12	13	18	14	14	15	11

-7.2%

cycle	204	205	206	207	208	209	210
vehicle							
1	1.51	2.84	1.36	1.26	2.17	1.57	1.47
2	1.64	1.45	2.03	3.94	2.13	3.81	1.53
3	2.18	1.15	3.12	1.83	1.32	1.37	4.40
4	1.88	2.41	3.17	1.56	1.58	2.03	1.09
5	1.57	1.71	1.97	1.33	1.69	2.75	1.34
6	1.10	1.36	1.87	1.95	2.66	1.61	1.43
7	1.10	1.62	1.37	1.83	2.33	1.64	2.72
8	2.05	2.13	2.88	1.49	3.60	2.24	2.41
9	1.38	1.98	2.77	1.69	1.81	3.20	2.19
10	1.63	1.57	1.47	1.40	1.49	1.24	1.81
11	2.33	1.63	2.28	3.06	1.08	2.98	1.17
12	2.13	2.70	1.24	1.40	1.70	1.82	2.37
13	1.78	1.22	2.02	1.80	2.05	2.23	1.92
14		1.81		2.07	1.61		1.84
15		1.73					
16							
17							
18							
no. of cars per cycle	13	15	13	14	14	13	14

-7.2%

cycle	211	212	213	214	215	216	217
vehicle							
1	1.76	2.08	1.47	2.12	1.87	1.31	1.50
2	2.12	2.16	2.62	2.87	1.33	1.69	2.41
3	1.29	1.45	1.61	1.56	2.18	1.51	1.72
4	2.21	1.39	1.73	1.43	2.21	2.31	1.27
5	1.76	3.13	1.08	2.36	1.26	1.58	2.34
6	1.23	2.57	1.32	2.18	1.28	1.55	1.22
7	1.38	1.99	2.65	2.31	1.78	2.72	1.26
8	1.26	3.74	1.69	2.63	2.14	1.47	3.92
9	1.43	1.60	1.63	1.25	1.80	2.04	1.43
10	1.27	1.99	1.89	2.47	1.97	1.95	1.12
11	1.53	2.72	2.54	1.72	1.18	2.41	2.73
12	1.65	1.69	2.89	1.30		1.54	2.25
13	2.58	1.67	2.83	1.62		2.20	1.03
14	1.29		1.64			1.59	
15	1.26					3.68	
16	2.37						
17							
18							
no. of cars per cycle	16	13	14	13	11	15	13

-7.2%							
cycle	218	219	220	221	222	223	224
vehicle							
1	2.86	1.95	1.65	1.07	1.27	2.31	1.35
2	1.37	2.75	1.93	2.61	1.76	2.10	2.27
3	1.97	1.51	1.10	2.82	2.01	1.58	2.55
4	2.84	2.39	1.84	1.71	2.64	1.45	2.00
5	2.49	2.11	1.91	1.78	2.16	1.38	1.57
6	1.88	1.63	1.14	2.16	2.31	2.02	2.16
7	1.43	1.05	1.32	1.51	2.84	2.08	2.21
8	1.42	2.03	2.78	1.93	1.89	3.38	1.24
9	0.91	1.29	1.26	1.30	2.52		1.82
10	5.44	1.94	1.37	1.78	2.08		1.72
11	1.69	1.64	1.88	2.48	1.28		1.47
12	3.17	1.10	2.76	2.72	3.01		1.59
13		1.04	1.52	3.29	1.37		1.24
14				2.94			2.62
15							
16							
17							
18							
no. of cars per cycle	12	13	13	14	13	8	14

-7.2%							
cycle	225	226	227	228	229	230	231
vehicle							
1	3.45	1.66	1.53	1.63	2.66	1.52	2.13
2	3.53	0.72	1.71	1.66	1.53	2.29	1.88
3	1.82	3.66	1.31	1.74	2.38	1.63	1.55
4	1.59	1.63	1.66	1.38	1.46	1.37	1.77
5	1.52	1.47	1.83	1.31	3.68	2.90	1.90
6	2.13	2.21	3.24	1.49	2.03	1.98	1.77
7	1.42	1.44	1.40	1.72	1.87	1.76	1.84
8	1.71	1.38	1.73	1.96	1.47	2.54	1.42
9	1.71	1.37	1.55	1.38	1.63	2.10	1.95
10	1.57	2.40	2.04	1.85	2.29	1.61	2.29
11		1.34	3.28	1.65	1.06	1.93	1.68
12		2.29	1.50	2.43	2.65	1.37	1.58
13		1.30	2.26	2.33	2.03	1.98	1.44
14		1.37	1.39	2.59	1.87		1.10
15							1.73
16							
17							
18							
no. of cars per cycle	10	14	14	14	14	13	15

-7.2%

cycle	232	233	234	235	236	237	238
vehicle							
1	1.61	1.95	1.68	2.23	1.03	1.81	1.60
2	1.81	1.40	1.81	2.32	2.53	^.00	2.13
3	1.88	1.80	1.63	0.64	1.75	.97	2.06
4	1.91	1.75	2.35	2.15	1.43	1.97	2.51
5	1.98	2.12	2.80	1.45	2.22	1.83	2.50
6	1.43	2.32	1.73	1.79	1.42	1.86	1.38
7	1.14	2.29	2.07	2.15	2.59	1.46	1.98
8	1.44	1.06	2.10	1.51	0.99	1.50	1.88
9	1.75	1.48	1.72	1.99	3.01	3.81	1.98
10	2.84	3.16	2.69	2.20	2.35	1.20	1.11
11	3.01	2.64	1.27	2.37		1.46	2.40
12		0.91	2.44	2.49		1.08	3.40
13		1.24	1.69	2.28		2.13	2.29
14		1.48		0.99		1.86	
15		1.29				1.57	
16							
17							
18							
no. of cars per cycle	11	15	13	14	10	15	13

-7.2%							
cycle	238	239	240	241	242	243	244
vehicle							
1	1.60	1.57	2.55	1.19	2.29	2.37	1.66
2	2.13	1.29	2.92	1.93	1.22	1.47	1.64
3	2.06	3.33	1.59	2.33	1.56	1.43	1.73
4	2.51	2.08	1.79	2.13	2.36	1.73	1.71
5	2.50	2.30	3.21	1.55	[illegible]06		1.30
6	1.38	1.54	1.52	1.58	[illegible].02		1.72
7	1.98	0.96	2.27	2.30	1.91		2.13
8	1.88	1.97	1.29	1.72	1.47		1.97
9	1.98	1.26	1.79	1.54	1.46		1.72
10	1.11	2.43	1.11	3.35	1.77		1.30
11	2.40	1.17	1.87	1.33	2.90		1.74
12	3.40	1.14	2.79	1.14	1.94		1.33
13	2.29	2.21	2.58	1.40	2.00		1.49
14		1.37		1.90	1.30		1.25
15		1.28		3.58			2.02
16				1.05			2.16
17							
18							
no. of cars per cycle	13	15	13	16	14	4	16

-7.2% cycle	245	246	247	248	249	250	no.of cycles
vehicle							
1	1.93	1.70	1.75	1.79	1.98	1.02	250
2	2.61	1.37	1.71	1.72	2.08	1.49	250
3	1.39	2.53	1.34	1.21	3.69	1.64	249
4	1.47	1.71	3.49	1.87	1.95	2.10	248
5	1.55	1.68	1.30	1.28	1.63	2.22	245
6	1.61	1.31	2.42	2.79	1.99	2.37	245
7	1.76	2.10	1.47	3.90	2.82	2.48	243
8	2.48	1.78	1.45	1.53	1.05	2.82	240
9	1.57	1.52	1.85	1.34	1.82	1.28	235
10	2.08	2.18	2.31	2.16	1.14		222
11	1.69	1.43	1.14	2.24	2.16		206
12	1.39	2.68	2.16	1.84	1.86		189
13	1.09	1.82	1.39	1.40	1.76		175
14	1.54	1.72	1.23	1.09	3.46		129
15	1.63						70
16	1.58						18
17	1.01						
18							
no. of cars per cycle	17	14	14	14	14	9	

-7.2% cycle	mean head secs	-7.2% stan dev	HEADWAY min head	max head
vehicle				
1	1.84	0.56	0.61	4.43
2	2.00	0.71	0.70	5.83
3	1.88	0.62	0.34	4.40
4	1.90	0.62	0.61	4.42
5	1.88	0.64	0.54	4.02
6	1.91	0.62	0.67	5.27
7	1.87	0.58	0.71	4.27
8	1.99	0.70	0.93	5.35
9	1.91	0.63	0.91	4.67
10	1.90	0.63	0.86	5.44
11	1.97	0.70	0.83	4.32
12	1.99	0.69	0.75	5.42
13	1.86	0.54	0.69	3.70
14	1.77	0.56	0.83	3.46
15	1.89	0.66	0.55	3.68
16	1.77	0.58	0.74	3.41
17	1.48	0.32	1.01	1.50
18	1.49	ERR	1.49	1.49

no. of
cars per
cycle

+0.7% HEADWAY

cycle	1	2	3	4	5	6	7
vehicle							
1	2.39	1.96	1.34	1.38	3.75	1.87	2.78
2	2.51	3.00	2.29	2.61	2.67	1.30	1.56
3	2.14	2.55	2.52	2.71	1.88	1.84	1.71
4	1.72	1.21	1.56	1.33	2.63	1.51	1.19
5	1.10	1.96	1.29	1.53	1.70	1.31	2.57
6	2.22	0.52	1.63	1.58	2.88	1.39	1.22
7	2.18	1.70	1.15	2.63	2.14	2.40	1.77
8	2.13	2.24	2.15	2.18	1.61	1.79	2.62
9		1.69	1.73	1.66	1.96	2.09	2.76
10		2.27	2.28	1.53	1.26	1.60	1.06
11			2.26	1.18	1.73	1.27	1.87
12				3.19	2.04	2.04	1.95
13				1.53	2.52	1.78	2.90
14				2.51	2.57	2.00	2.18
15				1.42	1.91	1.17	
16				2.76	2.43	1.74	
17				3.34		2.06	
18				1.03		2.19	
19				3.66		2.58	
20				2.01		2.07	
21				2.86		1.88	
22				1.47		3.55	
23				1.06		2.22	
24						1.48	
25						2.02	
26						1.89	
27						1.41	
28							
29							
30							
31							
32							
33							
34							
35							
36							
37							
no. of cars pe cycle	8	10	11	23	16	27	14

+0.7%

cycle	8	9	10	11	12	13	14
vehicle							
1	2.97	1.38	1.96	1.94	1.90	2.45	1.27
2	1.27	2.28	1.94	1.41	2.18	2.89	2.32
3	1.63	2.07	2.57	1.36	1.37	1.15	2.37
4	2.74	2.63	2.00	1.48	1.76	1.46	1.51
5	2.67	1.46	1.79	2.14	1.32	2.88	3.14
6	1.51	1.83	2.60	1.26	2.72	2.04	1.99
7	1.86	4.08	1.33	2.03	3.62	1.22	1.04
8	1.69	1.94	1.57	2.15	4.71	1.20	1.89
9	1.49	1.78	2.16	2.62	2.35	1.48	1.53
10	2.00	1.37	2.44	2.50	2.21	1.86	1.90
11	1.98	2.18	1.84	2.49	4.44	1.55	1.73
12	1.78	2.08	1.32	1.82	1.55	1.23	1.67
13	1.58	1.65	2.02	3.18	1.09	2.66	1.23
14	1.86	1.49	1.23	1.72	1.69	1.91	1.74
15	2.05	2.67	1.54		1.27	3.30	3.37
16	1.69	1.91	2.84		2.37	1.25	1.52
17	1.94	1.91	2.58		2.15	1.48	2.55
18	1.45	2.33	1.29		1.61	3.04	3.02
19	2.01	2.20	1.31		1.27	2.81	1.27
20	1.26	2.23	1.80		2.75	2.25	2.03
21	1.74	2.05	1.87		0.71		1.73
22	1.10		2.06		1.54		2.40
23	2.82		1.91		1.31		1.84
24	2.52		2.13		1.22		2.74
25	1.33		1.72		1.51		3.39
26	1.58		2.48		1.86		2.69
27	1.54		1.80				2.07
28	1.69		1.29				1.39
29	3.28		1.36				1.92
30							1.76
31							
32							
33							
34							
35							
36							
37							
no. of cars pe cycle	29	21	29	14	26	20	30

+0.7%

cycle	15	16	17	18	19	20	21
vehicle							
1	2.35	1.83	1.56	1.81	1.41	2.74	2.23
2	1.73	1.68	2.12	3.11	1.59	1.90	1.23
3	2.23	1.89	2.30	4.02	2.20	2.06	1.40
4	2.27	1.74	1.55	1.96	1.55	1.59	1.81
5	1.24	2.22	1.75	2.13	2.00	1.29	1.93
6	1.49	2.17	2.14	1.47	1.28	1.85	1.57
7	1.90	1.02	1.47	1.88	1.86	1.42	2.82
8	2.30	2.73	1.11	1.88	1.39	3.47	2.55
9	1.95	1.54	1.33	2.11		1.90	3.20
10	1.18	2.84	1.60	1.13		1.81	1.96
11	1.57	3.17	2.70	2.80		3.84	1.74
12		2.51	1.44	1.64		2.38	1.32
13		3.39	1.37	1.86		2.61	1.87
14		1.31	3.11	1.94		2.76	1.73
15		2.56	2.07	2.50		1.62	2.27
16		1.75	1.42	1.68		3.31	2.33
17		1.79	1.93	2.07		4.11	1.71
18		2.47	1.29	3.61			2.40
19		1.39	3.37	1.35			1.08
20		1.07	1.98	1.01			2.16
21		1.76	2.03	1.74			1.81
22		1.76	1.61	1.68			3.62
23		2.05	1.09	1.12			1.25
24		3.50	1.79	2.66			1.10
25		1.42	1.03	1.69			2.67
26		3.07	1.25	1.18			2.31
27		1.24	1.28	2.23			2.08
28		2.98	1.99	1.41			1.53
29		3.74	2.11	1.61			
30		1.11	1.96				
31			1.27				
32			1.24				
33							
34							
35							
36							
37							
no. of cars pe cycle	11	30	32	29	8	17	28

+0.7%

cycle	22	23	24	25	26	27	28
vehicle							
1	1.33	2.64	2.11	1.88	2.07	1.90	1.94
2	1.81	2.36	4.72	1.47	2.18	2.40	1.56
3	1.76	1.40	1.12	1.70	3.45	1.71	1.69
4	2.83	2.05	2.03	1.99	1.51	1.43	1.36
5	1.78	1.58	1.60	2.07	0.93	3.29	1.80
6	1.79	1.46	1.31	1.63	1.39	1.15	2.57
7	1.92	1.95	1.06	1.52	1.45	1.65	1.77
8	1.88	1.64	1.69	1.37	1.39	2.63	1.48
9	1.71	2.86	1.68	0.80	1.23	1.60	3.17
10	2.91	2.23	1.46	0.89	0.92	2.17	2.34
11	2.11	2.46	1.83	3.60	1.94	1.95	2.82
12	1.24	2.45	2.68	1.22	1.64	1.80	2.06
13	1.73	1.67	2.32	1.76	1.29	2.16	1.30
14	3.05	2.15	1.77	2.80	1.57	4.38	2.38
15	3.23	2.07	1.19	2.42	2.54	1.33	3.54
16	1.58	2.95	2.70	1.06	3.35	1.60	1.63
17	1.65	2.32	1.92	1.09	2.17	1.87	2.24
18	2.19	2.33	1.32	1.05	2.70	2.32	2.29
19	2.21	2.54	1.38	3.72	3.13	1.47	1.43
20	4.25	2.06	2.25	2.43	1.36	1.28	1.16
21	1.88	3.19	1.12	2.00	1.55	3.27	1.11
22	2.21	1.44	1.11	2.33	3.00	3.02	2.31
23	2.46	1.90	1.73	0.96	3.31	2.76	3.66
24	2.22	3.34	1.12	1.34		2.63	
25	2.12	1.34	0.96	1.71		2.31	
26	2.56	1.42	1.55	3.67			
27		1.45	2.19	2.09			
28			1.80	2.17			
29			2.62	1.57			
30			2.41	2.23			
31							
32							
33							
34							
35							
36							
37							
no. of cars pe cycle	26	27	30	30	23	25	23

+0.7%

cycle	29	30	31	32	33	34	35
vehicle							
1	1.67	1.42	2.34	1.86	1.82	2.56	2.77
2	2.23	2.72	2.93	2.67	1.98	1.68	2.02
3	1.64	1.22	1.84	1.80	2.32	1.49	1.49
4	1.56	1.45	1.51	1.67	3.03	2.03	1.06
5	1.74	1.65	1.75	3.21	2.37	4.40	1.98
6	2.55	2.00	2.40	2.30	1.68	1.69	2.04
7	1.89	2.00	1.78	2.45	1.39	2.71	1.54
8	1.86	1.84	2.25	2.51	1.41	1.41	1.68
9	1.66	1.71	2.12	1.76	1.97	3.13	3.40
10	1.62	2.41	1.55	1.76	2.64	2.33	1.43
11	1.68	1.81	0.87	1.41	1.72		3.81
12	2.40	2.03	2.97	1.11	2.10		2.40
13	2.50	1.74	2.12	2.43	2.16		1.54
14	1.68	1.19	2.90	2.15	1.55		2.08
15	2.85	3.36	1.75	1.32	2.86		3.49
16	3.50	1.55	1.87	1.80	2.19		1.19
17		1.85	1.71	2.12	2.79		1.63
18		2.71	1.92	2.50	1.54		1.28
19		1.50	1.58	2.31	2.19		2.55
20		2.70	1.33	1.82	1.63		2.23
21		2.43	2.00	1.39	1.12		3.67
22		1.19	1.47	3.33	1.43		2.04
23		1.81	2.52	1.46	3.17		1.57
24		2.41	1.49	2.12			1.63
25		2.72	1.96	1.44			2.55
26		2.73	3.15	1.51			1.48
27		1.86	3.17				2.83
28		1.15					2.51
29		1.20					2.08
30							
31							
32							
33							
34							
35							
36							
37							
no. of cars pe cycle	16	29	27	26	23	10	29

+0.7%

cycle	36	37	38	39	40	41	42
vehicle							
1	1.65	2.47	2.98	2.26	4.73	1.08	2.90
2	1.17	1.47	2.47	1.82	2.95	1.91	2.10
3	1.44	1.25	2.38	1.38	1.81	3.10	1.89
4	1.32	1.98	2.95	2.99	1.94	1.54	1.39
5	1.09	2.02	1.60	3.27	1.53	2.20	2.48
6	1.77	1.30	2.02	1.91	1.74	1.03	1.32
7	1.24	1.45	1.89	1.56	1.73	1.87	2.50
8	1.19	1.83	2.09	2.94	3.55	1.96	1.96
9	2.07	1.85	1.53	1.68	2.05	2.70	1.81
10	1.59	1.37	0.93	2.54	1.40	2.20	1.65
11	1.18	1.16	1.29	4.80	1.60	2.38	2.71
12	1.47	1.59	2.78	2.23	1.76	2.21	1.50
13	1.75	1.89	2.25	1.83	4.18	1.51	2.81
14	4.05	2.71	4.21	2.68	2.18	1.50	1.64
15	3.21	1.56	2.01	1.31	2.18	2.52	5.09
16	1.10	1.04	1.63	1.62	1.33	1.58	1.47
17	1.29	1.66	1.71	1.66	1.43	1.24	1.67
18	1.09	1.01	1.52	1.43	2.88	1.40	1.88
19	1.61	1.99	1.84	0.98	2.49	2.44	2.58
20	1.93	1.15	1.02	1.59	4.44	1.35	2.55
21	1.48	2.25	2.95	1.16	2.46	2.09	2.47
22	1.02	1.90	2.56	1.95	1.80	1.40	1.42
23	1.89	1.10	2.14	1.47	1.91	1.77	1.09
24	0.99	1.46	2.43	2.96	1.86	0.85	2.74
25	2.00	2.14	2.68	1.70	1.90	1.83	2.07
26	2.52	1.15	1.55	5.29	1.87	2.41	1.77
27	1.76	1.28	3.24	1.81	1.46	1.82	
28	2.27	1.90	2.21	2.00		2.25	
29	1.71	3.15	2.48			2.12	
30	1.55	1.07					
31	2.05	1.47					
32	1.57	2.55					
33	1.37	1.75					
34	1.15	3.43					
35	0.95						
36	1.17						
37	1.67						
no. of cars pe cycle	37	34	29	28	27	29	26

+0.7%

cycle	50	51	52	53	54	55	56
vehicle							
1	1.21	1.31	1.31	1.97	3.02	2.98	2.38
2	1.60	1.71	1.75	1.63	1.66	3.09	1.91
3	1.63	1.52	1.45	1.89	1.46	1.69	1.81
4	1.94	2.32	2.03	1.80	2.07	2.69	2.33
5	1.67	1.29	2.34	1.28	2.01	1.37	2.00
6	2.38	1.08	1.75	3.47	3.11	2.95	1.15
7	1.41	3.43	1.25	1.[illegible]6	1.53	1.97	1.80
8	1.28	2.37	2.76	1.69	2.34		0.95
9	2.96	1.59	1.38	1.80	3.79		2.12
10	3.02	1.37	2.46	2.83	2.84		1.53
11	2.13	1.99	4.11	1.86	3.48		1.74
12	1.51	1.14	2.13	1.65	3.44		0.90
13	1.67	2.36	2.30	2.13	4.31		1.42
14	2.78	1.97	2.18	1.81	3.31		2.51
15	2.02	1.85	1.32	2.08	2.64		1.61
16	1.38	2.12	1.52	1.30	1.80		2.12
17	1.40	1.02	2.06	2.26	3.31		1.41
18	1.67	2.80	2.22	1.48	2.33		1.49
19	1.71	1.89	1.22	2.03	1.65		
20	1.31	2.45	1.32	1.52	2.30		
21	1.74	1.55	3.25	2.03	3.63		
22	2.19	3.96	1.21	1.96	1.13		
23	1.53	1.39	1.57	1.41	4.20		
24	1.33	1.14	2.26	1.19			
25	1.58	2.26	2.70	1.12			
26	3.10	1.64	1.80	1.60			
27	1.98	1.52	1.10	1.31			
28	2.30	1.39	4.24	1.09			
29	1.56	1.73	1.36	1.44			
30	1.39	1.73	1.24				
31	2.07	1.19					
32	3.18	1.34					
33	1.47	2.68					
34							
35							
36							
37							
no. of cars pe cycle	33	33	30	29	23	7	18

+0.7%

cycle	43	44	45	46	47	48	49
vehicle							
1	1.69	1.68	1.60	1.95	1.40	1.40	4.43
2	1.83	2.27	2.09	1.57	3.27	2.35	1.14
3	1.41	2.04	2.07	2.85	1.84	1.42	2.60
4	2.63	1.10	2.33	1.50	1.23	1.88	2.85
5	1.57	1.09	1.13	1.54	1.90	1.87	1.95
6	1.84	3.00	1.87	2.09	1.39	0.93	1.95
7	3.42	1.52	1.73	1.26	1.33	3.34	2.32
8	2.47	2.36	2.11	1.74	3.58	2.27	1.66
9	2.16	1.83	1.42	2.43	1.79	1.88	2.59
10	1.59	2.76	2.03	1.54	1.46	2.50	1.75
11	1.46	1.49	1.41	0.95	1.39	1.30	2.22
12	1.34	2.14	2.18	3.19	2.27	4.63	2.65
13	1.23	1.70	2.06	2.84	1.72	1.15	1.44
14	1.31	3.92	1.71	1.47	1.43	3.82	1.77
15	2.27	1.33	2.30	2.60	2.64	1.61	1.95
16	3.63	2.20	2.42	3.11	4.34	2.47	2.90
17	2.29	1.98	4.10	0.94	1.65	2.40	1.16
18	1.33	2.84	2.54	2.23	2.09	1.63	1.52
19	2.37	1.70	3.25	2.16	1.85	5.70	1.90
20	2.57	2.07	3.38	2.14	1.58	1.94	3.03
21	1.31	1.50	1.58	2.57	2.29	1.23	1.49
22	1.43	4.55	3.35	1.04	2.18	1.38	1.08
23	1.32	2.18	1.96	1.96	3.07	1.62	1.80
24	1.61	2.02	2.48	1.61	1.01	1.63	2.19
25	3.12	2.48	2.35	1.76	0.87	3.60	1.63
26	1.82	1.91	2.13	1.69	3.50	1.74	2.09
27	2.15	3.15	4.26	2.82	1.72	2.96	1.67
28	1.22	2.53		1.22	1.32	2.67	1.63
29	1.99			3.33	2.69		2.86
30	1.83						2.09
31							2.57
32							
33							
34							
35							
36							
37							
no. of cars pe cycle	30	28	27	29	29	28	31

+0.7%

cycle	57	58	59	60	61	62	63
vehicle							
1	1.97	1.58	1.85	2.21	2.22	1.24	2.10
2	2.09	1.98	1.96	1.99	2.45	2.04	2.80
3	1.47	2.32	1.47	1.97	1.10	2.62	2.45
4	1.21	1.45	1.55	1.73	1.86	1.46	1.50
5	2.03	1.71	1.97	1.82	1.79	1.26	1.81
6	2.33	1.51		1.35	1.59	1.37	1.97
7	2.02	2.94		1.43	2.60	2.86	2.02
8	2.59	1.65		3.07	1.53	1.68	3.34
9	2.55	2.70		2.23	1.13	1.78	1.87
10	1.74	1.44		2.34	3.74		2.80
11	1.33	1.80		1.50	2.24		
12	1.77	2.72		2.60	2.30		
13	1.30			1.40	2.05		
14	1.34			1.38	2.07		
15				1.27	1.62		
16				3.75	1.44		
17				1.64	1.54		
18				1.77	2.16		
19				1.40	1.73		
20				1.49	2.53		
21				2.43	2.07		
22				1.58	2.10		
23				1.21			
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
35							
36							
37							
no. of cars pe cycle	14	12	5	23	22	9	10

+0.7%

cycle	64	65	66	67	68	69	70
vehicle							
1	1.54	2.30	1.56	3.56	1.24	1.57	2.01
2	3.40	1.50	2.40	2.59	2.83	1.60	2.29
3	1.57	1.10	2.07	2.63	2.00	2.52	1.79
4	1.28	2.15	2.15	1.97	2.24	2.26	1.88
5	1.32	1.48	1.71	1.46	1.46	2.06	1.67
6	3.02	2.76	1.38	1.13	1.49	2.25	1.83
7	2.06	1.48	1.68	1.24		1.66	1.37
8	1.04	1.28	1.66	1.60		1.69	1.23
9	2.95	1.75	1.62	1.91		1.69	1.98
10	1.73	2.22	2.30	2.83		2.37	0.90
11	1.14	2.17	2.07	1.87		1.88	1.29
12		1.50	2.87	1.59		2.02	2.23
13		2.78	1.19	2.01		1.78	1.38
14		1.53	1.78	2.28		1.62	1.25
15		1.85	1.75	2.20		1.34	2.97
16		2.67	1.94	1.54		1.97	1.41
17		1.54	2.41	1.67		1.89	
18		2.71	1.67	1.95		2.70	
19		1.64		1.59			
20				1.15			
21				1.99			
22				0.99			
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
35							
36							
37							
no. of cars pe cycle	11	19	18	22	6	18	16

+0.7%

cycle	71	72	73	74	75	76	77
vehicle							
1	2.14	1.75	1.23	2.97	3.02	1.69	1.41
2	1.91	3.32	2.13	2.80	1.67	2.00	1.94
3	1.78	1.56	1.93	1.20	1.45	2.85	2.75
4	1.69	1.45	2.27	1.33	1.31	1.07	1.73
5	1.83	1.01	2.07	1.70	2.42	1.21	1.10
6	2.18	1.38	2.44	1.94	2.23	1.56	1.64
7	1.86	1.37	1.06	1.54	2.76	2.54	1.30
8	2.41	1.96	1.33	1.39	1.77	2.22	1.29
9	1.87	1.68	1.67	1.65	1.96	3.58	2.37
10	2.76	2.62	1.83	2.39	1.34	2.08	1.86
11	1.54		4.34	1.59	2.71	2.03	1.65
12	1.57		1.86	3.06	3.56	3.34	2.50
13	1.20		1.41	2.23	1.83	1.99	1.16
14	3.13		1.98	3.05	1.17	2.02	1.66
15			3.05	2.07	1.33	1.73	2.00
16			1.71	2.75	2.94	1.82	2.55
17			1.67	1.89	2.05	1.25	1.33
18			3.38	1.67	1.01	1.31	2.43
19			2.86	1.46	1.15	1.74	1.95
20			1.63	1.82	1.93	1.78	1.28
21				2.40	3.06	1.46	2.37
22				1.21	1.41	2.11	1.67
23				1.46	1.35	1.29	1.38
24				1.04	2.00	1.39	1.81
25				2.71	1.18	2.21	3.10
26				1.33	1.87	2.14	2.18
27				1.54	1.59	1.29	1.73
28				3.71	1.27	1.87	1.94
29				2.51	1.21	1.70	2.57
30				1.55	0.70	1.71	1.65
31				1.31	2.25	1.20	1.71
32				1.99	1.82	1.59	1.03
33				1.84		1.43	1.26
34						2.16	
35							
36							
37							
no. of cars pe cycle	14	10	20	33	32	34	33

+0.7%

cycle	78	79	80	81	82	83	84
vehicle							
1	1.69	1.43	0.96	1.56	2.19	1.80	1.71
2	1.84	1.53	2.25	1.44	1.70	3.49	5.75
3	1.48	3.62	2.37	2.30	1.98	3.47	1.87
4	1.79	1.98	2.31	1.42	1.59	1.31	2.98
5	1.70	1.38	1.40	2.74	1.05	1.34	1.60
6	1.20	1.63	1.71	1.74	2.54	1.44	1.65
7	2.37	1.56	2.38	1.20	1.90	1.78	1.24
8	1.57	2.02	1.61	1.74	1.44	2.28	1.70
9	2.27	2.38	1.68	1.59	1.57	2.31	3.05
10	2.99	1.55	1.80	2.56	2.15	1.23	1.38
11	1.37	1.88	3.10	1.51	4.91	1.92	1.89
12	2.94	1.40	1.24	1.51	1.02	4.68	1.63
13	1.91	2.06	1.34	2.37	1.10	1.18	1.97
14	1.82	2.14	1.28	2.05	2.43	1.38	1.80
15	1.40	2.53	2.16	5.58	3.79	2.96	1.04
16	0.88	2.65	1.95	1.66	2.49	2.44	2.57
17	2.60	2.31	1.50	1.21	2.77	2.61	1.53
18	1.91	1.80	3.11	1.36	2.87	2.29	2.47
19	1.72	1.43	1.57	1.63	1.30	2.11	2.48
20	2.63	2.29	1.06	1.96	1.27	1.82	
21	1.48	3.60	1.80	1.82	2.10	2.16	
22	2.77	2.15	2.22	1.95	1.53	2.27	
23	2.27	2.18	2.51	1.33	1.97	1.63	
24	1.76	2.53	1.74	1.76	4.39	2.59	
25	1.52	2.63	1.45	2.24	1.94	2.33	
26	1.76	1.11	2.12	2.64	1.52	2.67	
27	2.05	1.68	1.80	1.50	1.57	1.51	
28	1.09	3.10	1.54	1.43	1.80		
29	2.65	1.62	1.80	2.19	2.22		
30	1.93	1.99	3.41	1.29	1.61		
31	1.99	1.65	2.11	4.54			
32	1.34	1.55	1.41	1.41			
33	2.18		2.02				
34			2.30				
35							
36							
37							
no. of cars pe cycle	33	32	34	32	30	27	19

+0.7%

cycle	85	86	87	88	89	90	91
vehicle							
1	2.37	3.72	1.44	2.10	2.14	2.18	1.89
2	1.47	1.57	2.38	1.94	1.39	1.60	1.67
3	1.70	1.15	2.35	1.36	2.53	3.27	1.46
4	2.20	3.24	1.75	1.62	1.93	1.01	2.20
5	1.66	1.31	1.60	2.12	4.16	1.22	1.46
6	1.62	2.86	2.01	1.29	1.13	1.54	1.60
7	1.42	2.21	1.31	2.45	2.00	0.97	2.87
8	2.72	1.52	2.06	1.28	2.18	1.69	1.71
9	2.05	1.61	1.61	1.27	3.32	1.74	2.36
10	1.15	2.88	1.71	2.43	1.42	1.30	2.52
11	1.75	1.96	1.90	4.47			1.95
12	3.19		1.30	1.03			2.11
13	1.56		1.43	1.43			1.60
14	2.65		1.29	1.66			2.43
15	1.65		1.82	1.75			2.08
16	1.28		1.52	1.77			1.58
17	2.32		2.65	1.16			2.54
18	1.92		1.63	1.58			1.81
19	2.84		1.29	2.17			1.87
20	1.05		1.34	1.72			
21	1.56		1.60	2.12			
22	2.50		1.93	1.62			
23	2.33		1.99	2.04			
24	2.14		2.97	1.84			
25	1.54			1.61			
26	1.74			1.14			
27	1.76			1.44			
28	1.55			3.88			
29	1.38			2.17			
30	3.56			1.30			
31	2.77						
32							
33							
34							
35							
36							
37							
no. of cars pe cycle	31	11	24	30	10	10	19

+0.7%

cycle	92	93	94	95	96	97	98
vehicle							
1	1.55	5.69	2.91	1.14	1.23	1.91	1.12
2	2.18	1.73	2.16	1.30	2.46	1.56	1.57
3	1.82	2.34	2.37	1.39	1.80	1.96	1.91
4	4.56	1.63	2.27	1.94	1.59	1.79	1.27
5		2.22	1.73	1.84	2.64	1.54	2.39
6		1.45	2.66		1.21	1.83	1.05
7		2.12	1.87		1.60	1.39	3.28
8		2.02			1.84	1.68	1.60
9		2.46			1.01	2.61	1.58
10		2.36			3.26	0.70	1.71
11		2.54			1.49	1.21	2.76
12		2.26			2.23	2.49	1.59
13		2.75			1.65		1.59
14					2.53		1.44
15					2.30		2.53
16							2.77
17							1.97
18							2.67
19							1.00
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
35							
36							
37							
no. of cars pe cycle	4	13	7	5	15	12	19

+0.7%

cycle	99	100	101	102	103	104	105
vehicle							
1	2.13	1.47	1.97	2.28	1.22	1.51	2.12
2	1.28	1.31	1.67	3.15	1.44	1.99	2.32
3	1.83	1.99	2.03	1.96	2.34	1.74	1.12
4	3.54	0.96	1.29	1.89		1.36	2.38
5	1.95	1.80	2.38	2.36		1.27	1.57
6	1.74	1.47	2.00	1.43		1.76	1.30
7	1.29	1.83	1.29	3.04		2.11	1.87
8	1.53	1.67	1.81	1.50		2.02	2.44
9	1.90	1.69	1.21	1.96		1.50	2.34
10	1.40	1.60	2.15	1.28		1.84	1.88
11	2.40		3.57	1.59		2.55	2.26
12			1.57	0.88		1.89	
13			2.85	2.05		0.96	
14			2.65	3.90		1.59	
15			1.93	1.19		1.24	
16			1.23	0.64		2.64	
17			2.55	2.50		1.27	
18			2.09	3.17		1.17	
19			1.41	2.57		2.33	
20			2.66	1.26		1.43	
21			3.80	3.22		1.49	
22				1.44		1.80	
23				1.54		1.13	
24				2.92		1.85	
25				1.98		3.35	
26				2.23		2.33	
27				1.28		1.48	
28				2.25		1.27	
29				2.34		1.51	
30				1.96		2.13	
31						1.55	
32						2.50	
33						2.52	
34							
35							
36							
37							
no. of cars pe cycle	11	10	21	30	3	33	11

+0.7%

cycle	106	107	108	109	110	111	112
vehicle							
1	2.21	3.36	2.19	3.13	2.19	1.43	3.13
2	2.57	1.45	1.36	2.55	1.67	1.89	1.81
3	2.15	1.48	3.44	2.60	2.23	1.74	1.29
4	1.68	1.73	1.16	1.13	2.13	1.47	1.58
5	3.11	1.22	1.34	1.50	1.26	1.75	1.59
6	0.89	2.32	1.31	3.91	1.37	2.45	1.98
7	2.29	1.55	1.99	1.75	2.44	1.74	1.53
8	3.89	2.06	2.09	1.57	2.18	1.57	2.09
9	0.94	1.99	2.95	2.00	1.54	1.85	1.96
10	1.58	0.96	2.96	3.24		1.46	1.59
11	1.13	1.65	1.60	1.50		2.26	3.55
12	1.45		1.66	2.61		2.58	
13	1.92		1.10	1.56		1.44	
14	2.12		1.07	1.45		2.29	
15	1.27		3.41	2.67		2.50	
16	1.54		1.02	1.10		2.90	
17	1.44		1.78	3.23		0.69	
18	2.54			1.34		4.14	
19	2.04			1.81		2.24	
20	2.66			1.09		1.28	
21	1.63			1.31		1.45	
22	1.58			1.14		1.32	
23	2.05			2.84		1.83	
24	1.10					1.09	
25	2.80					4.81	
26	2.14					1.78	
27	0.93					1.67	
28	1.98					1.53	
29	2.30					1.09	
30	1.20					1.35	
31	2.17					5.09	
32	1.14					1.51	
33	1.66					0.92	
34							
35							
36							
37							
no. of cars pe cycle	33	11	17	23	9	33	11

+0.7%

cycle	113	114	115	116	117	118	119
vehicle							
1	2.38	1.13	1.41	2.34	0.91	2.46	3.49
2	2.54	1.03	1.03	1.85	2.18	1.88	1.84
3	2.17	3.65	2.59	1.22	2.29	2.04	1.33
4	1.89	2.50	1.63	1.50	1.33	1.33	1.50
5	1.24	3.22	1.82	2.33	2.33	1.12	2.21
6	1.77	2.22	3.22	2.13	1.11	1.31	2.35
7	1.66	1.93	1.71	2.11	1.80	2.40	0.92
8	1.98		1.70	3.31	1.05	1.13	2.11
9	1.02		1.25	1.42		1.27	1.65
10	2.27		1.92	1.81		1.03	2.10
11	1.64		1.73	1.69		2.24	0.98
12	2.32			1.82		1.73	1.93
13	2.68			2.15		2.10	2.07
14	2.80					1.17	
15	2.02						
16	2.73						
17	2.02						
18	3.00						
19	1.84						
20	2.45						
21	3.38						
22	1.73						
23	1.59						
24	1.60						
25	0.75						
26	3.05						
27	1.01						
28							
29							
30							
31							
32							
33							
34							
35							
36							
37							
no. of cars pe cycle	27	7	11	13	8	14	13

+0.7%

cycle	120	121	122	123	124	125	126
vehicle							
1	2.30	3.98	1.81	2.31	1.14	2.59	1.39
2	2.50	0.80	1.61	1.81	1.61	1.68	2.35
3	1.28	2.71	1.44	1.99	3.54	1.61	3.29
4	2.28	1.34	2.02	1.54	1.24	2.11	3.97
5	1.36	2.10	1.29	3.54	1.97	2.49	3.50
6	1.45		1.03		1.86		1.55
7	1.53		1.37		1.52		1.41
8	1.50		2.33		2.68		1.47
9	1.33		1.45		2.09		2.11
10	1.81		1.05		2.25		1.35
11	1.35		0.87				1.49
12	1.15		1.15				1.10
13	1.79						1.41
14	1.48						
15	1.86						
16	1.83						
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
35							
36							
37							
no. of cars pe cycle	16	5	12	5	10	5	13

+0.7%

cycle	127	128	129	130	131	132	133
vehicle							
1	2.27	2.35	2.28	2.54	2.23	1.39	2.33
2	3.14	2.44	1.39	1.84	1.46	1.90	1.21
3	2.73	1.67	1.71	1.40	1.82	1.93	2.57
4	1.72	1.12	1.48	1.57	1.71	2.28	2.37
5	1.88	1.91	1.42	2.86	1.92	1.57	2.66
6	2.04	1.40	1.05	1.37	1.30	2.88	2.76
7	1.49	2.02	1.31	1.78	1.66	1.61	1.99
8	1.52	1.89	5.01	1.90	1.49	2.10	1.65
9	1.12		2.03	1.02	3.73	1.62	3.13
10			1.67	0.92	2.49	1.39	2.54
11				1.24	1.22	2.22	
12				1.53	2.26	1.24	
13				1.32	2.52	2.09	
14				1.52	2.02		
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
35							
36							
37							
no. of cars pe cycle	9	8	10	14	14	13	10

+0.7%

cycle	134	135	136	137	138	139	140
vehicle							
1	2.63	2.23	1.26	4.20	2.39	0.99	2.05
2	1.68	1.27	2.21	2.07	1.56	1.87	2.53
3	1.43	2.46	1.33	1.98	2.01	1.07	2.03
4	1.20	1.35	1.37	2.50	1.91	3.14	1.36
5	2.26	2.99	3.06	1.77	2.03	1.92	1.93
6	1.68	1.37	1.56	1.70	1.25		1.17
7	2.56	2.03	1.13	1.42	2.20		1.47
8	1.79		1.45	1.65	1.77		2.55
9	1.21		1.56	2.59	1.79		2.05
10	3.75		1.50	1.14	1.01		1.67
11	2.13		2.81	2.60	3.54		1.96
12	1.72		2.43	1.43	1.39		1.92
13	2.37		1.79	1.10	3.81		
14	1.73		2.66	3.52	1.43		
15	1.43		2.53	1.38			
16	2.23		1.88				
17	1.32		1.74				
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
35							
36							
37							
no. of cars pe cycle	17	7	17	15	14	5	12

+0.7%

cycle	141	142	143	144	145	146	147
vehicle							
1	1.49	1.49	2.16	1.99	1.43	2.35	1.26
2	1.54	1.55	1.27	3.40	2.23	1.60	1.55
3	2.57	1.74	2.07	1.55	1.29	1.34	1.34
4	1.45	2.34	1.23	1.44	2.51	1.99	1.58
5	2.94	1.53	1.75	1.73	2.00	1.25	2.10
6	1.39	2.34	2.27	1.55	1.49	3.62	1.94
7	1.55	2.58	1.71	1.48	1.90	3.42	1.49
8	2.52	1.82	1.58	2.42	3.34	2.54	2.63
9	1.38	2.31	2.21	3.32	2.54	2.48	1.14
10	2.92	2.04	1.51	1.85	1.60		2.18
11	2.55	2.41	2.13	2.08	1.27		3.85
12	1.71	2.90	1.64	2.16			1.63
13	2.28	2.94	1.56	1.38			
14	1.43	1.31	1.74				
15	2.03		1.78				
16	2.56		2.17				
17	2.34						
18	2.15						
19	2.96						
20	2.18						
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
35							
36							
37							
no. of cars pe cycle	20	14	16	13	11	9	12

+0.7%

cycle	148	149	150	151	152	153	154
vehicle							
1	1.45	1.80	1.90	3.12	2.29	1.92	1.46
2	1.67	1.46	1.88	1.75	2.23	2.49	1.83
3	1.64	2.60	1.83	1.67	1.44	1.08	1.99
4	1.23	2.05	1.51	1.56	1.91	2.82	4.30
5	1.62	1.19	2.12	1.75	1.65	4.38	2.89
6	1.79	3.30	1.53	2.21	1.74	2.41	2.69
7	2.31	1.41	1.55		1.26	1.78	
8	1.87	1.47	2.90		1.89	1.74	
9	1.42	2.20	2.11		1.75	1.60	
10	1.45	1.89	2.47		2.39		
11		2.35			1.34		
12		2.07			2.87		
13		2.80			1.80		
14		1.86			2.12		
15		1.50			1.54		
16		1.75			2.70		
17		1.52			1.20		
18		2.18			2.50		
19		2.34			0.75		
20					2.52		
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
35							
36							
37							
no. of cars pe cycle	10	19	10	6	20	9	6

+0.7%

cycle	155	156	157	158	159	160	161
vehicle							
1	1.65	3.40	1.37	1.82	1.75	2.59	2.31
2	2.07	1.50	2.35	2.41	2.54	1.63	1.68
3	1.09	1.95	1.12	2.06	2.02	1.51	1.60
4	2.24	1.65	1.56	1.30	1.68	1.14	1.89
5	1.41	1.94	1.69	1.73	1.75	1.06	1.13
6	1.62	1.83	3.68	2.86	2.30	2.14	1.93
7	1.12	1.84	2.33	2.22	2.14	1.59	2.61
8	2.25	2.54	1.16	1.46	2.45	2.44	1.28
9	2.77	0.91	1.75		3.05	1.66	1.33
10	2.80	3.64	2.49		1.33	0.97	1.31
11	2.08	1.64	1.64		1.13	1.23	1.30
12	3.8[illegible]	2.38	3.03		1.09	1.91	1.14
13	2.03	1.28	1.36		1.53	1.76	3.54
14	1.49	1.77	1.82		1.99	4.72	1.76
15	1.93	2.14	1.55		2.11	1.68	2.05
16	1.04	3.05	2.87		1.70	2.50	2.62
17	2.86	2.40	1.82		1.96	1.89	2.36
18		1.21	2.67		1.39	2.50	1.47
19		2.10	1.11		2.05	3.12	1.16
20		1.67	3.00		3.01	1.76	1.47
21		1.65	1.43		2.46	1.56	1.38
22		2.04	1.93		1.74	2.29	1.38
23		1.74	2.50		2.30	1.18	0.91
24		2.36	2.51		1.02	2.35	1.15
25		1.93	2.36		1.85	1.59	1.98
26		0.95	3.14		1.68	1.90	1.43
27		2.23	2.71		1.23	1.49	1.58
28		3.53	1.95		1.32	0.99	2.63
29		3.23	1.38		2.06	1.24	2.76
30		1.32	1.78		1.22	1.04	2.33
31					1.24	1.27	1.92
32					1.81	2.01	2.01
33					1.44	1.61	1.92
34							1.59
35							1.23
36							1.21
37							
no. of cars pe cycle	17	30	30	8	33	33	36

+0.7%

cycle	162	163	164	165	166	167	168
vehicle							
1	2.01	1.34	1.75	2.07	1.59	4.47	3.25
2	2.63	1.47	1.60	2.08	1.51	1.86	1.50
3	1.33	3.42	1.77	1.49	1.54	1.34	1.69
4	1.56	1.51	1.51	1.57	1.62	1.51	2.55
5	1.67	1.25	1.52	2.17	2.33	2.39	0.99
6	1.36	1.77	0.98	2.81	1.72	1.80	1.94
7	1.23	1.65	1.67	2.53	2.86	1.22	1.08
8	2.22	2.65	2.29	1.20	1.06	2.09	1.30
9	2.84	1.53	1.44	1.60	1.62	1.35	1.52
10	1.90	1.68	1.22	3.36	3.09	2.57	1.79
11	2.04	1.71	1.34	1.78	1.26	2.42	2.88
12	3.00	2.39	2.24	1.38	2.33	1.90	1.49
13	2.62	1.55	1.23	1.48	3.39		2.22
14	1.89	1.81	3.17	2.66			1.88
15	1.62		2.85	1.14			1.28
16	1.80		1.38	1.62			2.39
17	3.74		1.21	1.40			1.99
18	2.11		1.25	1.94			1.60
19	1.89		2.06	2.36			1.83
20	1.44		1.97				
21	1.09						
22	1.31						
23	1.59						
24	2.21						
25	1.43						
26	3.79						
27	1.23						
28	1.55						
29	1.27						
30							
31							
32							
33							
34							
35							
36							
37							
no. of cars pe cycle	29	14	20	19	13	12	19

+0.7%

cycle	169	170	171	172	173	174	175
vehicle							
1	2.41	2.65	1.35	1.68	1.23	1.58	2.80
2	1.62	2.85	1.46	2.37	1.83	1.33	2.56
3	1.78	1.84	1.58	1.48	1.38	3.90	1.69
4	1.98	2.56	2.30	1.25	1.71	1.54	1.56
5	1.42	1.12	1.20	1.68	1.86	2.47	2.10
6	1.56	1.26	1.05	1.22	3.66	2.28	2.91
7	2.46	2.10	1.34	2.05	2.32	2.39	
8	1.54	1.29	1.43	1.34	1.60	2.77	
9	2.34	2.25	1.68	1.41	2.00	1.46	
10	2.87	1.99	0.93	1.96		1.50	
11	2.32	2.81	1.24	3.12		1.81	
12	1.85		1.46	2.12		2.16	
13			1.71	3.13			
14			1.35	1.97			
15				2.65			
16				2.14			
17							
18							
19							
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33							
34							
35							
36							
37							
no. of cars pe cycle	12	11	14	16	9	12	6

+0.7%

cycle	176	177	178	179	180	181	182
vehicle							
1	2.26	2.02	2.21	2.38	1.79	1.63	3.04
2	1.26	1.51	1.59	3.03	1.43	1.66	1.68
3	1.73	1.08	1.87	2.64	2.02	1.92	1.24
4	2.65	1.28	1.43		1.98	1.54	1.38
5	2.05	2.01	1.58		2.10	1.82	1.61
6	1.02	1.33	1.55		2.10	2.42	1.94
7		1.50	2.07		1.28		1.57
8			2.15		1.58		3.36
9			1.21		1.07		1.40
10			1.01		1.22		1.50
11					1.61		1.96
12					1.60		3.78
13							
14							
15							
16							
17							
18							
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32							
33							
34							
35							
36							
37							
no. of cars pe cycle	6	7	10	3	12	6	12

+0.7%

cycle	183	184	185	186	187	188	189
vehicle							
1	2.54	3.23	1.69	2.20	1.49	1.55	1.74
2	2.10	2.40	2.19	1.34	2.09	1.98	4.12
3	2.06	2.03	1.71	2.24	1.33	2.17	1.34
4	1.72	1.14	2.43	1.70	3.01	1.32	1.61
5	1.91	2.40	2.79	1.70	1.96	1.41	1.22
6	1.97	2.43	1.71	1.48	1.85	1.95	1.58
7	2.14		2.17	1.61	2.42	0.85	1.76
8	1.71		1.49	1.36		1.33	1.90
9	1.86		2.02	2.81		2.25	2.66
10	1.42		1.84	2.35		1.87	3.17
11	1.57		1.24	1.86		2.91	2.12
12	2.63		2.04			2.03	
13	2.34		1.21			2.37	
14	2.33					1.69	
15						1.71	
16							
17							
18							
19							
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32							
33							
34							
35							
36							
37							
no. of cars pe cycle	14	6	13	11	7	15	11

+0.7%

cycle	190	191	192	193	194	195	196
vehicle							
1	2.29	2.65	2.48	1.40	1.59	1.79	2.08
2	1.78	1.95	1.63	3.69	1.49	1.74	2.38
3	1.84	2.51	1.07	2.67	1.92	1.78	1.52
4	0.99	1.22	1.39	1.58	2.59	1.64	1.29
5	1.65	1.65	2.04	1.69	1.65	1.76	2.40
6		1.38	1.35	1.16	1.41	1.79	
7		1.88	1.17	2.80	1.34	2.73	
8		1.25	4.27	2.46	2.45	1.81	
9		1.27	2.24	1.14	2.30	2.07	
10		1.31	1.37	2.06		2.09	
11		2.45	1.62	1.59		2.95	
12		1.12	2.58	1.39			
13		1.98		2.12			
14				2.26			
15				2.26			
16				2.25			
17				3.29			
18				2.24			
19				1.45			
20				1.69			
21				2.84			
22				1.70			
23							
24							
25							
26							
27							
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31							
32							
33							
34							
35							
36							
37							
no. of cars pe cycle	5	13	12	22	9	11	5

+0.7%

cycle	197	198	199	200	201	202	203
vehicle							
1	2.75	2.92	1.43	1.13	1.80	3.18	2.27
2	1.15	1.16	3.41	1.47	3.80	1.53	1.62
3	1.80	1.94	1.38	2.79	1.64	0.95	1.25
4	2.12	2.03	1.95	1.73	1.25	2.39	2.37
5	2.44	3.14		2.30	1.63	1.97	2.07
6	1.41	2.78		2.39	1.33	2.07	1.07
7	1.61	1.37		1.01	1.27	2.37	1.17
8	4.39	1.07		1.42	1.64	1.95	1.54
9	1.81			2.01	2.44	1.25	2.09
10	1.85				1.66	0.96	2.23
11	2.91				4.12		
12	2.79						
13	2.70						
14							
15							
16							
17							
18							
19							
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34							
35							
36							
37							
no. of cars pe cycle	13	8	4	9	11	10	10

+0.7%

cycle	204	205	206	207	208	209	210
vehicle							
1	4.03	2.69	1.80	1.86	2.07	1.54	2.55
2	3.95	1.03	1.93	1.26	1.85	1.34	1.13
3	1.57	1.88	1.63	1.70	1.79	0.93	0.85
4	1.65	1.60	1.94	1.60	2.25	1.57	1.35
5	1.54	1.88	1.59	1.07	1.46	2.85	2.26
6	1.09	1.46	3.14	1.43	1.84	0.89	1.79
7	1.44	1.30	1.85	3.39	1.85	2.23	1.67
8	1.33	1.83	2.35	2.16	1.64	2.06	2.09
9	2.45	2.44	1.62	1.32	1.74	3.03	1.94
10	2.19	2.37	2.97	1.43	2.06	1.38	1.76
11	1.95	1.44	2.00	1.63	1.68	1.97	2.25
12	1.58	1.29	1.56	1.84	2.02	2.00	1.45
13	1.76	1.74		1.70	1.91	1.16	2.07
14		2.10		2.05	1.79	1.77	1.58
15		1.61		1.60	2.00	2.00	1.00
16				1.26	2.57	1.29	1.51
17				1.92	1.93	1.66	1.66
18					1.62	2.58	2.47
19						1.17	2.96
20						1.70	2.67
21						1.87	2.06
22						1.52	1.64
23						2.17	4.13
24						1.04	2.34
25						3.40	2.15
26						1.77	1.65
27						3.10	1.30
28						2.48	1.90
29						2.18	2.31
30						0.83	1.42
31						2.61	1.79
32						2.10	1.97
33						2.16	
34							
35							
36							
37							
no. of cars pe cycle	13	15	12	17	18	33	32

+0.7%

cycle	211	212	213	214	215	216	217
vehicle							
1	2.04	1.37	4.77	2.41	3.11	4.00	2.25
2	2.04	1.77	1.30	2.12	1.62	1.11	1.35
3	2.06	2.32	1.25	1.58	1.43	1.60	1.62
4	1.30	1.81	1.20	2.15	1.36	1.12	2.47
5	0.96	1.70	1.27	3.75	2.61	2.50	2.13
6	1.94	1.84	2.14	1.53	1.92	1.64	1.54
7	2.23	2.17	1.53	1.64	1.97	3.31	1.68
8	1.99	2.75	1.40	1.53	2.81	1.38	1.71
9	1.18	2.74	0.94	1.83	1.30	1.20	3.00
10	1.36	1.62	1.89	2.01	1.30	2.12	2.95
11	2.36	1.86	2.19	1.67	2.06	1.71	
12	1.73	1.61	1.91	2.40	1.53	1.22	
13	1.81	1.45	1.77	1.97	2.47	1.25	
14	1.50	1.61	2.17	1.44	1.58		
15	0.90		1.79	1.74	2.81		
16	0.73			3.31	1.53		
17				3.99	1.80		
18					1.21		
19					1.97		
20					2.94		
21					2.02		
22					1.82		
23					1.83		
24					1.56		
25					1.81		
26					1.58		
27					2.23		
28					1.72		
29					1.65		
30					1.19		
31					1.41		
32					1.24		
33					2.13		
34					0.84		
35							
36							
37							
no. of cars pe cycle	16	14	15	17	34	13	10

+0.7%

cycle	218	219	220	221	222	223	224
vehicle							
1	1.39	1.99	1.49	1.15	2.43	2.46	2.32
2	3.14	1.67	3.36	1.55	2.64	3.02	1.63
3	1.34	1.16	2.70	2.19	1.28	1.33	2.14
4	2.82	1.67	1.45	1.47	1.20	3.00	1.45
5	1.36	1.33	1.99	1.05	1.64	0.94	1.20
6	1.27	1.68	1.72	1.52	2.73	1.89	1.38
7	1.18	2.59	2.08	3.05			1.91
8	1.65	1.57	1.83	1.14			1.75
9	1.61	2.33		2.98			1.93
10	1.40	2.25		2.03			5.32
11	1.27						1.86
12	1.22						1.76
13	1.41						1.92
14	1.65						
15	2.26						
16	1.11						
17							
18							
19							
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33							
34							
35							
36							
37							
no. of cars pe cycle	16	10	8	10	6	6	13

+0.7%

cycle	225	226	227	228	229	230	231
vehicle							
1	2.58	2.09	3.08	1.61	1.69	1.43	2.28
2	2.44	2.61	1.34	1.61	1.04	2.13	1.34
3	1.23	2.16	1.28	2.34	2.35	2.29	1.18
4	1.93	2.43	1.46	1.95	2.87	2.27	2.82
5	2.31	2.75	1.88	1.10	1.78	3.44	1.56
6	2.02	1.89	2.97		2.40	1.92	1.38
7	2.93	3.22	2.75		2.15	1.40	1.08
8	1.66	1.61	1.23		3.06	1.62	2.30
9		2.13	2.14		1.52	1.13	4.37
10			1.78			2.66	
11			2.14			1.65	
12			1.93			3.14	
13			2.86			2.07	
14			1.86				
15			2.67				
16							
17							
18							
19							
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32							
33							
34							
35							
36							
37							
no. of cars pe cycle	8	9	15	5	9	13	9

+0.7%

cycle	232	233	234	235	236	237	238
vehicle							
1	2.79	1.87	1.86	1.82	2.21	3.45	1.49
2	1.84	1.07	1.57	1.86	2.12	1.99	1.43
3	1.26	2.66	1.78	1.67	3.89	2.21	3.00
4	1.34	1.88	1.89	3.56	1.57	1.61	1.73
5	1.41	1.73	1.87	0.93	1.33	1.89	1.84
6	1.62	2.22	2.14	1.96	1.26	2.06	1.57
7	1.78		2.16	1.48	1.57	2.21	1.41
8	1.68		2.18	2.51	1.26	1.55	3.03
9	1.78		1.67	1.48	1.57	2.07	1.21
10	1.70		2.89	1.26	2.62	1.49	1.71
11	1.55			1.92	1.38	1.85	1.34
12	2.00			2.41		1.60	1.35
13	2.02			2.65		1.94	1.40
14	1.44			1.85		2.41	1.62
15							2.57
16							1.67
17							
18							
19							
20							
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33							
34							
35							
36							
37							
no. of cars pe cycle	14	6	10	14	11	14	16

+0.7%

cycle	239	240	241	242	243	244	245
vehicle							
1	4.67	4.07	1.50	2.93	1.74	2.53	2.24
2	1.16	1.84	1.38	1.54	1.74	2.17	1.61
3	1.28	1.22	2.04	1.63	2.18	1.12	1.92
4	1.48	2.41	1.34	1.42	1.61	2.41	1.47
5		1.96	1.54	2.12	2.36	1.30	2.02
6		1.74	2.46	1.85	1.98	1.44	1.95
7		1.41	1.65	1.78	3.92	3.80	1.89
8		1.44	1.61	1.73	1.86	1.81	1.51
9		2.80	1.24			1.45	2.27
10		1.97	1.53			1.89	1.45
11		2.24	1.74			1.68	1.60
12		1.58				1.65	1.93
13		2.85				1.45	1.59
14							2.29
15							1.49
16							
17							
18							
19							
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32							
33							
34							
35							
36							
37							
no. of cars pe cycle	4	13	11	8	8	13	15

+0.7% cycle	245	246	247	248	249	250	no. of cycles
vehicle							
1	2.24	1.71	2.07	2.14	1.29	2.59	250
2	1.61	2.39	1.14	1.68	1.80	1.39	250
3	1.92	1.18	1.31	2.13	1.66	1.51	250
4	1.47	1.74	2.08	1.86	2.25	3.14	248
5	2.02	1.61	1.84	1.86	1.49	1.87	245
6	1.95	1.56	1.72	2.60	1.57	1.77	236
7	1.89	2.05	1.25	2.05	1.53	1.93	226
8	1.51	1.49	1.69	1.35	1.36	2.63	220
9	2.27	3.11	1.79	1.09	1.77		209
10	1.45	2.43	2.24	1.65	2.34		198
11	1.60	1.88	1.89	3.26	2.25		179
12	1.93	1.70	2.01	2.41	1.55		162
13	1.59		1.42				147
14	2.29		2.15				131
15	1.49		2.27				115
16			1.57				108
17			1.49				99
18			2.29				92
19			2.14				88
20							80
21							75
22							73
23							70
24							63
25							62
26							61
27							57
28							50
29							46
30							35
31							24
32							22
33							17
34							6
35							2
36							2
37							1
no. of cars pe cycle	15	12	19	12	12	8	

+Ø.7% cycle	mean head secs	+Ø.7% stand dev	HEADWAY min head	max head
vehicle				
1	2.13	Ø.77	Ø.91	5.69
2	1.98	Ø.67	Ø.8Ø	5.75
3	1.89	Ø.6Ø	Ø.85	4.Ø2
4	1.85	Ø.58	Ø.96	4.56
5	1.88	Ø.61	Ø.93	4.4Ø
6	1.84	Ø.58	Ø.52	3.91
7	1.89	Ø.61	Ø.85	4.Ø8
8	1.96	Ø.66	Ø.95	5.Ø1
9	1.95	Ø.62	Ø.8Ø	4.37
1Ø	1.95	Ø.67	Ø.7Ø	5.32
11	2.Ø5	Ø.78	Ø.87	4.91
12	2.ØØ	Ø.68	Ø.88	4.68
13	1.95	Ø.63	Ø.96	4.31
14	2.Ø7	Ø.71	1.Ø7	4.72
15	2.11	Ø.77	Ø.9Ø	5.58
16	2.Ø2	Ø.72	Ø.64	4.34
17	1.99	Ø.67	Ø.69	4.11
18	2.Ø5	Ø.65	1.Ø1	4.14
19	2.ØØ	Ø.74	Ø.75	5.7Ø
2Ø	1.95	Ø.69	1.Ø1	4.44
21	2.Ø3	Ø.7Ø	Ø.71	3.8Ø
22	1.91	Ø.72	Ø.99	4.55
23	1.91	Ø.7Ø	Ø.91	4.2Ø
24	1.94	Ø.71	Ø.85	4.39
25	2.Ø7	Ø.73	Ø.75	4.81
26	2.Ø9	Ø.77	Ø.95	5.29
27	1.86	Ø.65	Ø.93	4.26
28	1.97	Ø.75	Ø.99	4.24
29	2.Ø7	Ø.65	1.Ø9	3.74
3Ø	1.68	Ø.61	Ø.7Ø	3.56
31	2.Ø5	Ø.95	1.19	5.Ø9
32	1.74	Ø.51	1.Ø3	3.18
33	1.79	Ø.45	Ø.92	2.68
34	1.91	Ø.85	Ø.84	3.43
35	1.Ø9	Ø.14	Ø.95	1.23
36	1.19	Ø.Ø2	1.17	1.21
37	1.67	Ø.ØØ	1.67	1.67

no. of
cars per
cycle

+3.0% HEADWAY

cycle	1	2	3	4	5	6	7
vehicle							
1	1.90	1.53	2.10	2.34	2.06	2.00	1.75
2	2.35	2.15	1.93	2.31	1.10	1.89	2.43
3	1.81	1.62	2.31	2.98	2.37	1.91	2.31
4	1.19	3.33	2.13	1.04	1.27	0.92	1.52
5	2.66	1.50	1.32	2.20	1.36	2.95	3.10
6	1.50	1.24	1.17	1.75	1.41	1.28	1.87
7	1.88	1.07	1.89	3.54	1.77	1.46	2.19
8	2.08	3.11	1.36	2.44	1.20	1.34	1.23
9	1.66	2.64	1.08	2.14	2.33	1.08	1.62
10			2.00		1.90	0.86	0.93
11			2.46		0.43	3.06	1.27
12			1.04		1.83	2.09	1.51
13			1.64		3.94	1.03	1.17
14			1.37		2.46		2.72
15			1.13		1.63		1.23
16			1.19				1.65
17			1.39				0.95
18			1.46				
19			1.06				
20			1.47				
21			1.28				
22			1.64				
23			1.22				
24			2.69				
25			1.06				
26			1.21				
27			1.31				
28			1.01				
29			1.74				
30			1.55				
31			1.88				
32			2.18				
33			2.65				
34			1.08				
no. of cars pe cycle	9	9	34	9	15	13	17

+3.0%

cycle	8	9	10	11	12	13	14
vehicle							
1	1.38	2.62	1.32	1.22	1.34	1.64	2.17
2	2.88	1.10	1.74	1.52	3.40	1.16	1.83
3	1.34	1.20	1.07	1.23	1.03	2.42	1.62
4	1.35	2.31	1.44	1.35	1.32	2.41	1.95
5	2.00	3.04	1.06	1.82	1.25	4.62	2.13
6	2.04	2.38	1.90	1.17	1.25	0.96	1.69
7	1.24	2.04	1.60	1.43	1.82	1.58	2.29
8	3.06	1.59	2.75	2.28	2.37	1.25	1.62
9	1.25	2.52	1.25	1.33	2.59	2.14	0.97
10	2.53	1.35	1.87	2.57	1.42	1.76	1.80
11	1.81	1.64	1.37	2.10	1.37	1.24	
12	1.30	1.14	1.31	1.24	1.07	1.67	
13	0.92	1.45	1.50	1.70	1.99	2.47	
14	1.70	1.71	2.07	1.00	3.42	2.22	
15		1.53	2.20	1.54	1.30	1.97	
16		0.86	1.81	1.45	1.37	1.57	
17			1.61	1.80	2.36		
18			2.31	1.54	1.31		
19			1.72	1.55			
20				1.75			
21				1.47			
22				1.83			
23				1.90			
24				1.53			
25				1.26			
26				2.04			
27				1.63			
28				2.09			
29							
30							
31							
32							
33							
34							
no. of cars pe cycle	14	16	19	28	18	16	10

+3.0%

cycle	15	16	17	18	19	20	21
vehicle							
1	2.36	2.53	1.42	2.77	1.17	3.61	1.45
2	2.28	1.17	2.60	1.63	2.51	1.49	1.33
3	1.63	1.12	1.22	1.94	1.41	1.22	1.76
4	2.00	2.54	1.84	2.04	1.94	1.34	1.93
5	2.21	2.06	2.18	1.69	4.05	1.22	3.01
6	2.70	2.06	1.46	1.79	1.16	1.70	2.19
7	7.39	1.36	1.59	1.33	1.59	2.62	1.36
8	1.39	1.12	2.14	2.60	2.06	1.54	1.85
9	1.95	2.04	3.94	2.02	2.17	1.86	1.13
10	1.70	1.32	1.22	1.79	1.27	1.06	1.89
11	1.63	2.03	1.17	2.27	1.39	2.24	0.98
12	2.08	2.66	1.70	1.30	1.63	1.65	3.30
13	1.62	1.75	1.43	1.23	1.98	1.84	1.73
14		1.57	1.12			1.46	1.67
15		1.92	1.14			1.50	
16		1.14	1.12			1.25	
17		2.43	1.30			1.07	
18		1.96	1.19			2.02	
19		1.83	1.26			2.08	
20		1.26				1.91	
21		1.70				1.73	
22		1.71				1.25	
23		1.24				1.28	
24						1.54	
25						1.42	
26						1.36	
27						3.38	
28						1.54	
29						1.54	
30							
31							
32							
33							
34							
no. of cars pe cycle	13	23	19	13	13	29	14

+3.0%

cycle	22	23	24	25	26	27	28
vehicle							
1	2.35	1.07	2.68	1.29	1.70	1.68	1.57
2	1.79	2.26	2.54	2.49	2.11	1.52	1.73
3	1.79	1.82	3.83	1.56	1.80	1.46	1.04
4	1.48	1.40	1.56	1.98	1.43	1.29	1.02
5	1.14	1.96	1.77	1.96	1.43	1.60	1.61
6	1.59	1.29	1.72	1.82	2.27	1.26	1.41
7	1.81	1.64	1.64	3.38	1.43	1.54	3.39
8	1.50	1.43	1.56	2.54	2.03	1.58	1.92
9	1.61		2.01	1.18	2.68	1.73	
10	1.65		2.12	1.24	1.36	1.45	
11	2.88		1.99	1.42		0.99	
12	1.55		1.32	1.43		1.52	
13			2.13	1.18		2.19	
14				1.59		2.04	
15				1.87			
16				1.77			
17				2.38			
18				3.14			
19				0.97			
20				2.25			
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
no. of cars pe cycle	12	8	13	20	10	14	8

+3.0%

cycle	29	30	31	32	33	34	35
vehicle							
1	2.50	1.24	2.71	1.56	2.39	1.66	1.60
2	2.11	1.52	2.65	1.37	2.50	1.23	1.70
3	1.44	2.68	2.21	1.33	2.28	1.15	2.36
4	1.77	1.89	2.51	1.66	1.24	1.70	1.59
5	1.86	1.38	1.09	1.37	1.84	1.66	2.61
6	3.46	1.44	3.43	2.36	2.92	1.49	2.23
7	1.50	1.63	1.52	1.94	1.25	2.22	2.77
8	1.19	1.23	1.13	2.37	1.27	1.54	2.57
9	1.69	2.15	3.23	1.63	1.14	2.27	1.24
10	3.30	2.22	1.43	2.09	1.68	1.38	2.74
11	1.46	1.43	1.72	1.62	1.36	2.22	1.47
12	1.70	1.23	2.66	1.90	2.64		2.11
13	1.41	3.11			1.46		2.12
14	1.35				1.92		
15	1.68				3.23		
16	1.59				1.38		
17	2.00				1.69		
18	0.63				1.50		
19	2.72						
20	1.30						
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
no. of cars pe cycle	20	13	12	12	18	11	13

+3.0%

cycle	36	37	38	39	40	41	42
vehicle							
1	1.57	1.89	1.70	3.38	1.42	2.33	1.48
2	1.92	1.99	1.80	2.59	1.41	3.23	2.28
3	1.94	2.26	1.72	1.92	1.19	1.66	2.87
4	2.29	2.96	1.00	1.44	1.47	1.27	1.19
5	1.94	1.93	1.17	2.14	1.56	1.43	1.32
6	1.96	2.30	2.04	1.26	1.98	1.46	1.27
7	1.95	1.47	2.12	1.43	2.14	0.99	2.05
8	1.51	1.61	1.36	1.75	1.45	2.93	1.27
9	1.08	2.04	1.45	2.15	2.83	0.84	1.96
10	1.84	1.20	2.18	1.53	1.48	1.16	1.46
11	1.48	1.45	1.44	1.48	2.00	1.69	4.95
12	2.36	1.25	2.11	1.27	1.88	1.63	2.78
13	0.95	1.06	3.34	1.16	1.69	1.42	
14	1.52	2.10	1.25	2.27	1.50	1.49	
15	2.86	0.82	1.57	2.07	1.57	2.76	
16	1.51	2.02	1.59	1.52	1.55		
17	1.70	1.34		2.18	1.28		
18	1.88	1.56		1.25	1.59		
19		1.33		1.48			
20		1.97					
21		0.85					
22		1.71					
23		1.68					
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
no. of cars pe cycle	18	23	16	19	18	15	12

+3.0%

cycle	43	44	45	46	47	48	49
vehicle							
1	1.62	1.60	1.67	1.47	1.66	1.87	1.27
2	1.52	2.14	2.71	1.46	1.63	2.32	1.67
3	1.53	2.80	1.46	1.77	2.02	2.81	2.43
4	1.46	1.75	1.28	1.58	1.24	1.37	1.26
5	1.49	1.93	2.39	1.18	1.37	1.41	1.81
6	1.62	1.44	1.32	1.41	1.62	1.82	1.52
7	2.58	1.66	1.33	1.33	1.13	1.29	1.76
8	0.98	1.88	1.58	3.13	1.79	1.38	1.69
9	1.09	1.95	1.73	3.20	1.75	1.56	1.41
10	2.48	1.39	1.17	1.91	2.05	1.82	1.24
11	2.21	1.61	2.88	2.38	1.49	1.65	1.57
12	1.50	1.71	1.40	1.35	0.94	1.41	0.91
13	1.98	1.67	2.06	1.66	3.17	2.06	1.84
14	1.30	3.19	2.01	2.14	1.14	2.43	
15			2.09	2.29	1.51	2.80	
16			1.22	2.11	2.20	1.63	
17			1.72		2.20	2.55	
18			2.11		1.26	0.84	
19					1.06	1.24	
20					0.99	1.54	
21						1.78	
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
no. of cars pe cycle	14	14	18	16	20	21	13

+3.0%

cycle	50	51	52	53	54	55	56
vehicle							
1	1.54	1.41	1.84	1.74	2.95	2.11	1.29
2	1.31	2.23	2.01	1.53	1.67	0.91	2.31
3	1.43	1.92	1.41	1.56	1.83	1.23	1.57
4	3.88	1.22	1.22	1.95	2.83	1.21	1.95
5	1.91	1.83	2.26	1.59	1.47	1.25	1.10
6	1.48	1.34	1.70	2.25	1.70	3.25	1.54
7	1.76	1.61	3.01	1.74	1.80	1.43	1.39
8	1.68	1.32	1.14	2.37	4.10	1.86	2.56
9	1.74	1.13	1.27	1.46		2.07	1.21
10	1.18	2.73	1.69	2.21		2.64	1.38
11	1.71	1.40	1.40	1.78		1.76	1.55
12	1.42	1.52	1.82	1.34		2.82	2.10
13	1.19	1.78	1.66	1.11		0.98	2.85
14	1.64	1.12	0.72	3.57		1.73	1.61
15	1.92	1.09	1.40	1.05			1.38
16	2.30	1.68	2.08				1.70
17	1.27	2.66	1.86				2.96
18	1.27	2.00	1.52				1.67
19	1.34	2.02	1.10				1.71
20	1.06	1.54	1.64				1.52
21	1.53	1.19	2.66				1.49
22		2.27					1.88
23							1.77
24							1.66
25							1.40
26							1.97
27							1.53
28							
29							
30							
31							
32							
33							
34							
no. of cars pe cycle	21	22	21	15	8	14	27

+3.0%

cycle	57	58	59	60	61	62	63
vehicle							
1	1.01	2.17	1.46	2.14	1.06	1.76	1.90
2	1.52	1.73	4.17	1.88	3.60	1.74	2.42
3	1.64	2.33	1.70	1.54	1.27	1.13	1.74
4	2.52	1.63	1.39	1.50	1.63	1.48	1.49
5	1.82	1.46	1.97	1.18	1.50	1.55	1.50
6	2.74	2.24	2.02	2.59	1.42	1.46	1.44
7	2.07	1.63	1.74	2.86	1.52	1.57	1.44
8	1.43	1.37	1.48	2.43	1.59	2.42	1.59
9	1.53	2.07	1.76	1.76	1.39	1.53	2.48
10	3.53	1.51	1.23	1.96	2.57	1.35	1.66
11	1.57	1.65	3.28		2.31	2.16	1.66
12	1.31	1.72	1.69		1.78	3.28	1.95
13	1.59	1.76	2.00		2.28	1.52	1.60
14	1.55	1.36	1.45		2.19	1.70	1.16
15	2.63	1.70	2.31		1.28	1.81	
16	1.54	1.17	1.88		1.67	1.33	
17	1.48	1.93	1.73		3.32	1.07	
18	1.03	1.50	1.74		1.45	2.61	
19	1.63	2.03	1.24		2.38	1.14	
20	3.46	1.53	1.85		3.55	1.62	
21	1.31	1.58	1.87		1.20		
22	1.10	1.97	1.60		1.64		
23	1.87	2.94	1.51		1.91		
24	2.03		2.59				
25	2.02		1.86				
26	1.07		1.61				
27	1.65						
28	1.33						
29	2.06						
30							
31							
32							
33							
34							
no. of cars pe cycle	29	23	26	10	23	20	14

+3.0%

cycle	64	65	66	67	68	69	70
vehicle							
1	1.87	1.59	2.02	1.20	2.04	1.72	2.23
2	2.21	3.54	1.51	1.33	2.29	2.15	1.42
3	2.47	1.04	1.42	1.56	1.31	2.33	1.73
4	1.48	1.85	1.40	2.05	1.45	2.19	2.11
5	2.05	2.40	1.28	2.33	2.58	1.65	1.15
6	2.40	1.59	1.57	1.50	2.31	1.96	1.26
7	1.67	2.23	1.29	1.44	1.18	2.38	2.34
8	2.23	1.56	1.42	1.51	1.70	1.67	1.41
9	1.36	1.27	1.86	2.64	0.97	1.58	3.25
10	1.47	1.25	1.87	1.55	2.78	1.92	2.03
11	1.64	1.06	1.13	2.16	1.28	1.23	2.37
12	1.60	1.71	1.47	1.55	1.77	1.58	0.96
13	2.88	2.38	1.64	2.91	1.38	1.66	1.71
14		1.63	1.67	2.00	1.82	1.16	1.94
15		1.60	1.77	1.84		2.11	1.29
16		1.33	2.08	1.56		1.47	2.43
17		2.01	2.21	1.71		1.31	2.43
18		1.90	1.54	1.45		1.60	1.73
19				1.77		1.72	3.28
20				1.63		2.30	
21				1.39			
22				2.49			
23				1.30			
24				2.32			
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
no. of cars pe cycle	13	18	18	24	14	20	19

+3.0%

cycle	78	79	80	81	82	83	84
vehicle							
1	1.73	2.32	1.64	3.16	1.63	1.42	1.83
2	1.72	1.94	1.85	2.85	1.98	1.86	1.40
3	1.56	2.92	1.77	1.22	1.50	1.97	1.86
4	2.74	1.51	4.46	1.74	2.65	1.56	2.09
5	2.60	3.00	1.33	1.81	1.55	2.52	2.01
6	1.22	1.59	1.67	3.34	1.66	3.09	1.90
7	1.53	2.20	2.22	2.53	1.90		
8	1.36	2.27	1.33	3.41	1.62		
9	1.64	1.16	1.35				
10	2.13	1.90					
11	2.09	1.97					
12	1.43	1.59					
13	2.95	1.19					
14		3.18					
15		3.25					
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
no. of cars pe cycle	13	15	9	8	8	6	6

+3.0%

cycle	71	72	73	74	75	76	77
vehicle							
1	1.73	2.03	1.34	1.55	1.93	2.39	3.21
2	1.76	2.05	1.20	2.17	1.78	1.43	1.55
3	1.51	3.46	1.29	1.36	1.32	1.66	1.40
4	2.03	1.45	1.42	1.54	2.75	1.91	1.38
5	1.49	1.56	2.71	1.80	1.54	1.99	1.29
6	2.01	2.50	1.84	1.06	1.86	3.46	1.68
7	1.35	2.56	1.88	1.50	1.25		1.44
8	1.55	1.74	1.51	1.46	1.00		1.77
9	1.60	2.30	1.61	2.12	1.45		2.96
10	1.15	1.46	0.84	1.15	1.39		1.70
11	1.58	1.23	3.19	1.94	2.16		2.42
12	2.00	1.19	1.46	2.11			2.04
13	1.11	2.93	1.55	1.42			1.31
14			1.43				1.35
15			2.60				1.75
16			1.45				2.20
17							1.69
18							1.45
19							1.28
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
no. of cars pe cycle	13	13	16	13	11	6	19

+3.0%

cycle	85	86	87	88	89	90	91
vehicle							
1	1.38	2.07	1.85	1.95	1.71	1.48	1.60
2	3.43	1.74	2.25	1.39	1.72	2.65	2.21
3	2.34	1.04	2.41	1.59	2.52	2.46	1.81
4	1.83	1.73	2.34	1.28	1.57	1.41	2.36
5	1.20	2.03	2.28	2.30	2.33	2.03	1.38
6	3.40	1.76	2.89	1.66	1.64	2.93	1.30
7	1.34	1.21	2.44	2.56	1.38	1.44	2.19
8	1.02	2.01	2.57	1.63	2.00	1.74	1.43
9	2.27	1.90	1.82	2.17	1.16	2.39	2.91
10	2.34	1.40	1.70	1.24	1.98	2.18	
11	1.06	1.27	1.45	2.15	1.42	1.67	
12	3.24	1.49	1.59	1.29	2.04	1.81	
13	3.03	1.10	1.14	1.88	1.16	2.00	
14	1.63	1.35	1.97		2.70	1.83	
15		1.95	1.79		1.66	1.42	
16		1.30	1.35			1.65	
17			2.50			1.51	
18			1.72			1.69	
19			3.08			1.84	
20			2.76			1.26	
21			1.20			1.92	
22			1.58			2.57	
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
no. of cars pe cycle	14	16	22	13	15	22	9

+3.0%

cycle	92	93	94	95	96	97	98
vehicle							
1	1.42	2.15	1.47	2.14	2.58	1.54	2.72
2	1.46	2.52	1.66	2.40	1.41	2.55	1.56
3	2.64	1.60	2.48	1.53	1.43	1.93	1.78
4	2.11	1.43	1.41	1.48	1.63	1.84	1.60
5	1.66	1.44	2.00	1.96	1.70	1.71	1.84
6	1.80	1.44	1.55	1.29	1.43	1.43	2.63
7	1.24	3.10	1.92	1.57	2.02	1.58	1.37
8	0.88	1.17	3.09	2.09	1.22	2.52	1.12
9	1.11	1.59	1.74	1.35	1.16	1.42	1.94
10	1.45	1.74	1.04	1.84	2.20	1.54	1.90
11	1.71	3.32	2.28	1.90	1.64		1.53
12	3.56	2.07	2.55	1.43	1.85		1.79
13		2.58	1.99	1.41	2.72		1.47
14			2.46	1.47	1.17		1.96
15				2.81	1.49		1.16
16				1.50	1.64		1.32
17				2.81	1.36		1.44
18				1.84	1.91		1.60
19					1.50		2.23
20					1.33		0.94
21					1.17		2.78
22					1.49		1.59
23					1.11		1.73
24					1.30		1.41
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
no. of cars pe cycle	12	13	14	18	24	10	24

+3.0%

cycle	99	100	101	102	103	104	105
vehicle							
1	1.67	1.56	1.57	1.43	2.38	1.32	2.22
2	2.50	1.86	1.39	1.50	1.75	1.23	2.08
3	3.02	2.11	1.93	2.20	1.34	1.83	1.44
4	1.40	1.88	1.83	1.40	1.98	1.53	1.62
5	2.97	2.05	1.41	1.30	1.68	1.53	1.08
6	1.21	1.60	2.24	2.83	1.85	2.64	1.63
7	1.65	1.36	1.66	1.72	1.87	1.48	2.46
8	2.45	1.84	2.15	2.75	1.99	1.08	1.53
9	1.19	1.99	1.43	1.36	1.50	1.51	1.12
10	2.29	1.67	1.52	3.02	1.61	1.72	1.75
11	1.03	2.01	1.37		1.68	2.38	1.27
12	2.30	2.33	1.53		1.51	1.08	0.94
13	1.40	1.50	2.16		1.41	2.85	1.82
14	2.06		1.83		1.22	2.34	3.12
15	1.73		1.71		0.97		0.91
16	1.95		1.69		1.51		3.11
17	2.24		0.38				0.98
18	1.43		2.46				1.12
19			1.34				
20			2.50				
21			1.63				
22			1.67				
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
no. of cars pe cycle	18	13	22	10	16	14	18

+3.0%

cycle	106	107	108	109	110	111	112
vehicle							
1	1.31	2.36	1.65	1.68	2.80	1.66	1.68
2	1.64	1.89	2.44	1.28	1.36	3.47	1.71
3	1.91	1.48	2.61	1.78	1.50	1.64	1.32
4	1.63	1.41	1.19	2.35	1.14	1.86	2.46
5	1.42	1.69	1.74	2.11	2.52	2.74	1.53
6	2.05	1.60	1.94	3.14	0.45	1.25	1.94
7	1.59	1.98	3.23	1.95	1.80	1.40	1.50
8	2.75	2.04	1.93	1.51	1.35	1.87	1.95
9	1.76		1.84	1.29	1.95	2.41	1.73
10				1.91	1.52	2.33	1.62
11				2.15	1.03	1.34	1.93
12				1.17	1.35		2.69
13				1.48	1.40		1.51
14				2.01	1.09		2.67
15				1.65	1.86		1.52
16				1.10	1.41		1.63
17				1.66	1.87		1.95
18				1.28	1.10		1.65
19				1.76	1.42		1.51
20				2.72	2.19		1.67
21							1.64
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
no. of cars pe cycle	9	8	9	20	20	11	21

+3.0%

cycle	113	114	115	116	117	118	119
vehicle							
1	1.29	2.20	1.90	2.54	1.17	2.32	1.29
2	1.41	1.82	1.49	1.11	1.44	1.23	2.18
3	1.16	2.74	1.82	1.57	1.62	1.92	1.30
4	2.43	1.37	1.42	1.83	1.51	2.30	1.57
5	2.51	1.83	1.74	2.26	2.27	1.31	1.46
6	1.27	1.83	1.31	2.34	1.53	2.20	1.36
7	1.00	1.22	1.19	0.98	1.73	1.57	1.75
8	1.79	2.88	1.15	2.30	1.70	1.33	1.93
9	1.66	1.72	2.09	1.01	1.38	1.16	3.40
10	1.81	1.66	1.46	1.13	1.19	1.95	2.53
11	2.32	1.66	1.26	1.56	0.93	1.27	1.18
12	1.08	2.95	1.15	1.64	1.23	1.57	1.82
13	1.70	2.32	1.12	1.14	1.44	1.49	0.89
14	1.24	1.52	2.50	1.09	0.88	2.49	1.46
15	2.46	1.38	2.45	2.00		1.93	
16	2.04	1.24	1.15	1.00			
17		2.04	2.93	1.58			
18		1.35	1.00	1.39			
19		1.65	1.36	1.31			
20		1.69	1.28				
21		1.16	4.36				
22		1.71	1.48				
23		2.52	1.86				
24			1.28				
25			1.75				
26			1.44				
27			1.88				
28							
29							
30							
31							
32							
33							
34							
no. of cars pe cycle	16	23	27	19	14	15	14

+3.0%

cycle	120	121	122	123	124	125	126
vehicle							
1	1.37	1.77	2.31	1.53	1.30	1.18	1.52
2	2.46	2.10	1.78	1.48	1.43	1.69	1.70
3	1.21	1.60	1.15	1.70	1.23	1.40	1.40
4	1.51	2.36	1.08	1.67	1.10	2.41	1.68
5	1.69	3.10	0.54	1.91	2.77	2.46	2.20
6	2.85	1.53	2.34	1.41	1.47	2.43	2.08
7	1.93	1.46	1.62	1.05	1.75		1.57
8	2.97	1.68	1.18	1.61	1.58		1.05
9	2.41	1.47	1.79	3.19	1.57		1.56
10	2.48	1.81	1.39	1.11	1.27		1.26
11	2.37	2.49	2.01	1.86	1.89		1.23
12	1.99	1.90	2.61	1.96	1.17		
13	2.00	2.49	1.45	1.93	2.05		
14		1.87	1.65	1.54	2.63		
15			1.48	1.81			
16			1.58	0.88			
17			2.07	2.46			
18			1.96	1.16			
19				2.34			
20				2.10			
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
no. of cars pe cycle	13	14	18	20	14	6	11

+3.0%

cycle	127	128	129	130	131	132	133
vehicle							
1	1.23	1.37	4.29	2.60	2.05	1.69	2.16
2	1.36	1.69	1.14	1.54	3.78	1.50	3.11
3	1.10	1.78	1.50	1.47	0.99	3.75	2.75
4	1.14	2.14	2.62	3.49	1.32	2.02	1.30
5	1.26	1.63	1.00	2.05	2.10	2.00	1.14
6	2.30	1.29	2.27	1.32	1.64	0.78	3.26
7	1.19	2.12	1.30	1.54	1.05	1.31	1.30
8	1.05	3.00	2.17	2.25	1.57	2.01	1.23
9	2.14	1.99	1.70	2.21	1.23	1.86	1.93
10	2.44	1.74	1.51	1.33	1.43	1.28	1.45
11	2.56	1.42	0.90	1.51	2.25	1.70	2.12
12		1.51	1.19	1.16	0.92	1.92	1.57
13		1.43	1.40	1.21	1.79	2.26	2.00
14		2.06	1.55	2.28	2.20	2.05	2.09
15		1.43	1.52	1.22	1.86	1.46	1.72
16		1.76	2.83	2.14	1.43	1.51	
17		2.23	1.88		2.34		
18			2.37		1.97		
19			1.32		1.82		
20			1.41		2.01		
21					1.71		
22					2.26		
23					1.60		
24					2.53		
25					1.29		
26					2.52		
27							
28							
29							
30							
31							
32							
33							
34							
no. of cars pe cycle	11	17	20	16	26	16	15

+3.0%

cycle	134	135	136	137	138	139	140
vehicle							
1	2.00	1.21	2.67	1.44	1.97	2.80	1.77
2	0.95	2.17	1.62	2.70	1.42	1.23	1.58
3	2.29	1.35	1.35	1.37	1.54	1.08	1.69
4	2.36	1.39	1.58	2.28	2.88	1.93	1.43
5	1.41	2.12	1.73	1.59	1.76	3.37	1.71
6	1.38	1.58	1.54	3.06	1.46	1.37	2.12
7	1.00	1.31	1.49	1.82	1.44	1.79	1.88
8	2.18	1.57	1.41	1.55	1.69	1.53	1.71
9	1.32	1.34	1.89	2.22		1.19	2.86
10	1.28	1.44				2.47	2.06
11	1.81	1.90					1.32
12	1.14	1.33					1.43
13	1.33	2.49					1.33
14	1.26	2.28					2.74
15	1.64						
16	2.01						
17	3.85						
18	1.53						
19	1.35						
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
no. of cars pe cycle	19	14	9	9	8	10	14

+3.0%

cycle	141	142	143	144	145	146	147
vehicle							
1	1.52	1.77	4.07	3.17	1.48	1.17	3.01
2	2.12	1.81	1.59	1.40	2.31	2.71	2.55
3	1.49	1.34	2.01	1.82	1.92	1.65	2.63
4	0.95	1.18	1.53	1.47	1.45	3.18	2.54
5	1.62	1.49	1.22	1.19	1.43	3.74	2.21
6	1.68	1.42	0.78	1.90	2.34	2.37	2.10
7	1.69	1.54	1.49	1.74	1.54	1.40	1.02
8	2.19	2.11	1.68	1.32	1.47	1.33	1.53
9	2.15	1.81	1.80	1.80	1.48	1.83	1.59
10	1.67	2.06	1.45	1.01	1.20	1.47	2.80
11	1.44	2.18	2.58	2.22	2.31	1.21	1.55
12		1.75	1.93		1.90	1.89	2.31
13		1.39	1.59		1.93	2.04	
14		1.25			3.14	1.75	
15		1.16					
16		1.38					
17		0.45					
18		2.72					
19		0.83					
20		1.41					
21		1.18					
22		1.54					
23		1.44					
24		3.41					
25		1.87					
26		1.15					
27		1.76					
28							
29							
30							
31							
32							
33							
34							
no. of cars pe cycle	11	27	13	11	14	14	12

+3.0%

cycle	148	149	150	151	152	153	154
vehicle							
1	1.85	1.94	2.20	1.25	2.33	2.74	1.93
2	2.44	1.38	0.68	1.28	1.45	1.53	1.92
3	1.05	4.06	1.73	1.37	1.89	1.57	0.95
4	1.50	1.79	2.80	1.55	2.92	0.96	1.69
5	1.53	1.79	1.81	1.74	1.94	2.92	1.93
6	3.51	2.15	1.37	1.63	1.74	2.35	2.55
7	2.66	1.68	1.81	0.88	1.16	2.03	1.65
8	1.29	2.64	1.23	1.70	1.78	2.56	1.17
9	1.55	2.05	1.70	1.54	1.85	1.54	1.68
10	0.95	3.31	1.30	2.15	3.22	1.18	1.45
11	1.19	1.15	1.38	1.41	1.97	2.36	1.63
12	1.25	2.05	1.52	1.76	1.89	1.49	1.84
13	2.13	1.51	1.15			1.57	1.43
14	1.61	1.47	1.68			1.25	1.54
15	1.92		1.54			1.38	2.27
16	2.09					1.86	
17	1.28					1.48	
18	1.46					1.96	
19						1.00	
20						1.37	
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
no. of cars pe cycle	18	14	15	12	12	20	15

+3.0%

cycle	155	156	157	158	159	160	161
vehicle							
1	1.33	2.14	1.60	1.87	1.29	1.41	2.07
2	1.24	1.07	1.76	1.30	2.01	2.46	1.92
3	1.70	2.40	1.42	3.64	1.97	1.78	1.78
4	1.54	1.37	1.51	1.82	1.48	1.38	1.38
5	1.07	1.01	1.07	1.51	1.93	1.77	1.77
6	1.79	2.97	1.43	1.78	1.90	1.73	1.73
7	1.60	1.19	0.93	1.53	2.53	2.09	2.09
8	3.60	1.83	1.59	1.55	1.33	1.60	1.60
9	1.13	2.18	2.20	2.03	1.56	1.11	1.11
10	2.07	2.88	1.14	1.73	1.41	1.54	1.54
11	2.03		1.38	1.92	2.76	2.14	2.14
12	1.38		1.65		1.86	1.99	1.99
13	1.71		1.54		2.00	3.38	1.97
14	1.32		2.06		2.30	1.91	
15			1.47		1.41		
16			2.30		2.12		
17			1.24				
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
no. of cars pe cycle	14	10	17	11	16	14	13

+3.0%

cycle	161	162	163	164	165	166	167
vehicle							
1	2.07	2.36	1.73	1.82	2.30	1.31	3.48
2	1.92	1.78	1.98	2.69	1.73	3.04	1.28
3	1.78	1.44	1.33	1.03	1.78	2.14	1.75
4	1.38	1.26	1.64	1.23	2.38	2.40	1.74
5	1.77	2.25	2.33	1.27	1.23	1.23	1.22
6	1.73	1.69	2.17	2.06	2.30	1.81	2.20
7	2.09	1.85	1.70	1.16	2.36	1.64	1.43
8	1.60	2.04	1.70	1.39	1.47	1.76	1.38
9	1.11	1.69	1.67	3.63	2.62	0.99	2.69
10	1.54	1.48	2.95	1.92		1.25	1.33
11	2.14	1.41	1.49	1.14		1.32	
12	1.99	1.22	1.52	2.80		2.45	
13	1.97		1.59	1.92		1.95	
14			1.32	1.64		2.17	
15			1.08	1.54		1.43	
16			1.20	2.08		0.92	
17				1.08		1.78	
18				1.57		2.26	
19						2.06	
20						1.71	
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
no. of cars pe cycle	13	12	16	18	9	20	10

+3.0%

cycle	168	169	170	171	172	173	174
vehicle							
1	3.46	2.74	1.80	1.58	1.73	1.95	1.29
2	3.26	1.49	1.04	1.88	1.90	2.36	1.77
3	1.46	1.76	1.52	1.77	1.61	1.30	1.71
4	1.49	1.09	1.68	1.88	3.91	1.89	1.14
5	1.58	1.67	1.25	1.40	1.75	3.06	2.03
6	1.51	1.36	2.06	1.32	1.12	2.43	1.39
7	1.82	3.63	1.18	2.40	1.39	1.27	1.68
8	1.35	1.64	2.06	1.47	1.01	1.61	1.41
9	2.40	1.51	2.11	1.38	1.12	1.05	1.29
10	2.10	1.13	2.17	1.17	1.99	2.40	1.28
11		1.68	1.43	1.07	2.08	1.06	1.23
12		1.09	1.36	1.53	1.74	2.13	1.38
13		2.75	1.31	1.20	1.84	1.54	2.67
14		2.14		1.55	1.19	1.26	3.30
15		1.41		1.46	1.85	0.88	1.52
16				2.01	1.29	1.59	
17					1.41	1.76	
18					1.84	1.46	
19					1.27	1.46	
20					0.81		
21					1.16		
22					2.56		
23					1.34		
24					1.73		
25					2.07		
26					0.59		
27							
28							
29							
30							
31							
32							
33							
34							
no. of cars pe cycle	10	15	13	16	26	19	15

+3.0%

cycle	175	176	177	178	179	180	181
vehicle							
1	1.33	1.82	4.02	1.60	2.67	1.48	2.65
2	1.97	1.43	1.16	1.98	1.27	1.59	1.81
3	1.67	1.21	1.84	1.53	1.83	2.79	1.17
4	2.08	1.85	1.64	1.26	1.93	1.40	1.45
5	1.26	2.26	0.52	1.53	2.20	1.69	1.38
6	2.00	1.12	1.85	2.30	1.25	1.38	1.37
7	2.07	1.44	1.53	1.17	1.84	1.17	2.62
8	1.56	2.17	2.51	2.35	1.01	1.88	1.94
9	2.04	3.29	1.20	3.16	2.77	1.40	1.31
10	1.79	2.51	1.53	1.26	2.43	2.62	1.97
11	1.30	2.86	2.26	2.08	1.98	1.56	1.93
12	2.03	1.48	2.22	2.51	2.40	1.97	0.92
13	1.45	1.89		1.74	1.74	1.30	1.44
14	2.13	2.44		1.92	1.63	1.69	2.16
15	1.40	1.89		1.65	1.45	0.79	2.27
16	2.64			1.56		1.07	
17	1.28					2.72	
18	1.57					1.64	
19	1.40					1.50	
20	1.76					1.85	
21	1.22						
22	1.45						
23	0.88						
24	1.62						
25	0.94						
26	1.93						
27	2.16						
28							
29							
30							
31							
32							
33							
34							
no. of cars pe cycle	27	15	12	16	15	20	15

+3.0%

cycle	182	183	184	185	186	187	188
vehicle							
1	1.43	1.94	2.15	1.78	2.67	1.44	2.87
2	0.99	0.82	2.35	1.58	1.72	2.94	5.20
3	3.88	1.76	1.88	1.59	1.58	1.81	3.73
4	1.53	0.91	2.77	2.11	1.35	1.45	2.11
5	1.53	4.10	1.59	1.26	1.69	0.87	
6	2.81	3.25	1.66	2.40	1.86	2.16	
7	2.24	1.85	1.40	1.64	1.74	3.63	
8	1.37	2.12	2.69	1.90	1.39	1.51	
9	1.40	1.64	1.13	1.68	2.71	1.28	
10	2.33	1.93		1.74	3.39		
11	2.06	1.71		5.34	1.15		
12		1.29			2.01		
13		2.96			2.07		
14		1.36			1.48		
15		2.05			2.04		
16		2.21			1.78		
17					1.55		
18					1.19		
19					1.86		
20					1.59		
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
no. of cars pe cycle	11	16	9	11	20	9	4

+3.0%

cycle	189	190	191	192	193	194	195
vehicle							
1	2.11	1.27	1.57	1.08	2.73	2.40	2.21
2	1.32	1.23	1.55	0.92	1.24	1.20	3.70
3	1.47	2.21	1.92	1.77	1.79	1.09	1.33
4	3.36	2.40	1.79	2.07	1.54	2.10	1.36
5	1.74	2.53	2.34	1.87	2.08	2.78	1.40
6	1.40	1.71	2.03	1.38	2.24	1.66	1.71
7	1.71	2.28	2.72	2.26	1.38	1.96	1.68
8	1.55	2.09	3.46	1.46	1.39		
9	1.32	3.60	1.22	1.17	2.57		
10	1.41	2.70	1.41	1.42	2.55		
11		1.56	1.61	2.12			
12		1.28	1.67	2.45			
13		1.20	1.10	1.78			
14			1.28	0.98			
15			1.96	2.67			
16			2.65	1.17			
17				1.77			
18				1.48			
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
no. of cars pe cycle	10	13	16	18	10	7	7

+3.0%

cycle	195	196	197	198	199	200	201
vehicle							
1	2.21	1.67	2.03	2.79	1.37	1.24	1.92
2	3.70	1.51	1.56	1.66	1.13	1.31	2.30
3	1.33	1.76	1.77	2.77	1.87	2.10	2.05
4	1.36	2.66	2.18	1.47	1.02	2.35	2.16
5	1.40	1.59	1.61	1.28	3.01	1.05	1.51
6	1.71	1.35	1.85	1.38	1.38	3.39	1.57
7	1.68	1.12	1.26	1.33	1.89	1.62	1.46
8		2.37	1.44	1.44	1.04	1.85	1.18
9		2.67	1.42	1.34	2.03	1.17	1.65
10		1.34	2.60	2.85	2.08	1.42	1.54
11			2.74	1.44	1.83	1.10	2.12
12			1.48	2.03	1.32	1.85	1.14
13			1.89	1.88	2.37	1.88	
14			2.03	2.20	1.44	2.56	
15				2.75	2.00	1.44	
16				2.30	1.21		
17				2.55	1.41		
18				3.05	1.46		
19					1.64		
20					1.27		
21					1.54		
22					2.19		
23					1.71		
24					1.33		
25					2.80		
26					1.74		
27					1.15		
28							
29							
30							
31							
32							
33							
34							
no. of cars pe cycle	7	10	14	18	27	15	12

+3.0%

cycle	202	203	204	205	206	207	208
vehicle							
1	1.61	2.16	1.46	1.10	1.21	1.96	1.05
2	1.95	2.14	2.01	1.43	2.16	1.39	2.18
3	1.32	1.85	1.35	1.43	2.63	2.16	2.15
4	1.74	1.41	1.72	2.21	2.90	1.99	1.78
5	1.25	1.17	2.13	1.28	1.81	2.07	1.35
6	3.46	2.86	1.48	1.43	1.44	2.45	1.26
7	3.06	1.67	1.91	1.19	1.38	2.49	1.73
8	1.06	2.71	1.67	1.91		1.39	1.75
9	1.35	1.92	1.23	2.20		1.39	1.64
10	1.76	1.70	2.22	1.65		1.28	1.50
11	1.24	1.46	0.99	1.85		1.80	1.94
12	1.64	1.73	1.23	1.51		1.01	1.17
13	1.80	0.88	2.19	2.65		1.65	1.67
14	1.30	1.83	4.07	1.51		1.38	1.90
15	2.47	1.46	1.47	1.04		1.06	2.14
16	2.01	2.21	1.21	2.14		1.45	
17		2.00	1.41	1.28		1.45	
18		1.66	1.89	2.35		1.40	
19		1.09	1.20				
20		2.70	1.12				
21		1.10	1.44				
22		1.24	3.20				
23		2.58	2.50				
24		1.84					
25		1.77					
26		1.39					
27		3.20					
28		2.13					
29							
30							
31							
32							
33							
34							
no. of cars pe cycle	16	28	23	18	7	18	15

+3.0%

cycle	209	210	211	212	213	214	215
vehicle							
1	1.07	1.48	1.58	1.90	1.56	3.13	2.62
2	1.54	2.25	1.13	1.77	1.40	1.18	1.70
3	1.66	1.67	2.24	2.70	1.77	2.55	1.80
4	1.52	1.75	1.58	1.85	1.50	2.06	1.40
5	1.58	1.46	2.18	1.32	1.74	1.91	1.63
6	1.30	1.55	1.17	1.48	2.07	1.29	1.90
7	1.65	2.52	1.31	1.25	1.66	1.53	2.13
8	3.39	1.66	1.46	2.70	1.26	1.07	1.55
9		1.42	1.14	2.41	2.18	1.10	2.25
10		2.57	0.93	1.32	1.82	1.79	1.33
11		1.70	1.56	1.42	1.37	1.32	1.11
12			1.40	1.44	1.53	2.65	2.16
13			3.57	1.06	1.54	2.02	
14			1.62				
15			1.25				
16			0.95				
17			1.25				
18			2.40				
19			2.10				
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
no. of cars pe cycle	8	11	19	13	13	13	12

+3.0%							
cycle	216	217	218	219	220	221	222
vehicle							
1	1.37	2.37	2.49	2.02	1.63	3.00	1.57
2	1.82	2.34	2.28	1.88	1.73	2.14	2.25
3	2.60	1.20	2.55	1.23	1.98	1.31	2.11
4	1.05	2.14	1.74	1.87	1.42	1.48	1.34
5	1.94	2.75	1.16	2.78	1.70	1.86	1.71
6	1.87	1.34	1.60	1.32	2.22	2.08	2.13
7	2.06	1.12	1.77	1.86	1.62	1.72	1.08
8	1.82	2.08	1.77		1.52		1.69
9	2.27	1.98	1.78		2.96		1.65
10	2.32	1.68	1.90				2.07
11		1.81	1.18				2.57
12		1.73	1.33				2.15
13		1.40					1.61
14		1.12					1.27
15		1.32					1.44
16		1.76					2.87
17		1.08					
18		1.32					
19		1.85					
20		1.32					
21		1.31					
22		1.63					
23		1.38					
24		0.96					
25		1.95					
26		0.55					
27		2.84					
28		1.63					
29		1.59					
30							
31							
32							
33							
34							
no. of cars pe cycle	10	29	12	7	9	7	16

+3.0%							
cycle	223	224	225	226	227	228	229
vehicle							
1	2.17	1.66	2.09	1.34	1.30	1.58	1.41
2	2.82	2.07	1.35	1.95	1.60	1.68	2.90
3	1.76	1.76	1.37	1.39	1.98	1.64	2.51
4	1.31	1.77	1.16	2.01	1.37	1.92	1.99
5	1.93	1.57	2.13	1.76	2.49	2.01	1.44
6	1.51	3.30	1.57	1.37	1.65	1.26	2.46
7	0.45	1.10	1.63	1.77	1.24	1.52	2.94
8	1.87	1.87	2.13	1.26	1.85	1.44	1.60
9	1.82	1.89	1.47	1.68	1.54	1.40	3.51
10	2.12		2.27	1.57	1.25	1.40	
11			1.10	2.36	1.55	1.00	
12			1.52	1.09	1.88	1.19	
13			1.65	1.41	2.94	1.39	
14			1.93	1.52	1.06	1.36	
15			0.97	2.13	1.51		
16			3.08	1.96	1.64		
17			1.25	1.65			
18			1.22	1.09			
19			1.21	2.19			
20			1.41	2.02			
21				1.48			
22				1.93			
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
no. of cars pe cycle	10	9	20	22	16	14	9

+3.0%

cycle	230	231	232	233	234	235	236
vehicle							
1	1.58	1.62	2.14	2.31	1.58	2.81	1.97
2	2.09	1.54	2.09	2.69	2.10	1.16	1.73
3	2.66	1.70	1.22	1.47	1.35	1.94	1.89
4	1.29	1.49	1.60	1.31	1.92	1.79	1.47
5	1.48	1.60	1.45	1.98	2.35	2.01	1.70
6	1.42	1.40	2.17	2.23	2.07	2.66	1.77
7	1.37	1.39	1.64	0.89	1.53	0.99	1.38
8	1.63	1.66	1.79	1.58	1.52	2.11	2.85
9	2.95	1.87	1.56	1.22	2.33	1.37	2.16
10	2.83	2.42	1.98	1.92	1.72	1.76	1.64
11	1.51	1.48	1.83	1.45	1.20	1.36	1.20
12	1.65	1.14	1.73	1.90	1.80	1.74	1.84
13	1.08	0.86	1.82	0.92	1.51	1.82	2.43
14	1.54	1.21		1.71	1.66		
15	1.18	2.03		1.69	1.60		
16	2.50			1.75			
17	1.89						
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
no. of cars pe cycle	17	15	13	16	15	13	13

+3.0%

cycle	237	238	239	240	241	242	243
vehicle							
1	1.52	2.69	1.64	1.61	1.31	0.99	1.43
2	2.26	1.67	1.45	1.43	1.43	1.43	1.65
3	2.05	2.16	2.15	2.04	2.53	1.63	2.85
4	3.32	1.41	2.20	1.88	1.14	2.66	1.59
5	2.05	2.50	1.41	2.13	1.84	1.54	1.83
6	1.73	1.80	0.78	1.28	2.12	1.63	1.24
7	1.22	1.67	1.12	2.06	1.88	1.14	1.46
8	3.43	2.40	3.19	2.20	1.59	2.14	2.08
9	1.39	1.41	1.78	1.30	1.61	1.57	2.23
10	2.23	1.35	1.41	2.24	0.57	1.45	2.24
11	2.13	1.57	2.71	1.24	2.02	3.65	1.30
12	[illegible]	2.02	1.76	2.27	1.35		1.52
13	1.55	1.89	1.58		0.76		1.15
14			1.39		2.26		1.60
15			2.15		1.48		1.58
16					1.42		1.23
17					1.61		1.73
18					1.81		2.08
19					1.29		2.14
20					1.72		1.50
21					1.56		1.23
22					2.16		2.17
23							1.62
24							1.77
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
no. of cars pe cycle	13	13	15	12	22	11	24

+3.0% cycle	244	245	246	247	248	no. of cycles	mean headway secs
vehicle							
1	1.60	2.51	2.00	1.11	2.00	248	1.89
2	2.43	1.94	2.29	2.63	1.34	248	1.89
3	2.10	2.27	1.44	1.66	1.97	248	1.82
4	2.08	1.89	1.17	1.60	2.44	248	1.78
5	2.92	1.16	2.04	1.82	2.10	247	1.83
6	1.43	1.94	0.92	1.20	1.97	247	1.84
7	1.73	1.82	1.34	1.56	1.66	243	1.74
8	1.40	1.09	3.27	1.99	2.90	238	1.82
9	1.93	1.28	1.68	2.31	2.64	230	1.81
10	1.25	1.80	0.99	1.55		214	1.77
11	1.93		1.30			198	1.76
12	2.56		0.82			186	1.71
13	1.68		1.72			172	1.77
14	1.13					142	1.80
15	2.11					118	1.72
16						98	1.69
17						78	1.79
18						74	1.67
19						57	1.63
20						48	1.74
21						34	1.58
22						30	1.85
23						24	1.70
24						18	1.86
25						14	1.68
26						14	1.47
27						11	2.04
28						6	1.62
29						4	1.73
30						1	1.55
31						1	1.88
32						1	2.18
33						1	2.65
34						1	1.08
no. of cars pe cycle	15	10	13	10	9		

+3.0% cycle	+3.0% stand dev	HEADWAY min head	max head
vehicle			
1	0.59	0.99	4.29
2	0.62	0.68	5.20
3	0.57	0.95	4.06
4	0.56	0.91	4.46
5	0.59	0.52	4.62
6	0.59	0.45	3.51
7	0.64	0.45	7.39
8	0.58	0.88	4.10
9	0.59	0.84	3.94
10	0.54	0.57	3.53
11	0.62	0.43	5.34
12	0.51	0.82	3.56
13	0.58	0.76	3.94
14	0.58	0.72	4.07
15	0.50	0.79	3.25
16	0.48	0.86	3.11
17	0.61	0.38	3.85
18	0.47	0.63	3.14
19	0.50	0.83	3.28
20	0.58	0.81	3.55
21	0.62	0.85	4.36
22	0.45	1.10	3.20
23	0.50	0.88	2.94
24	0.61	0.96	3.41
25	0.47	0.94	2.80
26	0.53	0.55	2.52
27	0.73	1.15	3.38
28	0.40	1.01	2.13
29	0.20	1.54	2.06
30	ERR	1.55	1.55
31	ERR	1.88	1.88
32	0.00	2.18	2.18
33	0.00	2.65	2.65
34	0.00	1.08	1.08

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no. of
cars per
cycle

-3.0% HEADWAYS

cycle	1	2	3	4	5	6	7
vehicle							
1	2.43	3.22	3.69	1.28	1.80	2.58	1.31
2	1.89	1.17	2.16	2.69	1.36	1.70	3.08
3	1.43	2.57	1.28	1.58	1.36	1.46	2.31
4	4.05	1.70	1.98	3.57		2.50	1.84
5	2.36	2.77	3.29	2.48			2.43
6	2.44		3.48	1.52			3.01
7	1.18		1.95	1.57			2.01
8	1.63		1.94	1.36			2.48
9	2.78		1.35	1.32			2.30
10			2.34	1.91			
11			3.00	1.84			
12				3.26			
13				1.67			
14				2.95			
15				1.14			
16				2.35			
17				4.22			
18				1.31			
19				1.56			
20				2.75			
21				1.77			
22				1.19			
23				2.09			
24				1.79			
25				3.19			
26				1.69			
27							
28							
29							
30							
31							
32							
no. of cars pe cycle	9	5	11	26	3	4	9

-3.0%

cycle	15	16	17	18	19	20	21
vehicle							
1	1.90	2.83	2.73	2.74	1.52	1.62	2.23
2	2.50	2.76	2.45	1.84	2.09	2.10	2.26
3	1.85	1.33	1.73	1.31	2.23	1.54	1.74
4	1.61	2.00	1.62	1.39	1.21	1.49	2.60
5	2.20	1.86	1.61	1.56	1.46	2.25	1.60
6	1.89	1.30	1.46	1.54	2.10	1.55	1.17
7	1.93	1.60	1.54	1.48	2.61	1.28	2.21
8	1.84	1.79	1.76	1.85	1.97	1.60	1.89
9	2.29	2.63	1.54	1.06	2.23	1.93	1.85
10	2.82	1.66	2.86	3.07	2.56	1.62	1.57
11	2.73	1.80	1.97	2.05		1.77	1.76
12		1.23	1.70	2.29			3.34
13		3.25	2.51	1.69			3.27
14			1.83				2.95
15			1.42				2.71
16			2.72				2.06
17			2.36				1.77
18			3.21				2.09
19			2.12				2.23
20			2.42				2.35
21			2.84				1.73
22			3.62				1.26
23			1.71				1.33
24			1.84				2.45
25			1.38				
26							
27							
28							
29							
30							
31							
32							
no. of cars pe cycle	11	13	25	13	10	11	24

-3.0%

cycle	8	9	10	11	12	13	14
vehicle							
1	2.43	1.44	2.24	2.72	0.99	1.84	1.49
2	2.15	2.60	1.60	2.56	1.72	2.67	3.46
3	1.50	2.07	2.06	1.58	1.22	2.99	1.21
4	2.16	1.12	2.30	1.56	1.93	1.66	2.51
5	1.72	2.64	2.53	1.40	1.60	1.65	1.79
6	1.89	2.16	2.10	1.82	1.53	1.66	1.73
7	1.17	1.92	2.13	2.15	2.17	1.68	1.78
8	1.51	1.36	1.01	3.39	1.40	1.77	1.85
9	2.74	1.20	1.86	1.52	1.39	2.15	1.64
10	2.15	2.36	1.86	1.33	1.17	3.11	2.25
11	1.88	2.22	2.72	1.61	1.41	2.88	1.31
12	1.43	1.57	1.47	1.91	1.49	1.59	1.89
13	1.50	1.53	1.30	2.26	1.91	1.99	1.08
14	0.93	1.81	1.25		1.68	1.84	1.46
15	1.95	1.21	1.84		2.25	1.33	1.83
16	1.48	1.60	1.80		1.11	2.13	1.33
17	1.11	1.90	1.05		2.98	2.44	3.11
18	1.53	5.35	1.85		2.18	1.33	1.84
19	2.41	2.94	1.48		3.70	3.81	2.54
20	1.87	2.31	1.51		1.47	2.20	1.79
21	2.06	1.82	1.38		4.17	1.43	1.94
22	1.90	1.68	2.07		1.60	1.91	1.63
23	1.51	1.26	3.04		1.65	1.62	1.74
24	1.95	2.25	1.03		2.70	1.94	1.52
25	1.90	1.92	2.79		2.48	2.53	1.51
26	1.47	1.62	1.18		2.23	2.33	1.99
27		1.39	2.24		1.90		1.96
28			1.98		2.13		1.84
29			1.67		2.47		1.52
30							
31							
32							
no. of cars pe cycle	26	27	29	13	29	26	29

-3.0%							
cycle	22	23	24	25	26	27	28
vehicle							
1	2.16	1.25	1.31	3.76	1.80	3.13	2.88
2	1.40	2.64	1.60	1.82	1.56	2.04	2.32
3	1.61	1.59	1.38	2.71	1.46	1.46	1.93
4	1.61	2.97	2.41	1.91	1.71	1.62	1.69
5	1.62	1.94	1.84	1.70	1.87	1.82	1.98
6	1.71	2.18	2.13	1.42	1.43	1.30	1.51
7	1.23	1.42	3.05	1.37	2.81	1.12	1.88
8	1.51	2.14	1.95	1.71	1.66	1.07	1.47
9	1.97	1.79	1.66	1.29	2.45	1.47	2.79
10	1.97	2.15	1.72	1.97	1.92	2.13	2.45
11	3.07	2.02	1.75	2.83	1.92	1.94	1.72
12	2.10		2.39	1.61	2.00	1.79	1.37
13	1.40		2.62	1.61	1.57	1.70	1.57
14			2.52	1.71	2.33	1.85	3.85
15			2.46	1.80	1.95	1.27	
16			1.63	1.93	1.86	2.59	
17			3.10	0.74	2.11	1.60	
18			2.94	1.96	1.69	2.03	
19				1.85	1.16	1.87	
20				1.70	1.76	3.07	
21				2.20	1.91	1.80	
22				2.88	1.54	1.60	
23				3.87	1.76	1.78	
24				1.07	1.78	2.89	
25				1.53	1.25	1.66	
26				2.07	1.47	1.97	
27				1.60	1.84	3.40	
28				1.99	1.90	1.56	
29				1.68	1.40		
30					1.93		
31							
32							
no. of cars pe cycle	13	11	18	29	30	28	14

-3.0%

cycle	29	30	31	32	33	34	35
vehicle							
1	1.83	2.06	1.88	3.39	2.28	1.73	3.07
2	1.87	1.61	1.80	2.28	1.56	1.89	1.46
3	1.60	1.74	1.57	1.72	1.54	1.06	2.52
4	1.60	2.94	2.19	2.02	1.89	2.11	1.96
5	1.96	2.00	1.84	2.42	1.47	1.73	2.28
6	1.46	1.69	1.60	1.87	2.25	1.49	1.88
7	2.09	1.31	1.94	1.70	2.19	1.87	1.97
8	1.75	1.32	2.93	2.03	1.88	2.06	1.51
9	2.27	3.59	1.63	1.52	2.43	1.58	1.71
10	1.53	1.63	1.63	1.98	1.48	1.79	1.80
11	1.24	1.81	1.68	2.13	1.24	1.88	2.71
12	1.81		1.58	1.34	1.91	2.02	
13	0.59		1.90	2.16	2.33	1.75	
14	1.06		1.04	0.86	2.72	4.06	
15			2.14	2.08	2.25	1.38	
16			2.77	1.68	2.55	1.83	
17			1.86	2.50	2.20	2.26	
18			2.72	2.66	1.87	1.33	
19			2.25	2.49	2.41	1.60	
20			2.48	2.59	2.61	1.34	
21			2.85	2.44	1.48	1.88	
22			3.20	3.07	3.47	2.05	
23			2.30	2.90	1.67	1.72	
24			1.50	2.15	1.37	1.76	
25			2.43		1.26	2.15	
26			2.25		1.38	1.88	
27			1.41		1.23	1.28	
28					1.32	2.61	
29						2.80	
30							
31							
32							
no. of cars pe cycle	14	11	27	24	28	29	11

-3.0%

cycle	36	37	38	39	40	41	42
vehicle							
1	2.23	1.99	1.41	1.38	1.58	1.33	2.39
2	1.84	1.98	1.79	1.97	1.52	3.41	1.53
3	1.74	2.93	2.29	2.64	2.58	1.21	3.48
4	1.76	1.87	2.31	2.33	1.99	2.21	
5	2.83	2.85	1.76	1.72	1.90	1.81	
6	2.50	2.55	1.55	1.94	2.16	1.96	
7	2.08	1.03	2.03	1.49	2.30	1.70	
8	1.30	1.62	2.09	1.59		2.04	
9	1.23	1.91	2.04	2.64		2.92	
10	2.30	1.54	1.69	1.78		1.25	
11	1.19	1.47	2.11	1.69			
12	1.66	1.37	2.63	1.93			
13	1.81	2.38	1.59	1.48			
14	3.33	2.39	1.31	3.38			
15	1.77	2.62	1.86	2.10			
16	2.77	1.83	2.98	1.73			
17	1.41	2.42	1.73	2.88			
18	1.93	2.71	2.80	2.51			
19	2.72	1.91	1.84	1.56			
20	2.13	1.88	2.43	1.84			
21	1.97	1.63	1.71	1.94			
22	2.36	3.09	1.74	1.53			
23	3.44	1.90	2.85	2.78			
24	1.94	1.56	1.50	1.90			
25	2.13	3.03	2.32	1.72			
26		2.14	4.07	1.61			
27				3.02			
28							
29							
30							
31							
32							
no. of cars pe cycle	25	26	26	27	7	10	3

-3.0%

cycle	43	44	45	46	47	48	49
vehicle							
1	1.80	1.18	1.41	1.97	2.71	2.47	1.63
2	2.37	2.39	2.04	5.03	2.05	1.91	1.94
3	1.85	1.54	1.22			3.29	1.68
4		1.65	1.43				1.78
5			2.99				1.68
6			1.29				1.41
7			1.37				1.21
8			1.78				1.61
9			0.97				1.34
10			1.10				1.83
11			1.37				1.45
12							1.19
13							1.82
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
no. of cars pe cycle	3	4	11	2	2	3	13

-3.0%

cycle	50	51	52	53	54	55	56
vehicle							
1	2.14	2.14	1.44	1.95	2.33	1.21	2.10
2	1.83	2.05	2.33	1.68	1.64	2.46	1.59
3	1.20	2.80	1.94	1.65	2.20	1.58	2.94
4	1.86	1.17	1.89	1.67	0.99	2.27	1.84
5	2.33	1.49	1.55	1.43	1.89	1.99	1.71
6	1.21	1.70	1.54	1.76	1.83	2.37	2.00
7	1.11	1.81	1.27	1.11	1.49	1.92	1.52
8		1.32	2.15	1.59	2.10	1.90	1.85
9		2.31	1.80	2.24	1.71	1.98	2.28
10		2.70	1.98	0.95	2.28	1.52	1.81
11		1.[illegible]	1.43	1.58	1.24	1.48	2.12
12		1.1[illegible]	1.08	2.01	1.89	2.46	1.45
13				1.31	1.32	1.31	2.06
14				1.58	1.66	1.47	1.47
15				1.68	1.56	1.41	
16				1.73	1.42	2.28	
17				1.67	1.88	1.66	
18				1.49	2.72	1.30	
19				2.25	1.41	1.44	
20				1.95	2.41	1.77	
21				2.83	2.27	1.34	
22				1.71	1.72	2.52	
23				2.40	0.94	2.38	
24				2.12	1.75	1.71	
25				1.50	1.45	1.54	
26				2.63	1.88	1.42	
27				1.46	1.61	2.53	
28				1.20	1.61	1.45	
29				1.79	2.06	1.37	
30				1.58	3.66	1.43	
31				1.81		1.54	
32							
no. of cars pe cycle	7	12	12	31	30	31	14

-3.0%

cycle	57	58	59	60	61	62	63
vehicle							
1	1.06	1.92	2.65	1.86	1.60	2.78	2.73
2	0.97	1.58	0.99	2.20	1.49	2.42	2.30
3	1.90	1.30	1.58	1.38	2.40	1.58	1.88
4	2.00	2.00	2.06	2.00	2.24	1.20	1.24
5	1.30	1.41	1.26	1.37	1.19	2.12	1.74
6	1.84	1.27	1.85	1.87	1.07	1.66	1.54
7	1.47	1.84	2.24	1.95	1.17	2.19	1.46
8	1.63	1.47	1.78	1.46	1.23	1.00	1.32
9	1.52	1.54	1.49	2.12	1.41	1.17	1.16
10	2.14	2.36	1.30	2.17	1.86	1.49	1.07
11	1.94	2.58	2.02	3.09	1.72	1.00	1.50
12	1.48	1.85	1.37		2.25	1.18	1.29
13	2.35	2.14	2.07		1.42	1.83	1.54
14	1.43	1.89	2.32		1.61	1.94	
15	2.27		1.79		1.31	2.06	
16	2.53		2.38			1.53	
17	2.61		0.84			1.94	
18	3.26		2.56				
19	2.88		1.73				
20	2.94		3.28				
21	2.43						
22	1.92						
23	1.19						
24	2.66						
25	2.54						
26	2.02						
27							
28							
29							
30							
31							
32							
no. of cars pe cycle	26	14	20	11	15	17	13

-3.0%

cycle	64	65	66	67	68	69	70
vehicle							
1	1.88	2.10	1.97	1.41	0.99	1.49	1.95
2	2.33	1.74	1.44	1.17	1.81	1.63	1.71
3	1.62	1.94	1.64	3.26	2.18	1.47	1.62
4	1.79	1.63	1.86	1.64	1.67	1.95	1.76
5	2.23	1.99	1.71	1.90	1.77	1.88	1.37
6	1.56	1.95	2.30	2.05	1.92	1.22	1.31
7	2.23	2.10	1.43	1.68	1.91	1.91	1.84
8	2.00	1.03	1.02	1.21	1.67	1.77	1.85
9	1.44	1.70	1.87	1.18	2.25	1.37	1.46
10	2.19	1.28	1.84	2.35		1.68	1.37
11	1.77	1.37	1.75	2.12		2.12	2.26
12	2.27	1.33	1.81				1.82
13	1.73	2.15					2.39
14	2.66	1.40					1.58
15		2.87					2.19
16							1.69
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
no. of cars pe cycle	14	15	12	11	9	11	16

-3.0%

cycle	71	72	73	74	75	76	77
vehicle							
1	1.53	1.66	1.58	2.36	1.36	1.73	2.10
2	1.44	2.30	1.66	1.50	1.68	1.87	2.33
3	2.17	2.91	1.99	2.48	2.07	1.90	1.47
4	1.94	0.90	1.18	1.67	1.90	1.59	3.50
5	1.52	1.67	2.18	1.53	1.94	1.52	2.07
6	1.88	1.10	1.32	1.44	1.49	1.13	1.52
7	1.95	1.42	1.11	1.50	1.42	3.35	1.41
8	1.07	2.05	1.69	1.42	1.46	1.38	2.26
9	3.91	1.94	1.48	1.59	1.82	1.97	1.59
10	1.91	1.51	1.52	1.57	1.53	2.04	2.54
11	2.43	1.27	1.12	2.42	1.29	1.62	1.88
12	1.62	1.40	1.24	1.53	1.13	2.41	1.42
13	1.94	2.09	1.27	1.84	1.61	1.58	1.38
14	2.61	2.22	1.26	1.93	2.15	2.42	1.26
15	1.65		1.30		1.31	2.20	1.38
16	1.19		1.97		1.27	1.78	1.19
17	2.55		1.23		3.33	1.34	
18	1.80		1.62		2.80	1.23	
19	2.02		1.22		2.30	1.85	
20					1.48		
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
no. of cars pe cycle	19	14	19	14	20	19	16

-3.0%

cycle	78	79	80	81	82	83	84
vehicle							
1	2.59	1.91	1.38	3.17	2.91	1.77	1.74
2	1.51	1.23	2.08	1.53	1.47	2.08	2.24
3	1.17	1.95	2.09	1.53	2.33		1.78
4	2.14	2.13	2.18	1.31			2.11
5	2.20	1.90	1.88	6.43			3.13
6	1.17	1.85	2.99	1.13			1.91
7	2.52	2.30	2.43	1.53			2.06
8	1.20	2.97	2.17	1.38			2.12
9	2.43	1.48	1.64	2.06			
10	1.33	1.03	1.23	1.87			
11	2.29	1.70	1.30	2.95			
12	1.83	2.41	1.23				
13	2.07	2.05	1.40				
14	1.57		1.35				
15	1.78		1.27				
16	1.76		2.49				
17	2.62		1.32				
18	1.71		1.91				
19			2.26				
20			1.56				
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
no. of cars pe cycle	18	13	20	11	3	2	8

-3.0%

cycle	85	86	87	88	89	90	91
vehicle							
1	2.02	2.16	1.13	1.28	2.59	1.93	2.35
2	2.08	2.62	2.19	1.42	2.85	1.60	1.20
3	3.65	2.58	1.42	2.40	2.89	2.19	1.23
4	2.93		1.75	1.98	2.02	2.09	1.61
5	3.03		2.09	1.54	1.39	2.14	2.44
6	3.02		1.61	2.12	1.87	1.86	1.34
7	1.87		2.54	2.53	1.75	2.29	3.13
8	1.66		1.74	1.72	2.01	2.21	1.50
9	1.34				1.14	2.62	
10						2.07	
11						1.74	
12						2.23	
13						1.69	
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
no. of cars pe cycle	9	3	8	8	9	13	8

-3.0%

cycle	92	93	94	95	96	97	98
vehicle							
1	1.52	1.68	1.62	1.68	1.73	2.70	1.19
2	1.58	2.99	1.47	1.58	2.04	1.85	2.10
3	1.59	1.17	1.56	1.80	1.79	3.12	1.91
4	2.56	1.92	1.97	1.70	1.44	1.96	1.96
5	1.32	1.73	1.65	1.94	2.90	1.52	1.58
6	2.84	1.94	1.36	2.33	1.67	2.42	1.87
7	1.45	1.93	1.19	1.67	1.29	2.70	1.48
8	1.88	1.96	1.60	2.16	1.82	1.33	2.90
9	1.33	1.74	1.59	2.22	2.05	1.57	1.24
10	2.33	1.60	1.19	1.62	2.07	1.79	1.20
11	1.07	1.79	3.01	1.17	1.98	1.71	1.43
12	1.23	1.45	1.99	1.27	1.58	1.54	1.14
13	1.81		2.85	1.17	1.32	1.89	1.39
14	1.75		1.51	1.87	4.40	2.50	2.70
15	1.67		2.76	1.31	1.71	2.55	
16	2.44		2.96	1.42	2.29	2.53	
17	1.84			1.99	2.12		
18	2.26			1.70	2.75		
19	2.59			1.54	2.31		
20	2.26			2.60	2.41		
21	1.98			1.88	2.13		
22	2.63				2.82		
23	2.14				1.71		
24	1.85				1.20		
25	3.23				1.26		
26	1.78						
27	1.57						
28							
29							
30							
31							
32							
no. of cars pe cycle	27	12	16	21	25	16	14

-3.0%

cycle	99	100	101	102	103	104	105
vehicle							
1	2.98	1.79	2.66	1.52	1.76	2.39	1.31
2	2.27	2.14	1.78	1.85	1.32	1.78	2.20
3	1.75	1.13	1.45	1.83	1.78	1.81	2.00
4	1.52	1.43	2.19	1.76	1.77	1.41	2.00
5	3.15	1.85	2.33	1.68	1.33	1.76	2.51
6	2.34	1.56	1.63	2.15	2.03	2.73	2.05
7	1.57	1.96	1.73	4.06	1.14	1.20	1.51
8	1.75	1.46	1.54	1.57	2.28	2.68	1.31
9	1.35	2.74	1.02	1.79	1.72	2.20	1.62
10	1.51	1.55	1.57	2.33	2.66	2.34	1.66
11	1.72	1.17	1.78	1.90	1.81	2.08	1.74
12	1.50	2.23	1.66	1.18	2.09	2.13	2.13
13	1.90	1.96	1.20	1.28	2.08	2.51	
14	1.55	1.96	1.11	2.44			
15	2.44	3.67	1.47				
16		1.70					
17		1.55					
18		1.22					
19		1.59					
20		1.67					
21		1.96					
22		2.34					
23		3.25					
24		1.69					
25		1.47					
26		2.91					
27		1.40					
28		2.05					
29							
30							
31							
32							
no. of cars pe cycle	15	28	15	14	13	13	12

-3.0%

cycle	106	107	108	109	110	111	112
vehicle							
1	2.42	1.41	1.52	2.53	1.87	2.53	1.75
2	1.13	3.54	1.62	1.81	1.46	1.48	2.21
3	2.96	2.40	2.15	1.72	2.63	1.31	1.23
4	1.19	1.40	1.45	1.35	1.81	2.55	2.12
5	1.09	1.17	1.09	1.82	1.82	1.13	1.83
6	1.43	1.32	1.61	1.83	1.67	1.67	1.34
7	1.80	1.46	1.58	1.60	1.62	2.39	1.02
8	2.43	1.23	1.20	1.64	1.23	1.83	1.10
9	2.43	1.91	1.48	2.48	2.69	1.95	0.96
10	1.62	2.53	1.83	2.28	2.04	1.43	2.68
11	1.49		3.88	1.55	1.53	1.16	1.35
12	1.92		1.33	1.78	1.90	1.97	1.34
13	1.03		1.35	1.66	1.24	2.75	1.44
14	1.09		1.52	1.34	2.31		1.90
15	2.22		1.33	1.72	1.93		1.56
16	2.43		2.01	1.58			1.72
17			3.03	1.74			2.52
18			1.81	2.66			1.71
19			1.67	1.74			2.32
20			1.72	1.11			
21			3.12	1.79			
22			1.40	1.30			
23			1.59	2.78			
24			1.97	2.50			
25			2.44	3.45			
26			2.10	1.51			
27			1.38	1.39			
28			1.53	3.30			
29				1.50			
30							
31							
32							
no. of cars pe cycle	16	10	28	29	15	13	19

-3.0%

cycle	113	114	115	116	117	118	119
vehicle							
1	1.49	1.17	2.46	1.78	2.49	1.65	1.05
2	2.43	1.69	1.19	1.72	1.67	1.63	2.00
3	1.78	2.91	1.58	2.56	1.69	1.10	1.72
4	1.32	1.56	3.17	1.86	2.31	1.76	1.78
5	1.52	2.07	1.50	1.49	2.12	1.11	1.90
6	1.91	2.20	1.19	1.43	1.57	1.56	2.45
7	2.37	1.90	1.61	1.06	1.19	2.31	1.33
8	2.23	2.64	0.64	1.98	1.58	2.00	1.43
9	1.58	2.31	1.55	2.24	2.10	1.76	2.23
10	2.35	2.58	1.23	1.97	1.44	1.73	2.36
11	2.17	2.12	1.14		1.36	1.72	1.43
12	1.54	2.32	2.77		2.19	1.29	1.76
13	1.77	1.46	2.52		2.41	2.72	
14	1.93	2.03	1.49		1.43	1.55	
15	1.87	1.90	2.49		2.88	3.00	
16	2.41	2.60	3.04		1.43	1.60	
17	1.71	2.08	1.56		2.10	1.80	
18	1.10	1.91	2.27		1.75	1.17	
19	1.10	2.63	1.90				
20	1.87	2.08	2.14				
21	0.92	2.11	1.19				
22	1.71	1.09	3.11				
23	2.76	2.42	1.76				
24	2.40	2.88	2.63				
25		1.70	1.42				
26		1.64	4.04				
27			1.44				
28			1.25				
29							
30							
31							
32							
no. of cars pe cycle	24	26	28	10	18	18	12

-3.0%

cycle	120	121	122	123	124	125	126
vehicle							
1	1.52	3.77	1.46	1.40	1.72	2.81	1.23
2	1.70		2.72	1.97	1.97	1.17	1.77
3			1.51	1.52	2.31	1.42	0.95
4			1.67	2.19	1.39	1.53	4.96
5			2.47	2.00	1.90	1.62	2.31
6			1.83	1.68	1.95	1.25	1.40
7			2.44		1.81	2.55	1.58
8					2.90	2.00	1.25
9						1.98	1.62
10						2.17	1.81
11						2.20	2.24
12							3.11
13							1.29
14							3.56
15							1.67
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
no. of cars pe cycle	2	1	7	6	8	11	15

-3.0%

cycle	127	128	129	130	131	132	133
vehicle							
1	1.23	2.40	1.42	1.05	1.29	2.17	1.69
2	1.35	1.76	1.66	2.52	1.61	1.75	1.37
3	1.25	2.03	1.57	1.88	2.00	1.65	1.77
4	2.55	1.97	1.47	1.89	1.68	1.43	3.90
5	1.69	1.67	1.86	1.49	2.61	2.06	1.64
6	3.61	1.95	1.48	3.27	2.90	1.41	2.12
7	1.61	1.41	1.74	1.29	1.23	1.38	1.56
8	2.21	1.74	1.83	1.27	1.77	1.85	1.58
9		1.50	1.76	1.24	1.71	1.47	2.18
10		1.57	1.72	2.40	1.00	1.37	2.15
11		1.71	2.49	1.08	2.48	2.45	2.15
12		2.45	1.94	1.91	2.05	2.75	1.65
13		2.46	1.68	1.97			1.45
14		2.31	3.34	2.16			1.49
15		1.83	2.49				2.00
16		2.22	1.81				1.34
17		3.18	2.50				2.01
18			2.30				1.81
19			3.27				1.23
20			3.54				2.68
21							1.61
22							1.77
23							1.55
24							1.36
25							2.52
26							2.49
27							1.52
28							2.20
29							2.00
30							0.57
31							1.60
32							
no. of cars pe cycle	8	17	20	14	12	12	31

-3.0%

cycle	134	135	136	137	138	139	140
vehicle							
1	1.17	1.20	1.78	2.16	2.38	2.89	1.28
2	1.67	2.54	1.95	1.70	1.99	1.62	1.58
3	2.01	1.47	1.26	1.98	1.43	[illegible]	1.97
4	2.21	1.61	0.97	1.26	1.87	[illegible]	1.68
5	1.33	2.65	1.01	1.61	1.38	1.55	1.95
6	1.51	1.77	1.39	1.86	2.14	1.50	1.83
7	2.03	2.01	1.01	2.20	1.31	1.17	1.17
8	1.41	1.83	2.16	1.93	1.60	2.10	2.20
9	2.19	1.63	2.50	1.45	0.66	2.10	1.57
10	1.86	2.86	2.90	1.56	2.35	3.01	1.56
11	1.62	1.71	1.43	1.00	1.45	1.50	2.41
12	2.49	2.10	3.12	3.39	1.89	1.54	1.80
13	1.34	1.02	1.10	3.26	1.25	2.36	2.21
14	2.61	1.04	1.71	2.81	1.49	1.62	1.29
15	1.77	1.45	1.95	1.76	2.74	1.80	
16	2.14	1.25	1.42	1.50	1.26	1.49	
17	3.11	1.08	2.55	1.49	1.31	1.75	
18	2.12			1.85	1.27		
19	1.63			1.89	2.63		
20	1.87			1.83			
21	1.79						
22	2.89						
23	1.16						
24	1.99						
25	2.29						
26	2.25						
27	2.52						
28							
29							
30							
31							
32							
no. of cars pe cycle	27	17	17	20	19	17	14

-3.0%

cycle	141	142	143	144	145	146	147
vehicle							
1	2.19	1.81	2.63	1.62	1.79	1.70	1.71
2	1.91	1.30	1.66	2.22	2.14	2.05	1.82
3	2.08	3.17	2.05	1.54	1.50	1.79	1.74
4	3.50	1.97	2.40	2.38	1.82	1.05	1.93
5	1.63	2.40	1.47	1.43	1.31	1.75	1.76
6	1.13	2.17	2.73	1.14	1.40	1.41	1.60
7	1.78	1.23	1.47	1.39	1.35	1.74	3.33
8	1.64	3.19	1.61	1.70	1.55	1.56	1.81
9	1.08	1.39	1.94	1.38	1.48	1.55	1.63
10	1.63	1.45	1.40		1.17	2.86	2.37
11	2.07	5.20	1.35		1.49	0.91	1.65
12	1.42		2.31		1.26	1.30	1.40
13			2.00		1.98	2.85	1.20
14			1.39		1.22	1.15	1.50
15					0.99	2.04	1.79
16					2.09	1.86	2.13
17						2.73	3.16
18						1.22	2.08
19						2.04	1.71
20						6.08	2.17
21						1.52	1.50
22						1.91	1.40
23						1.32	1.97
24						0.68	2.01
25						2.16	1.80
26						2.51	1.55
27						2.30	2.52
28						2.92	1.71
29						1.82	2.21
30							
31							
32							
no. of cars pe cycle	12	11	14	9	16	29	29

-3.0%

cycle	148	149	150	151	152	153	154
vehicle							
1	1.47	1.29	1.89	1.47	1.61	2.37	2.17
2	2.90	1.12	2.89	1.50	1.98	2.50	1.50
3	1.80	1.41	1.81	1.69	1.56	2.16	1.47
4	1.62	1.24	1.41	1.83	1.66	2.04	1.90
5	1.68	1.66	1.53	1.18	1.70	1.66	2.03
6	1.62	2.28	1.60	1.64	2.64	1.41	2.06
7	1.48	2.76	2.21	1.80	2.42	1.59	1.84
8	1.41	1.99	1.84	1.03	1.46	1.50	1.00
9	1.48	1.81	1.76	2.08	1.50	1.20	1.11
10	1.74	1.32	2.30	1.56	1.73	1.58	1.81
11	1.26	2.31	3.35	1.59	1.30	2.08	1.72
12	1.40	1.47	1.33	1.36	1.49	1.37	1.79
13	1.63	1.23	1.45	1.48	2.70	2.30	2.41
14	1.88	1.86	1.23	1.21	1.57	1.27	1.56
15	2.30	1.65	1.71	1.47	3.31	1.18	1.40
16	1.94	2.32	1.78	2.55	1.55	1.70	2.57
17	1.42	2.28	2.26	1.59		3.27	1.70
18	1.64	2.03	1.69	1.78		1.52	2.23
19		1.87	3.60	1.66		0.52	2.44
20		2.16	2.12	1.50		2.20	1.38
21		1.94	1.94	1.85		3.97	1.61
22		1.87	1.45	1.91		1.48	1.61
23		1.30		1.72		2.72	1.45
24		2.51		1.45		1.94	1.79
25		1.78		1.77		2.99	1.69
26		1.21		1.34		2.43	0.93
27		1.27		1.82		1.48	1.20
28		1.42		2.10		1.71	3.25
29		1.53		1.23			1.79
30		1.43		3.48			1.65
31				1.36			
32				1.25			
no. of cars pe cycle	18	30	22	32	16	28	30

-3.0%							
cycle	155	156	157	158	159	160	161
vehicle							
1	2.23	1.67	2.72	2.19	3.07	2.03	1.61
2	1.15	1.70	2.07	5.36	2.51	1.59	1.92
3	1.15	1.79	1.83	2.39	1.92	1.79	1.48
4	1.55	1.52	3.24	1.24	1.25	2.09	1.04
5	1.75	2.46	2.99	1.73	2.27	1.66	1.19
6	1.50	1.30	2.71	1.90	1.61	1.65	1.46
7	1.21			1.75	2.67	2.09	1.70
8	1.89			1.48		1.74	2.67
9	1.62					2.08	2.01
10	1.76						1.24
11	1.28						2.65
12	1.97						3.37
13	1.38						2.62
14	1.76						
15	1.53						
16	1.49						
17	2.18						
18	2.00						
19	1.22						
20	1.27						
21	1.87						
22	1.37						
23	2.68						
24	1.56						
25	1.36						
26	2.59						
27	2.21						
28	1.62						
29	1.42						
30	3.04						
31	1.78						
32							
no. of cars pe cycle	31	6	6	8	7	9	13

-3.0%

cycle	162	163	164	165	166	167	168
vehicle							
1	2.77	2.26	1.62	1.68	4.28	2.62	1.75
2	2.33	2.28	1.60	1.88	1.43	2.94	1.72
3	1.23	1.62	2.30	3.33	3.17	2.29	2.01
4	1.61	1.35	1.70	1.57	1.17	1.45	2.58
5	1.59	1.49	0.99	1.61	1.22	1.74	2.25
6	1.44	3.81	2.54	1.21	1.06	1.77	1.73
7	2.12	1.10	1.51	1.24	1.94	2.37	1.55
8	2.14	2.23	2.07	0.98	3.51	2.73	1.59
9	2.18	2.13	2.30	2.90	1.91	1.68	1.77
10	2.02	1.80	1.73	1.75	1.87	1.99	3.37
11	2.11	2.55	1.72	1.25	1.52	1.48	1.47
12	1.91	2.12	1.80	1.34	1.61	0.99	3.09
13	2.21	2.12	2.35	2.02	1.65	3.30	2.23
14	2.02	3.48	2.33	1.26	1.95	1.87	1.85
15	2.58	1.61	2.29	1.76	2.84	1.72	1.68
16	2.00	1.70	2.28	1.21	2.41	1.50	3.19
17	1.74	2.30	1.91	3.21	2.20	1.61	1.54
18	1.77	2.76	1.47	2.12	2.81	3.13	1.97
19	2.01	1.63	1.70	1.90	2.50	2.14	2.00
20	1.25	2.22	3.59	1.33	1.81	2.66	1.73
21	1.37	1.45	2.07	1.39	2.39	1.38	2.19
22	1.85	1.61	1.79	2.00	2.72	1.31	2.20
23		1.71	2.02	2.36	3.17	3.84	1.12
24		1.79	2.05	2.38	2.06	3.51	1.48
25		2.74	2.83	2.72		2.83	1.70
26			1.68			1.83	1.80
27							2.94
28							2.11
29							
30							
31							
32							
no. of cars pe cycle	22	25	26	25	24	26	28

-3.0%

cycle	169	170	171	172	173	174	175
vehicle							
1	1.93	2.23	0.82	1.58	2.56	1.46	2.16
2	2.38	2.24	3.14	1.25	2.53	2.04	1.26
3	1.43	1.89	1.54	1.80	1.71	1.17	1.48
4	1.46	1.37	1.52	2.92	1.05	2.20	1.26
5	1.53	1.40	1.84	1.76	2.41	1.40	2.36
6	1.62	2.11	1.55	3.53	3.27	1.77	1.79
7	1.32	2.06	1.75	2.35	2.76	1.76	2.55
8	1.52	2.09	1.45	2.13	2.08	1.88	1.85
9	1.40	2.36	2.48	1.93	2.91	1.42	1.31
10	1.38	4.56	1.61	3.38	2.51	2.48	
11	1.49	2.25	1.32	4.69	1.75	1.77	
12	1.65	2.54	1.91	1.82	1.49	1.84	
13	2.48		2.41	1.66	2.78	3.10	
14	2.00		1.05	1.67	2.13	2.62	
15	2.12		2.30		1.67	2.06	
16	2.03		2.45		3.25	3.62	
17	1.65		1.21		1.33	3.14	
18	1.27		1.49		1.31	2.29	
19	3.00		1.44			1.31	
20	1.56		2.51			2.64	
21	2.52					1.68	
22	2.94					1.72	
23	1.43					2.03	
24	3.23					1.83	
25	1.65					2.77	
26	3.03					2.83	
27	1.84						
28	1.16						
29							
30							
31							
32							
no. of cars pe cycle	28	12	20	14	18	26	9

-3.0%

cycle	176	177	178	179	180	181	182
vehicle							
1	1.84	1.81	2.64	1.20	2.47	1.29	1.54
2	1.71	5.16	1.96	1.61	1.66	1.53	1.64
3	1.84	1.72	2.20	1.23	1.05	2.03	1.98
4	1.31	1.53	2.13	2.07	1.49	1.96	1.65
5	2.91	1.73	1.67	1.60	1.72	1.25	1.51
6	1.40	2.18	1.67	2.32	1.53	1.33	1.69
7	2.92		1.51	1.69	1.53	2.05	1.68
8	1.51		2.51	2.54	2.28	1.67	2.39
9	2.14		1.18	1.95	2.00	1.92	2.27
10			2.57	1.22	1.86	1.55	1.57
11			2.50	1.39	5.61	2.48	1.34
12			1.54	1.82	2.05	2.06	1.07
13			1.94	3.92		2.64	1.79
14			1.69	2.35		2.32	1.56
15			2.41	1.82		2.40	1.52
16			1.49	3.35		1.77	1.45
17			1.12	1.54		2.05	1.56
18			1.70	2.13		1.65	1.28
19			1.84	1.89		2.16	2.25
20			1.18	1.90		2.73	2.23
21			1.55	1.96		2.05	2.47
22			2.31	1.07		1.57	1.76
23			2.02	2.11		1.75	1.69
24			3.30	1.71		3.34	1.98
25			2.99			2.52	1.92
26			2.48			2.26	
27			1.46				
28							
29							
30							
31							
32							
no. of cars pe cycle	9	6	27	24	12	26	25

-3.0%

cycle	183	184	185	186	187	188	189
vehicle							
1	1.67	1.65	1.92	2.80	1.49	1.34	1.65
2	2.41	2.26	1.67	2.50	1.82	2.79	3.28
3	1.81	1.76	1.51	2.48	1.62	1.55	1.52
4	2.34	3.01	1.71	1.67	2.41	2.00	2.18
5	1.47	1.47	2.28	1.49	1.93	1.55	2.08
6	1.72	1.31	1.58	2.12	1.99	1.81	1.65
7	2.85	1.31	3.01	1.54	3.48	1.79	1.89
8	1.59	1.94	2.23	3.17	1.37	1.97	1.30
9	1.07	2.72	1.88	2.13	1.57	1.70	2.86
10	2.11	1.70	3.18	2.20	3.36	1.64	2.53
11	2.13	2.62	1.80	3.28	1.64	1.56	2.14
12	1.39	1.56	2.40	2.99	2.59	1.38	1.57
13	2.21	3.23	2.07	0.98	1.92	2.06	1.79
14	1.40	1.50	1.28	1.58	1.75	3.13	2.16
15	2.36	1.90	2.08	1.47	2.20	1.46	1.57
16	1.42		1.97	2.76	1.77	1.57	1.38
17	2.68			1.09	2.00	1.75	1.41
18				2.57	1.99	2.22	1.35
19					2.01	1.68	2.60
20					3.32		
21					1.59		
22					1.82		
23					2.17		
24					2.07		
25					2.11		
26					2.08		
27					2.09		
28							
29							
30							
31							
32							
no. of cars pe cycle	17	15	16	18	27	19	19

-3.0%

cycle	190	191	192	193	194	195	196
vehicle							
1	4.03	1.19	3.20	1.91	2.04	1.32	1.63
2	2.47	1.45	1.55	2.73	2.23	1.13	1.71
3	2.33	1.47	1.11	1.83	2.17	2.72	2.10
4	2.05	1.86	1.95	2.97	1.02	1.53	1.49
5	2.19	1.50	1.62		1.33	1.83	1.67
6	1.52	2.49			1.44	1.71	2.31
7	2.42	2.20			2.11	3.60	2.10
8	2.10	3.30			2.15		1.52
9	3.15	2.24			1.81		1.98
10	2.33	2.83			1.31		2.80
11	1.57	2.02			2.50		1.78
12	1.10	1.91			2.35		
13	1.65	2.41			2.26		
14	1.29				2.09		
15	1.26				1.92		
16	2.46				1.25		
17	1.90				1.98		
18	2.74				1.69		
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
no. of cars pe cycle	18	13	5	4	18	7	11

-3.0%

cycle	197	198	199	200	201	202	203
vehicle							
1	1.35	2.44	2.71	2.30	1.37	1.17	1.90
2	1.72	2.02	2.39	2.26	2.28	1.25	1.38
3	1.68	1.52	1.16	1.98	1.54	1.46	2.62
4	1.61	1.14	1.82	1.69	2.24	1.99	1.56
5	2.13	2.47	1.30	1.33	2.37	3.65	1.48
6	2.54	1.97	1.40	2.09	1.04	1.32	1.46
7	1.19	1.73	1.60	1.02	1.55	1.16	1.18
8	1.99	1.19	1.35		2.04	1.08	2.52
9	2.93	1.71	1.27		1.62	1.45	2.46
10	2.23	1.89	1.87		1.35	2.41	2.50
11	1.35	2.14	1.22		2.83	2.30	2.21
12	1.50	1.11	1.25		2.65	1.64	1.46
13	3.00	2.30	2.09			3.29	1.70
14	2.15	2.58				2.02	2.16
15	1.74					1.29	2.01
16	1.21					3.03	2.26
17	2.47					1.24	2.81
18	2.38					1.65	
19	1.73					2.42	
20	3.05					1.80	
21	1.94					1.32	
22	2.19					1.83	
23	2.97					1.57	
24	1.38					2.34	
25	2.03					1.67	
26	1.85					2.20	
27	2.48					2.25	
28						1.32	
29						1.34	
30						1.45	
31							
32							
no. of cars pe cycle	27	14	13	7	12	30	17

-3.0%

cycle	211	212	213	214	215	216	217
vehicle							
1	2.42	2.73	1.47	1.65	1.97	1.09	1.70
2	2.02	2.02	1.51	2.29	1.67	3.17	2.62
3	1.89	1.48	1.70	1.99	2.20	1.30	1.31
4	1.38	1.26	1.56	1.67	1.61	1.10	1.54
5	1.47	1.29	1.32	1.43	1.81	1.49	1.24
6	1.65	1.73	1.41	1.84	1.48	1.54	1.84
7	1.33	1.16	1.35	1.51	1.73	2.56	1.68
8	1.53	2.30	0.90	1.79	1.78	1.78	1.92
9	1.63	3.26	2.96	1.56	1.39	3.02	1.85
10	1.44	1.97	1.66	1.09	1.30	1.72	1.37
11	1.53	2.23	2.07	1.12	2.94	1.39	2.29
12	1.57	2.77	1.99	2.23	1.53	2.01	
13	1.98		2.42	1.47	1.43	1.46	
14	2.25		2.07	2.48	1.67	1.14	
15	1.74		1.66	1.40	1.60	3.23	
16	2.33		2.46	1.84	1.50	3.03	
17	2.06		1.25	1.29	2.88	2.15	
18	2.24		1.57	1.79	2.02	1.58	
19	1.03		2.17	1.63	1.39	1.81	
20	2.29		3.71	2.56	2.72	1.62	
21			2.12	3.56	1.14	1.46	
22			2.25	1.26	2.31	1.92	
23			1.82	1.87	1.37	2.59	
24			2.75		2.19	2.06	
25			2.09		0.81	2.28	
26			2.28		3.52	1.64	
27			1.94			1.95	
28			1.42			1.60	
29						1.66	
30							
31							
32							
no. of cars pe cycle	20	12	28	23	26	29	11

-3.0%

cycle	204	205	206	207	208	209	210
vehicle							
1	3.20	2.41	1.90	1.58	1.44	2.21	1.28
2	2.30	1.58	2.45	1.90	1.15	1.46	1.44
3	3.50	1.68	1.79	1.81	1.84	1.27	1.97
4	3.20	1.04	1.61	1.21	2.26	1.57	1.11
5	1.28	1.21	3.82	1.23	1.51	1.09	1.64
6	2.24	1.79	2.02	2.71	1.98	2.93	1.81
7	1.06	1.56	1.58	1.76	1.57	1.39	1.54
8	2.40	1.41	1.22	2.24	1.33		2.25
9	2.77	1.75	2.84	1.58	1.32		1.35
10		1.88	3.66	2.70			2.14
11		1.38	2.08	1.73			2.10
12		2.52	2.06	2.29			2.00
13		2.10	1.56	1.56			1.71
14				1.80			1.46
15				2.03			1.68
16				1.99			2.16
17				2.13			1.42
18				1.56			2.56
19				2.53			
20				2.80			
21				1.28			
22				1.52			
23				3.74			
24				1.47			
25				3.61			
26				1.46			
27				1.86			
28				1.28			
29							
30							
31							
32							
no. of cars pe cycle	9	13	13	28	9	7	18

-3.0%

cycle	218	219	220	221	222	223	224
vehicle							
1	1.51	1.77	2.53	2.36	2.58	1.68	2.06
2	1.77	2.47	1.70	1.51	1.64	1.31	2.33
3	1.66	1.60	1.40	5.08	1.81	1.77	1.67
4	1.18	1.86	1.30	1.78	1.90	2.00	2.55
5	1.78	1.75	1.43		2.87	2.42	1.87
6	1.29	1.92	2.41		2.48	2.10	
7	1.50	1.41	2.68		3.60	1.49	
8	2.16	1.30					
9	1.46	1.76					
10	1.54						
11	1.44						
12	1.46						
13	1.77						
14	2.15						
15	2.85						
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
no. of cars pe cycle	15	9	7	4	7	7	5

-3.0%

cycle	225	226	227	228	229	230	231
vehicle							
1	1.40	3.85	1.67	1.78	2.40	1.90	3.23
2	1.64	2.38	1.47	1.93	3.33	2.30	2.35
3	2.57	1.62	2.07	1.18	1.62	1.32	1.78
4	1.19	2.37	1.85	1.81	1.36	1.48	1.36
5	1.72	1.56	2.46	2.43	1.87	1.84	1.72
6	1.42	2.35	2.11	2.07	2.00	1.76	
7	1.95	1.33	1.81	1.84	0.82	1.37	
8	1.23	1.58	1.37	1.87	2.13	1.70	
9	1.68	1.62	1.00	1.60	2.08	1.03	
10	1.83	1.44	1.58	1.39	1.78	1.10	
11		2.79	1.93	1.74	2.14	1.67	
12		1.43	1.65	2.48	2.55	1.34	
13		1.23	1.95		1.83	2.33	
14		2.09	1.43		1.84	1.24	
15		1.86	1.73		2.35	2.37	
16		1.19	1.53		1.86	2.60	
17		1.77	1.32		1.60	1.65	
18		1.07	1.61		1.53	2.87	
19		1.99	2.38		3.22	1.53	
20		3.68	1.98		1.47	1.77	
21		1.41	1.82		1.61	2.38	
22		1.47	1.48		1.59	1.61	
23		2.45	2.73		2.96	1.27	
24		1.25	1.91		1.51	1.93	
25		1.62	1.83		1.55	2.29	
26		2.07	2.01		3.22		
27			3.47				
28			1.98				
29			2.08				
30							
31							
32							
no. of cars pe cycle	10	26	29	12	26	25	5

-3.0%

cycle	232	233	234	235	236	237	238
vehicle							
1	1.59	2.24	1.84	1.44	3.13	3.15	2.30
2	1.31	2.65	1.15	2.29	1.57	2.42	1.97
3	1.44	1.38	1.18	1.86	1.87	1.57	1.56
4	1.61	1.37	1.11	1.50	2.05	1.82	1.45
5	1.37	2.25	1.57	1.53	1.15	1.60	1.65
6	1.55	1.79	1.38	2.12	2.67	1.52	2.23
7	1.24	1.86	1.58	1.35	1.93	2.14	
8	1.94	2.54	2.51	1.39	2.19	2.22	
9	2.88	3.40	1.93	1.58	1.51		
10	1.85	1.16		1.70	1.23		
11	1.72			3.55	1.20		
12	1.74			2.49	1.99		
13	1.51			3.50	2.42		
14	3.13			2.50	2.21		
15	2.73			2.66	1.98		
16	1.56			2.07	1.14		
17				1.39	1.29		
18				1.36	1.69		
19					2.14		
20					2.07		
21					2.25		
22					2.12		
23					2.04		
24					1.30		
25							
26							
27							
28							
29							
30							
31							
32							
no. of cars pe cycle	16	10	9	18	24	8	6

-3.0%

cycle	239	240	241	242	243	244	245
vehicle							
1	2.02	1.46	2.27	1.80	2.28	1.78	1.41
2	2.59	2.41	1.38	1.38	1.66	2.02	1.54
3	2.72	1.74	1.58	1.59	1.90	1.91	2.93
4	2.28	2.19	1.75	2.02	1.46	1.67	1.23
5	1.66	0.93	1.28	1.41	1.62	1.42	1.19
6	2.47	1.82	1.33	1.43	2.01	1.45	1.36
7	2.33	1.45	3.09	1.48	1.94	1.38	1.54
8	1.49		2.60	2.21	1.67	2.47	1.48
9	3.78		3.16		2.19	1.22	1.18
10	1.99				1.52	2.26	1.19
11	1.68						1.95
12	2.95						1.84
13	3.31						2.67
14	2.13						1.23
15	2.78						1.37
16							1.28
17							1.48
18							3.02
19							2.59
20							2.63
21							1.20
22							1.88
23							1.66
24							1.64
25							1.44
26							2.01
27							1.92
28							1.20
29							1.42
30							1.66
31							1.54
32							2.36
no. of cars pe cycle	15	7	9	8	10	10	32

-3.0% cycle	246	247	248	249	no. of cycles	mean head secs	-3.0% stan dev
vehicle							
1	1.94	1.81	3.31	1.44	249	1.99	0.62
2	1.71	2.30	1.38	1.86	248	1.98	0.61
3	2.00	1.43	1.40	1.27	244	1.85	0.56
4	1.93	1.62	1.34	1.82	238	1.84	0.56
5	2.23	1.37	1.07	3.30	234	1.84	0.59
6	1.41	3.06	2.76	1.53	230	1.84	0.51
7	1.66	1.20	1.96	1.73	225	1.80	0.55
8	1.47	1.22	2.74		213	1.81	0.49
9	1.58	1.40	1.00		204	1.87	0.57
10	1.65	1.84	1.44		190	1.91	0.57
11	2.21	4.57	1.70		182	1.94	0.71
12	2.45	2.16	2.16		167	1.85	0.52
13	1.29	2.53			152	1.95	0.59
14		1.11			135	1.92	0.67
15		1.70			121	1.94	0.51
16		2.69			112	1.99	0.56
17		1.73			103	1.99	0.65
18		1.27			96	2.00	0.64
19		1.44			85	2.03	0.60
20		2.04			78	2.22	0.75
21		1.72			71	1.94	0.60
22					69	1.96	0.59
23					67	2.10	0.69
24					66	1.97	0.57
25					60	2.09	0.62
26					53	2.09	0.65
27					39	1.93	0.58
28					31	1.83	0.56
29					21	1.75	0.39
30					11	1.99	0.93
31					6	1.61	0.15
32					2	1.81	0.55
no. of cars pe cycle	13	21	12	7			

-3.0% cycle	-3.0% stan dev	HEADWAYS min head	max head
vehicle			
1	0.62	0.82	4.28
2	0.61	0.97	5.36
3	0.56	0.95	5.08
4	0.56	0.90	4.96
5	0.59	0.93	6.43
6	0.51	1.04	3.81
7	0.55	0.82	4.06
8	0.49	0.64	3.51
9	0.57	0.66	3.91
10	0.57	0.95	4.56
11	0.71	0.91	5.61
12	0.52	0.99	3.39
13	0.59	0.59	3.92
14	0.67	0.86	4.40
15	0.51	0.99	3.67
16	0.56	1.11	3.62
17	0.65	0.74	4.22
18	0.64	1.07	5.35
19	0.60	0.52	3.81
20	0.75	1.11	6.08
21	0.60	0.92	4.17
22	0.59	1.07	3.62
23	0.69	0.94	3.87
24	0.57	0.68	3.51
25	0.62	0.81	3.61
26	0.65	0.93	4.07
27	0.58	1.20	3.47
28	0.56	1.16	3.30
29	0.39	1.23	2.80
30	0.93	0.57	3.66
31	0.15	1.36	1.81
32	0.55	1.25	2.36

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no. of cars per cycle

Appendix E

Data for analysis

This Appendix contains the final data set of 7200 headways. For each of the five study approaches, headway data is provided for each of the twelve queue positions under each of the two weather conditions. There are sixty observations at each queue position.

	fair +7.2% 1	fair +7.2% 2	fair +7.2% 3	fair +7.2% 4	fair +7.2% 5	fair +7.2% 6
1	4.33	1.22	1.56	1.88	1.55	1.24
2	1.57	2.05	1.55	1.78	1.97	1.38
3	3.06	2.90	1.29	1.94	1.71	1.06
4	2.97	2.35	1.74	1.81	1.11	1.24
5	1.84	1.53	2.14	1.88	2.22	1.45
6	1.25	1.80	2.10	0.82	1.40	1.92
7	2.21	1.49	2.35	1.91	2.21	2.59
8	1.98	2.85	1.93	1.17	2.15	1.34
9	1.42	1.69	1.36	1.50	2.13	1.50
10	1.43	2.59	2.70	1.67	1.39	2.44
11	2.16	1.60	2.33	2.16	1.30	2.18
12	2.04	1.84	1.44	1.16	1.65	3.97
13	1.68	1.85	1.30	1.50	1.39	1.20
14	1.23	1.22	1.06	2.28	1.69	1.09
15	2.91	1.55	1.54	2.14	0.88	2.36
16	1.41	1.30	1.61	1.93	1.51	1.52
17	1.48	2.88	1.84	1.95	2.91	1.24
18	1.20	2.31	1.85	1.81	1.29	1.64
19	2.47	1.90	3.32	2.38	1.22	1.63
20	2.37	1.59	1.31	1.62	1.12	1.90
21	2.72	1.34	1.12	1.76	1.37	3.89
22	2.08	1.44	2.35	2.26	3.06	1.38
23	1.88	1.39	1.79	1.44	1.24	2.12
24	2.10	2.60	1.76	1.13	1.94	1.77
25	1.69	2.84	1.88	1.21	2.02	1.29
26	2.32	1.86	1.53	1.92	1.93	2.11
27	1.72	1.48	1.77	1.02	1.69	1.64
28	3.84	1.27	1.69	1.54	1.70	1.36
29	1.14	1.38	2.09	2.69	2.21	1.08
30	2.47	2.16	1.45	2.55	2.13	1.75
31	1.64	1.28	1.54	1.30	1.71	1.80
32	1.18	1.18	1.78	1.96	1.77	3.01
33	2.33	2.15	1.75	3.15	1.32	2.01
34	1.63	1.24	1.40	2.08	1.24	1.36
35	2.03	1.25	2.35	1.76	1.41	0.97
36	1.33	1.79	2.95	1.18	1.52	1.70
37	2.40	1.65	1.36	2.14	1.52	1.83
38	2.65	1.88	2.23	2.50	1.15	1.74
39	1.35	2.12	1.89	2.41	1.89	1.46
40	2.27	1.04	1.79	1.44	1.26	2.03
41	1.91	2.16	1.09	1.97	2.77	1.94
42	1.88	2.75	1.94	1.26	1.92	1.56
43	1.90	2.77	1.93	1.34	1.51	1.25
44	1.54	2.25	3.44	1.94	1.19	1.27
45	1.92	2.36	1.31	1.24	1.65	1.35
46	2.04	2.07	1.21	1.40	1.65	1.11
47	1.98	1.90	1.88	1.41	1.42	1.85
48	3.40	1.46	2.41	3.07	1.52	1.30
49	2.38	1.58	2.76	1.36	1.90	1.20

50	2.65	1.22	1.04	1.04	0.96	1.37
51	1.75	1.27	1.32	4.24	1.54	3.18
52	2.12	2.10	2.37	1.24	1.99	1.21
53	1.73	1.15	3.06	2.80	1.17	1.34
54	2.41	3.27	1.20	1.52	1.47	1.52
55	1.22	2.43	1.96	2.45	1.77	1.43
56	1.60	1.71	1.35	1.49	1.80	1.06
57	2.57	1.30	2.66	1.88	1.13	2.17
58	2.08	1.60	1.37	1.98	1.26	1.17
59	1.73	1.40	1.43	3.56	1.38	1.56
60	1.50	1.01	1.00	2.13	2.10	1.90

	fair +7.2% 7	fair +7.2% 8	fair +7.2% 9	fair +7.2% 10	fair +7.2% 11	fair +7.2% 12
1	1.77	1.16	2.39	2.08	2.95	2.67
2	2.19	1.40	2.52	1.22	2.05	1.05
3	1.11	2.06	1.40	1.64	1.46	1.14
4	3.54	2.06	2.12	1.52	1.18	0.94
5	1.53	1.34	1.19	1.33	1.76	1.90
6	2.36	1.82	2.03	2.26	1.73	1.17
7	1.27	1.88	1.55	1.99	1.69	2.51
8	1.54	1.24	1.65	1.63	1.41	1.77
9	1.48	2.48	1.29	2.25	1.67	2.50
10	1.24	1.32	1.47	3.21	1.29	1.46
11	2.13	2.13	1.77	1.72	1.49	2.41
12	1.64	1.87	1.73	1.83	2.91	1.57
13	1.76	1.49	1.38	1.01	2.00	1.65
14	1.69	1.69	1.49	1.71	2.20	1.77
15	1.23	1.83	2.09	2.59	1.47	1.72
16	2.05	1.86	1.03	1.57	2.50	1.15
17	1.75	1.61	1.30	1.93	1.10	2.37
18	1.28	2.16	1.21	1.37	2.10	1.49
19	1.47	1.84	1.56	1.61	0.95	2.33
20	2.16	1.52	2.37	1.77	2.40	2.14
21	2.19	1.09	1.32	1.37	1.29	1.97
22	1.45	1.55	1.56	1.49	2.11	1.57
23	1.20	2.42	1.75	1.46	3.37	2.90
24	1.30	1.70	3.26	2.74	1.40	3.10
25	1.36	1.27	1.45	1.24	2.22	1.54
26	1.19	1.34	1.35	1.84	1.43	1.28
27	1.34	1.11	1.39	1.97	2.10	1.68
28	1.44	1.68	1.30	2.80	1.98	1.82
29	1.30	2.16	1.93	1.72	1.58	1.58
30	1.88	2.54	2.45	2.07	1.51	1.52

31	2.00	2.23	2.30	1.27	1.17	1.96
32	1.65	3.21	1.28	1.60	1.45	2.33
33	1.47	1.69	1.65	1.34	1.50	1.72
34	1.37	1.02	2.32	2.61	1.50	1.62
35	1.54	1.31	1.15	1.18	1.36	1.25
36	2.12	2.20	3.28	2.49	1.57	1.27
37	1.18	1.73	1.25	1.29	2.04	1.19
38	1.68	1.31	1.15	1.61	1.33	1.42
39	1.66	1.72	2.52	2.81	1.47	1.20
40	2.20	2.62	1.88	3.25	1.98	1.92
41	1.58	1.75	1.70	1.06	1.23	2.10
42	1.91	1.22	1.21	2.62	1.52	0.59
43	1.23	1.79	1.47	1.71	1.33	1.27
44	1.73	1.46	2.35	1.52	1.73	1.24
45	0.82	2.26	1.72	1.01	1.47	1.27
46	1.55	1.84	1.41	1.37	1.83	1.21
47	1.39	1.17	1.32	1.25	2.16	2.35
48	1.32	1.38	2.94	2.23	1.13	1.14
49	1.90	1.54	2.00	1.72	1.87	1.79
50	1.73	1.73	1.43	1.39	2.37	2.99
51	1.39	2.91	1.59	1.71	1.95	1.30
52	1.73	1.08	1.51	1.36	3.07	1.26
53	2.15	1.37	1.55	0.34	1.93	1.34
54	1.26	1.58	2.11	2.33	2.20	1.35
55	1.98	2.29	1.83	3.41	2.12	1.01
56	2.52	1.41	2.11	1.94	1.39	1.10
57	2.28	1.90	1.50	1.64	2.71	1.01
58	2.53	1.59	1.96	2.52	1.79	3.21
59	1.29	1.29	1.20	1.59	1.37	2.23
60	1.16	1.87	2.10	1.43	1.90	1.28

	fair -7.2% 1	fair -7.2% 2	fair -7.2% 3	fair -7.2% 4	fair -7.2% 5	fair -7.2% 6
1	1.92	1.52	2.51	2.94	0.70	1.96
2	1.54	2.54	1.00	1.22	3.06	1.41
3	1.50	1.20	1.31	1.84	2.04	3.21
4	1.98	1.76	2.40	2.62	2.05	1.32
5	0.78	1.93	3.12	1.41	1.59	2.30
6	1.14	1.42	1.68	0.71	2.55	1.28
7	2.72	2.18	1.33	1.48	1.46	1.04
8	2.50	1.90	2.26	2.00	2.51	1.48
9	2.73	1.08	1.88	1.86	3.29	1.50
10	1.67	3.14	1.16	1.25	1.21	1.21
11	1.82	1.23	1.34	2.81	1.40	1.93
12	1.72	2.16	2.85	1.02	3.39	1.42

13	1.79	1.38	1.80	1.33	2.04	2.19
14	2.23	1.77	2.18	1.88	1.07	2.06
15	1.51	1.73	1.14	3.45	1.65	1.87
16	1.59	2.88	2.28	1.64	1.54	3.40
17	2.18	1.98	1.44	1.53	1.06	1.57
18	1.54	2.23	1.45	1.39	3.11	1.40
19	1.30	1.50	1.25	2.08	2.09	1.08
20	1.32	2.83	2.29	1.38	1.52	1.31
21	1.72	1.54	3.04	1.35	1.13	2.12
22	2.04	2.00	1.64	2.57	3.62	1.41
23	1.83	1.67	1.30	1.41	0.54	2.13
24	1.74	1.83	2.76	1.28	3.05	2.01
25	1.44	1.70	1.93	2.45	2.07	1.18
26	2.37	2.01	2.19	3.04	2.36	1.30
27	3.28	1.68	2.06	1.99	1.35	2.40
28	1.50	1.86	1.78	1.40	1.90	1.92
29	1.87	2.18	1.35	4.03	0.91	2.04
30	2.07	1.54	1.73	1.37	2.05	3.16
31	1.68	0.70	3.46	1.65	2.99	2.00
32	1.95	2.39	2.03	1.86	1.03	2.78
33	1.95	1.25	1.41	1.80	1.75	1.41
34	3.19	1.81	1.90	2.06	1.48	2.64
35	1.57	1.51	1.10	3.79	1.68	1.09
36	1.81	1.97	2.72	1.64	2.00	2.51
37	1.50	0.94	2.42	2.59	1.56	1.41
38	1.51	1.91	1.33	3.44	3.40	1.77
39	0.96	1.27	0.98	4.18	2.06	1.27
40	1.55	1.70	1.73	1.39	1.12	1.83
41	1.63	1.63	1.52	2.04	3.09	1.62
42	1.13	1.33	2.37	1.64	2.11	3.58
43	1.12	2.51	0.97	1.62	1.39	1.37
44	1.54	3.33	2.83	2.51	2.24	1.98
45	2.78	3.25	1.22	3.08	1.83	1.13
46	2.28	2.63	3.17	1.02	1.61	2.30
47	1.57	2.09	2.24	1.14	1.89	1.65
48	1.34	3.41	2.33	1.29	1.83	1.79
49	1.62	2.49	2.12	1.62	1.24	2.41
50	1.40	3.53	3.08	2.39	2.65	1.19
51	1.92	1.35	1.65	1.93	1.54	3.06
52	1.50	1.61	1.27	2.41	1.94	1.28
53	2.68	1.30	1.66	1.69	2.03	1.38
54	1.41	1.78	1.89	1.76	1.51	1.66
55	1.48	2.05	2.01	1.73	2.20	1.65
56	1.63	2.09	1.43	1.33	1.88	1.40
57	1.69	3.65	2.43	1.35	1.81	2.16
58	1.44	1.98	1.81	1.95	2.24	1.66
59	2.87	1.62	1.92	1.56	2.23	1.80
60	2.40	1.08	1.38	1.52	1.77	1.25

	fair -7.2% 7	fair -7.2% 8	fair -7.2% 9	fair -7.2% 10	fair -7.2% 11	fair -7.2% 12
1	1.74	1.92	2.01	0.99	2.20	1.47
2	1.30	2.88	1.60	2.75	2.60	2.19
3	1.79	1.93	2.10	1.55	2.18	1.76
4	1.50	1.95	2.33	1.05	2.60	2.92
5	2.38	1.11	2.44	2.51	1.66	1.48
6	1.37	3.93	2.11	2.50	0.86	1.38
7	1.93	2.37	1.02	1.30	1.59	2.24
8	2.07	2.41	1.50	1.22	3.79	2.51
9	1.21	1.60	1.49	1.82	1.39	1.46
10	1.75	2.06	1.75	1.21	1.24	3.37
11	1.25	0.93	2.25	2.23	1.15	2.49
12	3.39	1.52	1.07	2.20	0.95	1.46
13	1.56	1.58	1.43	1.32	2.26	1.32
14	2.90	1.26	1.84	1.87	3.10	1.07
15	1.96	1.77	1.85	2.00	1.90	1.62
16	2.66	1.65	2.20	1.51	1.63	1.46
17	1.79	2.96	2.37	1.63	1.59	2.09
18	1.65	1.83	2.72	2.59	2.92	2.12
19	2.05	1.08	2.61	1.53	2.44	1.58
20	1.68	2.20	1.50	1.44	1.26	3.22
21	1.61	1.77	2.42	2.48	1.97	2.05
22	0.94	1.97	2.14	1.61	1.68	1.55
23	1.84	1.63	1.56	2.73	1.76	1.62
24	1.62	2.10	3.17	1.54	1.84	1.40
25	1.44	1.17	1.70	2.17	1.52	0.98
26	1.48	1.25	1.38	0.86	2.64	1.29
27	0.71	1.57	1.45	1.27	4.23	1.32
28	1.82	1.66	1.93	3.34	1.06	2.26
29	2.18	1.96	1.43	3.11	2.13	1.30
30	2.05	1.61	1.16	1.84	3.12	2.03
31	2.79	1.51	2.81	2.11	2.22	0.86
32	1.34	2.97	2.11	1.40	2.81	1.13
33	1.20	1.37	1.60	1.37	3.18	1.72
34	2.13	1.49	2.32	1.66	1.38	5.42
35	1.69	4.82	1.29	1.56	1.65	1.76
36	1.51	1.93	1.56	1.37	2.71	1.29
37	2.24	2.31	2.34	1.35	1.39	3.47
38	1.76	1.37	1.15	1.57	1.54	2.07
39	1.81	2.00	1.03	1.16	2.50	2.17
40	1.74	3.10	2.09	2.20	1.87	3.89
41	2.47	2.82	2.11	1.62	3.18	1.67
42	1.45	1.79	2.37	2.05	1.21	1.15
43	3.05	1.30	2.31	1.87	3.96	1.83
44	1.62	1.95	3.18	1.87	1.47	1.46
45	1.57	2.30	2.16	1.27	1.90	0.81
46	1.44	2.26	2.34	1.33	3.09	1.49

47	1.81	2.12	1.59	1.70	1.00	1.35
48	1.46	1.41	1.22	2.62	2.74	1.73
49	2.59	3.11	1.93	1.42	1.22	0.75
50	2.30	1.95	1.85	1.55	1.90	1.55
51	2.32	1.97	1.97	1.58	2.95	1.53
52	2.01	1.06	2.06	3.12	2.41	1.46
53	1.46	1.18	0.92	2.22	2.47	3.07
54	1.97	2.33	3.24	1.60	2.44	1.45
55	1.57	1.34	1.21	2.11	2.37	1.50
56	1.65	2.52	1.90	3.14	1.39	1.38
57	3.51	1.89	0.99	1.40	2.24	2.17
58	2.19	2.55	1.85	1.89	2.29	2.16
59	0.94	2.20	2.04	1.42	1.99	3.05
60	1.59	1.19	1.48	2.72	4.02	1.83

	fair -0.7% 1	fair -0.7% 2	fair -0.7% 3	fair -0.7% 4	fair -0.7% 5	fair -0.7% 6
1	2.39	2.51	2.14	1.72	1.10	2.22
2	1.96	3.00	2.55	1.21	1.96	0.52
3	1.34	2.29	2.52	1.56	1.29	1.63
4	1.38	2.61	2.71	1.33	1.53	1.58
5	3.75	2.67	1.88	2.63	1.70	2.88
6	1.87	1.30	1.84	1.51	1.31	1.39
7	2.78	1.56	1.71	1.19	2.57	1.22
8	2.97	1.27	1.63	2.74	2.67	1.51
9	1.38	2.28	2.07	2.63	1.46	1.83
10	1.96	1.94	2.57	2.00	1.79	2.60
11	1.94	1.41	1.36	1.48	2.14	1.26
12	1.90	2.18	1.37	1.76	1.32	2.72
13	2.45	2.89	1.15	1.46	2.88	2.04
14	1.27	2.32	2.37	1.51	3.14	1.99
15	2.35	1.73	2.23	2.27	1.24	1.49
16	1.83	1.68	1.89	1.74	2.22	2.17
17	1.56	2.12	2.30	1.55	1.75	2.14
18	1.81	3.11	4.02	1.96	2.13	1.47
19	1.41	1.59	2.20	1.55	2.00	1.28
20	2.74	1.90	2.06	1.59	1.29	1.85
21	2.23	1.23	1.40	1.81	1.93	1.57
22	1.33	1.81	1.76	2.83	1.78	1.79
23	2.64	2.36	1.40	2.05	1.58	1.46
24	2.11	4.72	1.12	2.03	1.60	1.31
25	1.88	1.47	1.70	1.99	2.07	1.63
26	2.07	2.18	3.45	1.51	0.93	1.39
27	1.90	2.40	1.71	1.43	3.29	1.15
28	1.94	1.56	1.69	1.36	1.80	2.57

29	1.67	2.23	1.64	1.56	1.74	2.55
30	1.42	2.72	1.22	1.45	1.65	2.00
31	2.34	2.93	1.84	1.51	1.75	2.40
32	1.86	2.67	1.80	1.67	3.21	2.30
33	1.82	1.98	2.32	3.03	2.37	1.68
34	2.56	1.68	1.49	2.03	4.40	1.69
35	2.18	1.60	3.27	1.01	1.22	1.54
36	1.89	1.67	1.46	2.20	1.46	1.60
37	1.55	2.18	1.82	4.56	2.33	1.31
38	5.69	1.73	2.34	1.63	2.22	1.45
39	2.91	2.16	2.37	2.27	1.73	2.66
40	1.14	1.30	1.39	1.94	1.84	1.11
41	1.23	2.46	1.80	1.59	2.64	1.21
42	1.91	1.56	1.96	1.79	1.54	1.83
43	1.12	1.57	1.91	1.27	2.39	1.05
44	2.13	1.28	1.83	3.54	1.95	1.74
45	1.47	1.31	1.99	0.96	1.80	1.47
46	1.97	1.67	2.03	1.29	2.[illegible]8	2.00
47	2.28	3.15	1.96	1.89	2.36	1.43
48	1.22	1.44	2.34	1.72	2.33	2.13
49	1.51	1.99	1.74	1.36	1.27	1.76
50	2.12	2.32	1.12	2.38	1.57	1.30
51	2.21	2.57	2.15	1.68	3.11	0.89
52	3.36	1.45	1.48	1.73	1.22	2.32
53	2.19	1.36	3.44	1.16	1.34	1.31
54	3.13	2.55	2.60	1.13	1.50	3.91
55	2.19	1.67	2.23	2.13	1.26	1.37
56	1.43	1.89	1.74	1.47	1.75	2.45
57	3.13	1.81	1.29	1.58	1.59	1.98
58	2.38	2.54	2.17	1.89	1.24	1.77
59	1.13	1.03	3.65	2.50	3.22	2.22
60	1.41	1.03	2.59	1.63	1.82	3.22

	fair -0.7% 7	fair -0.7% 8	fair -0.7% 9	fair -0.7% 10	fair -0.7% 11	fair -0.7% 12
1	2.16	2.13	2.11	1.67	2.81	2.90
2	1.70	2.24	1.69	2.27	2.60	1.64
3	1.15	2.15	1.73	2.28	2.26	2.16
4	2.63	2.18	1.66	1.53	1.18	3.19
5	2.14	1.61	1.96	1.26	1.73	2.04
6	2.40	1.79	2.09	1.60	1.27	2.04
7	1.77	2.62	2.76	1.06	1.87	1.95
8	1.86	1.69	1.49	2.00	1.98	1.78
9	4.08	1.94	1.78	1.37	2.18	2.08
10	1.33	1.57	2.16	2.44	1.84	1.32

11	2.03	2.15	2.62	2.50	2.49	1.82
12	3.62	4.71	2.35	2.21	4.44	1.55
13	1.22	1.20	1.48	1.86	1.55	1.23
14	1.04	1.89	1.53	1.90	1.73	1.67
15	1.90	2.30	1.95	1.18	1.57	1.71
16	1.02	2.73	1.54	2.84	3.17	2.51
17	1.47	1.11	1.33	1.60	2.70	1.44
18	1.88	1.88	2.11	1.13	2.80	1.64
19	1.86	1.39	2.09	1.35	2.13	1.92
20	1.42	3.47	1.90	1.81	3.84	2.38
21	2.82	2.55	3.20	1.96	1.74	1.32
22	1.92	1.88	1.71	2.91	2.11	1.24
23	1.95	1.64	2.86	2.23	2.46	2.45
24	1.06	1.69	1.68	1.46	1.83	2.68
25	1.52	1.37	0.80	0.89	3.60	1.22
26	1.45	1.39	1.23	0.92	1.94	1.64
27	1.65	2.63	1.60	2.17	1.95	1.80
28	1.77	1.48	3.17	2.34	2.82	2.06
29	1.89	1.86	1.66	1.62	1.68	2.40
30	2.00	1.84	1.71	2.41	1.81	2.03
31	1.78	2.25	2.12	1.55	0.87	2.97
32	2.45	2.51	1.76	1.76	1.41	1.11
33	1.39	1.41	1.97	2.64	1.72	2.10
34	2.71	1.41	3.13	2.33	1.22	1.43
35	0.97	1.69	1.74	1.30	2.22	1.39
36	2.87	1.71	2.36	2.52	1.95	2.11
37	2.40	2.33	1.45	2.25	1.24	1.39
38	2.12	2.02	2.46	2.36	2.54	2.26
39	1.87	2.11	1.65	1.03	2.24	1.72
40	1.80	1.50	1.33	2.10	0.98	1.24
41	1.60	1.84	1.01	3.26	1.49	2.23
42	1.39	1.68	2.61	0.70	1.21	2.49
43	3.28	1.60	1.58	1.71	2.76	1.59
44	1.29	1.53	1.90	1.40	2.40	1.53
45	1.83	1.67	1.69	1.60	1.49	2.26
46	1.29	1.81	1.21	2.15	3.57	1.57
47	3.04	1.50	1.96	1.28	1.59	0.88
48	2.11	1.13	1.27	1.81	1.35	1.10
49	2.11	2.02	1.50	1.84	2.55	1.89
50	1.87	2.44	2.34	1.88	2.26	1.15
51	2.29	3.89	0.94	1.58	1.13	1.45
52	1.55	2.06	1.99	0.96	1.65	1.15
53	1.99	2.09	2.95	2.96	1.60	1.66
54	1.75	1.57	2.00	3.24	1.50	2.61
55	2.44	2.18	1.54	1.05	1.69	1.93
56	1.74	1.57	1.85	1.46	2.26	2.58
57	1.53	2.09	1.96	1.59	3.55	1.73
58	1.66	1.98	1.02	2.27	1.64	2.32
59	1.93	3.31	1.42	1.81	1.49	1.93
60	1.71	1.70	1.25	1.92	1.73	1.82

	fair +3.0% 1	fair +3.0% 2	fair +3.0% 3	fair +3.0% 4	fair +3.0% 5	fair +3.0% 6
1	1.90	2.35	1.81	1.19	2.66	1.50
2	1.53	2.15	1.62	3.33	1.50	1.24
3	2.10	1.93	2.31	2.13	1.32	1.17
4	2.34	2.31	2.98	1.04	2.20	1.75
5	2.06	1.10	2.37	1.27	1.36	1.41
6	2.00	1.89	1.91	0.92	2.95	1.28
7	1.75	2.43	2.31	1.52	3.10	1.87
8	1.38	2.88	1.34	1.35	2.00	2.04
9	2.62	1.10	1.20	2.31	3.04	2.38
10	1.32	1.74	1.07	1.44	1.06	1.90
11	1.22	1.52	1.23	1.35	1.82	1.17
12	1.34	3.40	1.03	1.32	1.25	1.25
13	1.64	1.16	2.42	2.41	4.62	0.96
14	2.17	1.83	1.62	1.95	2.13	1.69
15	2.36	2.28	1.63	2.00	2.21	2.70
16	2.53	1.17	1.12	2.54	2.06	2.06
17	1.42	2.60	1.22	1.84	2.18	1.46
18	2.77	1.63	1.94	2.04	1.69	1.79
19	1.17	2.51	1.41	1.94	4.05	1.16
20	3.61	1.49	1.22	1.34	1.22	1.70
21	1.45	1.33	1.76	1.93	3.01	2.19
22	2.35	1.79	1.79	1.48	1.14	1.59
23	1.07	2.26	1.82	1.40	1.96	1.29
24	2.68	2.54	3.83	1.56	1.77	1.72
25	1.29	2.49	1.56	1.98	1.96	1.82
26	1.70	2.11	1.80	1.43	1.43	2.27
27	1.68	1.52	1.46	1.29	1.60	1.26
28	1.57	1.73	1.04	1.02	1.61	1.41
29	1.38	3.43	2.34	1.83	1.20	3.40
30	2.07	1.74	1.04	1.73	2.03	1.76
31	1.85	2.25	2.41	2.34	2.28	2.89
32	1.95	1.39	1.59	1.28	2.30	1.66
33	1.71	1.72	2.52	1.57	2.33	1.64
34	1.48	2.65	2.46	1.41	2.03	2.93
35	1.60	2.21	1.81	2.36	1.38	1.30
36	1.42	1.46	2.64	2.11	1.66	1.80
37	2.15	2.52	1.60	1.43	1.44	1.44
38	1.47	1.66	2.48	1.41	2.00	1.55
39	2.14	2.40	1.53	1.48	1.96	1.29
40	2.58	1.41	1.43	1.63	1.70	1.43
41	1.54	2.55	1.93	1.84	1.71	1.43
42	2.72	1.56	1.78	1.60	1.84	2.63
43	1.67	2.50	3.02	1.40	2.97	1.21
44	1.56	1.86	2.11	1.88	2.05	1.60

45	1.57	1.39	1.93	1.83	1.41	2.24
46	1.43	1.50	2.20	1.40	1.30	2.83
47	2.38	1.75	1.34	1.98	1.68	1.85
48	1.32	1.23	1.83	1.53	1.53	2.64
49	2.22	2.08	1.44	1.62	1.08	1.63
50	1.31	1.64	1.91	1.63	1.42	2.05
51	2.36	1.89	1.48	1.41	1.69	1.60
52	1.65	2.44	2.61	1.19	1.74	1.94
53	1.68	1.28	1.78	2.35	2.11	3.14
54	2.80	1.36	1.50	1.14	2.52	0.45
55	1.66	3.47	1.64	1.86	2.74	1.25
56	1.68	1.71	1.32	2.46	1.53	1.94
57	1.29	1.41	1.16	2.43	2.51	1.27
58	2.20	1.82	2.74	1.37	1.83	1.83
59	1.90	1.49	1.82	1.42	1.74	1.31
60	2.54	1.11	1.57	1.83	2.26	2.34

	fair +3.0% 7	fair +3.0% 8	fair +3.0% 9	fair +3.0% 10	fair +3.0% 11	fair +3.0% 12
1	1.88	2.08	1.66	1.11	1.07	1.92
2	1.07	3.11	2.64	1.27	2.08	1.57
3	1.89	1.36	1.08	2.00	2.46	1.04
4	3.54	2.44	2.14	1.26	1.43	0.92
5	1.77	1.20	2.33	1.90	0.43	1.83
6	1.45	1.34	1.08	0.86	3.06	2.09
7	2.19	1.23	1.62	0.93	1.27	1.51
8	1.24	3.06	1.25	2.53	1.81	1.30
9	2.04	1.59	2.52	1.35	1.64	1.14
10	1.60	2.75	1.25	1.87	1.37	1.31
11	1.43	2.28	1.33	2.57	2.10	1.24
12	1.82	2.37	2.59	1.42	1.37	1.07
13	1.58	1.25	2.14	1.76	1.24	1.67
14	2.29	1.62	0.97	1.80	1.68	1.16
15	7.39	1.39	1.95	1.70	1.63	2.08
16	1.36	1.12	2.04	1.32	2.03	2.66
17	1.59	2.14	3.94	1.22	1.17	1.70
18	1.33	2.60	2.02	1.79	2.27	1.30
19	1.59	2.06	2.17	1.27	1.39	1.63
20	2.62	1.54	1.86	1.06	2.24	1.65
21	1.36	1.85	1.13	1.89	0.98	3.30
22	1.81	1.50	1.61	1.65	2.88	1.55
23	1.64	1.43	3.40	1.39	1.32	1.19
24	1.64	1.56	2.01	2.12	1.99	1.32
25	3.38	2.54	1.18	1.24	1.42	1.43
26	1.43	2.03	2.68	1.36	1.90	1.51

27	1.54	1.58	1.73	1.45	0.99	1.52
28	3.39	1.92	1.16	1.39	1.81	1.17
29	1.34	1.02	2.27	2.34	1.06	3.24
30	1.21	2.01	1.90	1.40	1.27	1.49
31	2.44	2.57	1.82	1.70	1.45	1.59
32	2.56	1.63	2.17	1.24	2.15	1.29
33	1.38	2.00	1.16	1.98	1.42	2.04
34	1.44	1.74	2.39	2.18	1.67	1.81
35	2.19	1.43	2.91	1.81	2.12	1.96
36	1.24	0.88	1.11	1.45	1.71	3.56
37	3.10	1.17	1.59	1.74	3.32	2.07
38	1.92	3.09	1.74	1.04	2.28	2.55
39	1.57	2.09	1.35	1.84	1.90	1.43
40	2.02	1.22	1.16	2.20	1.64	1.85
41	1.58	2.52	1.42	1.54	1.70	2.61
42	1.37	1.12	1.94	1.90	1.53	1.79
43	1.65	2.45	1.19	2.29	1.03	2.30
44	1.36	1.84	1.99	1.67	2.01	2.33
45	1.66	2.15	1.43	1.52	1.37	1.53
46	1.72	2.75	1.36	3.02	2.25	1.90
47	1.87	1.99	1.50	1.61	1.68	1.51
48	1.48	1.08	1.51	1.72	2.38	1.08
49	2.46	1.53	1.12	1.75	1.27	0.94
50	1.59	2.75	1.76	1.95	1.42	1.57
51	1.98	2.04	1.38	2.53	0.90	1.82
52	3.23	1.93	1.84	2.48	1.51	1.99
53	1.95	1.51	1.29	1.91	2.15	1.17
54	1.80	1.35	1.95	1.52	1.03	1.35
55	1.40	1.87	2.41	2.33	1.34	1.23
56	1.50	1.95	1.73	1.62	1.93	2.69
57	1.00	1.79	1.66	1.81	2.32	1.08
58	1.22	2.88	1.72	1.66	1.66	2.95
59	1.19	1.15	2.09	1.46	1.26	1.15
60	0.98	2.30	1.01	1.13	1.56	1.64

	fair -3.0% 1	fair -3.0% 2	fair -3.0% 3	fair -3.0% 4	fair -3.0% 5	fair -3.0% 6
1	2.43	1.89	1.43	4.05	2.36	2.44
2	3.22	1.17	2.57	1.70	2.77	2.05
3	3.69	2.16	1.28	1.98	3.29	3.48
4	1.28	2.69	1.58	3.57	2.48	1.52
5	1.80	1.36	1.36	1.94	1.90	2.05
6	2.58	1.70	1.46	2.50	1.77	1.92
7	1.31	3.08	2.31	1.84	2.43	3.01
8	2.43	2.15	1.50	2.16	1.72	1.89

9	1.44	2.60	2.07	1.12	2.64	2.16
10	2.24	1.60	2.06	2.30	2.53	2.10
11	2.72	2.56	1.58	1.56	1.40	1.82
12	0.99	1.72	1.22	1.93	1.60	1.53
13	1.84	2.67	2.99	1.66	1.65	1.66
14	1.49	3.46	1.21	2.51	1.79	1.73
15	1.90	2.50	1.85	1.61	2.20	1.89
16	2.83	2.76	1.33	2.00	1.86	1.30
17	2.73	2.45	1.73	1.62	1.61	1.46
18	2.74	1.84	1.31	1.39	1.56	1.54
19	1.52	2.09	2.23	1.21	1.46	2.10
20	1.62	2.10	1.54	1.49	2.25	1.55
21	2.23	2.26	1.74	2.60	1.60	1.17
22	2.16	1.40	1.61	1.61	1.62	1.71
23	1.25	2.64	1.59	2.97	1.94	2.18
24	1.31	1.60	1.38	2.41	1.84	2.13
25	3.76	1.82	2.71	1.91	1.70	1.42
26	1.80	1.56	1.46	1.71	1.87	1.43
27	3.13	2.04	1.46	1.62	1.82	1.30
28	2.88	2.32	1.93	1.69	1.98	1.51
29	1.83	1.87	1.60	1.60	1.96	1.46
30	2.06	1.61	1.74	2.94	2.00	1.69
31	1.88	1.80	1.57	2.19	1.84	1.60
32	3.39	2.28	1.72	2.02	2.42	1.87
33	2.28	1.56	1.54	1.89	1.47	2.25
34	1.73	1.89	1.06	2.11	1.73	1.49
35	3.07	1.46	2.52	1.96	2.28	1.88
36	2.23	1.84	1.74	1.76	2.83	2.50
37	1.99	1.98	2.93	1.87	2.85	2.55
38	1.41	1.79	2.29	2.31	1.76	1.55
39	1.38	1.97	2.64	2.33	1.72	1.94
40	1.58	1.52	2.58	1.99	1.90	2.16
41	1.33	3.41	1.21	2.21	1.81	1.96
42	2.39	1.53	3.48	1.24	1.71	1.56
43	1.80	2.37	1.85	1.79	1.90	1.95
44	1.18	2.39	1.54	1.63	1.77	2.30
45	1.41	2.04	1.22	1.86	2.99	1.29
46	1.97	5.03	1.88	1.64	1.74	1.07
47	2.71	2.05	1.94	1.67	2.23	1.66
48	2.47	1.91	3.29	1.95	1.99	1.54
49	1.63	1.94	1.68	1.78	1.68	1.41
50	2.14	1.83	1.20	1.86	2.33	1.21
51	2.14	2.05	2.80	1.17	1.49	1.70
52	1.44	2.33	1.94	1.89	1.55	1.54
53	1.95	1.68	1.65	1.67	1.43	1.76
54	2.33	1.64	2.20	0.99	1.89	1.83
55	1.21	2.46	1.58	2.27	1.99	2.37
56	2.10	1.59	2.94	1.84	1.71	2.00
57	1.06	0.97	1.90	2.00	1.30	1.84
58	1.92	1.58	1.30	2.00	1.41	1.27
59	2.65	0.99	1.58	2.06	1.26	1.85
60	1.86	2.20	1.38	2.00	1.37	1.87

	fair -3.0% 7	fair -3.0% 8	fair -3.0% 9	fair -3.0% 10	fair -3.0% 11	fair -3.0% 12
1	1.18	1.63	2.78	1.52	1.29	1.50
2	1.91	1.07	3.91	1.57	1.62	1.11
3	1.95	1.94	1.35	2.34	3.00	1.25
4	1.57	1.36	1.32	1.91	1.84	3.26
5	1.68	1.77	1.37	1.37	1.27	2.35
6	1.91	1.85	1.46	1.91	1.12	1.91
7	2.01	2.48	2.30	1.51	2.42	1.23
8	1.17	1.51	2.74	2.15	1.88	1.43
9	1.92	1.36	1.20	2.36	2.22	1.57
10	2.13	1.01	1.86	1.86	2.72	1.47
11	2.15	3.39	1.52	1.33	1.61	1.91
12	2.17	1.40	1.39	1.17	1.41	1.49
13	1.68	1.77	2.15	3.11	2.88	1.59
14	1.78	1.85	1.64	2.25	1.31	1.89
15	1.93	1.84	2.29	2.82	2.73	2.41
16	1.60	1.79	2.63	1.66	1.80	1.23
17	1.54	1.76	1.54	2.86	1.97	1.70
18	1.48	1.85	1.06	3.07	2.05	2.29
19	2.61	1.97	2.23	2.56	2.43	1.42
20	1.28	1.60	1.93	1.62	1.77	1.83
21	2.21	1.89	1.85	1.57	1.76	3.34
22	1.23	1.51	1.97	1.97	3.07	2.10
23	1.42	2.14	1.79	2.15	2.02	1.13
24	3.05	1.95	1.66	1.72	1.75	2.39
25	1.37	1.71	1.29	1.97	2.83	1.61
26	2.81	1.66	2.45	1.92	1.92	2.00
27	1.12	1.67	1.47	2.13	1.94	1.79
28	1.88	1.47	2.79	2.45	1.72	1.37
29	2.09	1.75	2.27	1.53	1.24	1.81
30	1.31	1.32	3.59	1.63	1.81	1.53
31	1.94	2.93	1.63	1.63	1.68	1.58
32	1.70	2.03	1.52	1.98	2.13	1.34
33	2.19	1.88	2.43	1.48	1.24	1.91
34	1.87	2.06	1.58	1.79	1.88	2.02
35	1.97	1.51	1.71	1.80	2.71	1.24
36	2.08	1.30	1.23	2.30	1.19	1.66
37	1.03	1.62	1.91	1.54	1.47	1.37
38	2.03	2.09	2.04	1.69	2.11	2.63
39	1.49	1.59	2.64	1.78	1.69	1.93
40	2.30	1.67	2.25	1.68	1.50	1.82
41	1.70	2.04	2.92	1.25	1.77	1.62
42	2.23	1.03	1.70	1.28	1.37	1.40

43	2.10	1.02	1.87	1.84	1.75	2.27
44	1.43	1.21	1.18	2.35	2.12	1.33
45	1.37	1.78	0.97	1.10	1.37	1.81
46	1.17	1.00	1.17	1.49	2.12	2.25
47	2.19	1.32	1.16	1.07	2.26	1.18
48	1.46	2.00	1.44	2.19	2.43	1.29
49	1.21	1.61	1.34	1.83	1.45	1.19
50	1.11	1.23	1.41	1.86	1.72	1.50
51	1.81	1.32	2.31	2.70	1.53	1.17
52	1.27	2.15	1.80	1.98	1.43	1.08
53	1.11	1.59	2.24	0.95	1.58	2.01
54	1.49	2.10	1.71	2.28	1.24	1.89
55	1.92	1.90	1.98	1.52	1.48	2.46
56	1.52	1.85	2.28	1.81	2.12	1.45
57	1.47	1.63	1.52	2.14	1.94	1.48
58	1.84	1.47	1.54	2.36	2.58	1.85
59	2.24	1.78	1.49	1.30	2.02	1.37
60	1.95	1.46	2.12	2.17	3.09	2.25

	poor +7.2% 1	poor +7.2% 2	poor +7.2% 3	poor +7.2% 4	poor +7.2% 5	poor +7.2% 6
1	1.97	2.71	1.17	1.82	1.81	1.51
2	1.67	1.46	1.38	2.74	0.62	2.04
3	1.92	1.45	1.38	1.09	2.30	3.17
4	1.90	1.31	2.24	1.82	1.13	2.16
5	2.73	1.18	2.40	1.86	2.51	1.31
6	2.03	1.56	2.98	0.96	5.47	1.40
7	2.70	2.08	1.97	1.70	1.71	2.74
8	2.56	2.54	1.83	2.74	1.16	2.35
9	1.43	2.61	1.50	1.86	2.71	1.52
10	4.02	2.33	1.77	1.03	1.41	2.03
11	2.76	1.73	2.45	1.40	0.93	1.78
12	2.83	2.02	1.32	3.51	2.07	1.21
13	1.86	1.35	1.45	1.95	1.42	2.74
14	1.20	1.66	2.47	2.08	1.12	3.46
15	3.29	1.30	1.19	1.78	2.23	1.27
16	2.56	1.69	1.61	1.70	2.37	2.00
17	1.39	3.48	1.80	2.27	1.78	1.91
18	3.37	1.78	2.00	2.88	1.29	2.76
19	1.94	1.34	2.04	3.39	1.66	1.35
20	1.22	2.74	2.13	3.29	1.70	0.63
21	1.43	1.77	1.60	1.78	1.28	1.94
22	1.87	1.04	1.63	2.30	1.80	1.27
23	1.88	1.69	2.41	1.87	1.88	1.79
24	1.48	3.74	2.76	1.20	1.23	2.43
25	1.90	1.25	1.34	1.93	2.25	2.78
26	2.19	1.25	2.36	2.23	2.29	2.21
27	2.04	1.28	2.40	2.59	2.64	1.67
28	2.01	1.55	2.17	3.01	1.19	1.67

29	1.58	1.86	1.41	1.48	2.03	2.42
30	2.31	1.44	2.09	1.39	2.05	1.92
31	2.17	2.22	2.12	2.20	1.58	1.92
32	1.43	1.72	1.95	2.16	1.88	1.65
33	2.34	1.82	2.07	1.86	1.27	1.76
34	2.16	1.40	1.72	1.90	1.46	1.51
35	2.02	3.11	1.64	2.04	2.69	1.99
36	2.89	1.28	1.71	2.64	1.29	1.60
37	2.55	2.29	1.63	1.85	1.66	2.98
38	1.97	2.83	1.63	2.35	2.90	3.24
39	1.97	1.88	1.98	1.94	1.64	2.20
40	1.88	1.85	2.95	1.59	1.64	1.80
41	1.72	2.61	1.58	2.31	1.82	1.05
42	1.33	1.42	2.34	2.16	1.47	1.60
43	3.08	2.38	2.58	1.98	0.58	1.90
44	1.21	1.87	2.23	2.48	1.54	1.28
45	1.27	1.44	1.73	2.74	2.09	1.64
46	1.78	1.72	2.08	1.95	1.82	1.67
47	2.03	2.12	1.62	2.10	2.23	1.98
48	2.29	2.38	2.09	2.32	3.17	1.90
49	1.65	1.79	1.60	2.06	1.27	3.72
50	2.19	3.58	1.90	1.51	1.66	2.05
51	1.32	1.73	2.15	1.23	2.47	1.45
52	2.35	2.06	1.78	2.32	2.16	2.65
53	2.71	1.42	1.92	1.20	1.72	1.24
54	1.28	3.00	1.41	2.09	1.97	1.48
55	2.40	1.48	1.90	2.29	2.17	1.72
56	2.33	2.74	2.33	3.09	1.89	1.74
57	2.05	1.49	2.13	2.02	2.08	1.88
58	2.24	2.88	1.30	1.93	2.91	2.73
59	1.91	1.50	2.61	2.73	1.30	2.30
60	1.72	2.09	1.96	1.32	2.23	1.54

	poor +7.2% 7	poor +7.2% 8	poor +7.2% 9	poor +7.2% 10	poor +7.2% 11	poor +7.2% 12
1	2.61	2.51	1.98	1.07	1.65	2.49
2	1.99	2.23	2.06	1.44	1.97	1.79
3	3.13	1.47	1.00	2.06	1.02	1.68
4	2.20	1.39	1.49	1.25	2.12	1.84
5	1.51	1.86	2.02	2.51	1.17	2.19
6	3.49	1.93	1.53	1.92	1.56	1.73
7	1.59	2.90	2.80	1.94	2.20	2.69
8	2.39	2.29	0.89	0.92	1.42	2.18
9	2.34	2.85	1.20	1.77	2.59	1.78
10	1.75	2.41	1.40	2.51	1.78	2.95

11	1.75	1.79	2.89	1.83	1.62	2.32
12	1.24	1.06	1.81	1.39	1.32	1.43
13	1.52	1.69	2.04	2.53	2.02	2.35
14	1.47	1.19	4.95	1.20	1.44	2.17
15	1.68	1.92	2.17	1.41	2.51	2.97
16	1.33	1.48	1.47	3.87	2.52	2.75
17	2.00	2.22	0.84	1.67	2.37	1.75
18	1.77	2.44	2.17	2.45	2.19	1.41
19	1.42	1.98	1.51	1.83	2.41	1.32
20	1.91	2.27	1.27	1.61	1.71	1.64
21	1.37	1.40	2.33	1.71	2.19	1.03
22	2.04	1.09	1.35	1.50	1.93	1.38
23	2.56	1.57	2.08	2.53	2.59	2.05
24	1.55	2.11	3.21	1.93	1.78	1.79
25	1.28	1.39	1.53	1.67	1.48	1.79
26	1.27	2.11	1.72	1.44	2.20	2.84
27	2.26	2.27	1.14	1.43	1.97	1.64
28	2.27	1.80	1.68	1.61	1.70	1.82
29	2.16	1.67	1.46	1.90	1.61	2.62
30	1.66	1.74	2.48	2.27	2.74	2.58
31	1.82	1.46	2.82	1.31	2.45	1.89
32	2.00	1.91	1.64	1.48	1.78	1.94
33	1.56	1.58	1.89	1.55	1.63	1.53
34	1.10	2.26	1.50	1.55	1.46	2.41
35	1.79	1.15	2.10	1.56	1.89	2.08
36	1.50	2.38	1.25	1.55	2.93	1.81
37	1.38	1.62	1.53	2.11	2.02	1.30
38	2.36	1.66	1.81	1.65	2.57	1.37
39	0.90	1.47	2.62	2.43	2.59	1.98
40	1.30	1.59	1.58	2.14	1.99	2.24
41	1.01	2.21	1.99	2.15	2.25	1.82
42	1.45	2.43	1.60	3.08	2.15	1.92
43	1.98	1.61	1.43	2.80	2.11	2.30
44	2.25	1.73	3.30	1.72	1.59	2.97
45	1.36	1.02	1.95	2.33	2.59	2.31
46	1.75	2.98	2.53	1.28	2.74	2.40
47	1.34	1.48	2.30	1.46	1.68	2.31
48	1.62	2.41	1.84	1.29	2.97	1.32
49	1.62	2.83	2.31	1.33	1.43	1.66
50	1.29	1.63	3.11	1.57	1.87	1.73
51	1.74	1.39	2.18	1.29	3.85	1.39
52	1.80	1.41	2.58	1.44	2.10	2.24
53	2.17	2.17	1.51	1.95	2.54	1.13
54	1.56	2.30	2.06	1.19	2.93	1.84
55	1.64	1.73	1.63	1.61	1.43	2.20
56	1.47	1.99	2.42	2.88	1.94	1.32
57	1.29	1.33	2.27	1.28	1.95	1.06
58	3.18	1.35	2.15	1.80	2.15	1.90
59	1.46	1.95	1.39	1.08	1.30	2.62
60	1.90	1.27	2.16	4.27	1.53	1.31

	poor -7.2% 1	poor -7.2% 2	poor -7.2% 3	poor -7.2% 4	poor -7.2% 5	poor -7.2% 6
1	1.98	1.99	1.80	1.60	1.09	2.07
2	1.30	1.39	3.50	1.76	1.52	1.57
3	1.64	2.13	2.37	1.23	1.21	1.62
4	1.76	1.45	1.82	2.00	1.91	1.77
5	1.87	1.89	3.27	1.04	2.50	1.81
6	1.46	2.22	2.16	1.85	1.97	1.31
7	1.96	2.14	1.36	1.10	2.04	1.78
8	1.23	1.91	1.39	2.00	2.18	1.79
9	2.43	1.87	1.96	1.93	2.00	1.92
10	1.67	1.76	3.50	2.40	1.70	1.46
11	2.21	5.83	1.11	2.50	1.20	1.32
12	2.30	1.57	2.82	1.17	2.01	1.08
13	1.65	1.59	1.73	1.80	2.55	1.48
14	1.91	2.07	2.04	1.80	2.45	1.58
15	1.35	1.75	1.58	1.70	3.60	1.83
16	1.47	1.76	1.63	2.74	1.88	1.51
17	2.37	4.05	1.56	1.44	2.92	2.65
18	2.53	1.53	3.04	4.01	2.98	2.32
19	2.30	1.61	1.97	1.95	1.21	3.28
20	2.12	2.22	2.07	1.59	1.62	1.88
21	1.47	2.05	1.04	2.70	1.16	2.34
22	2.37	1.50	0.34	2.23	2.29	2.03
23	1.21	3.42	1.47	1.68	1.01	4.30
24	3.18	1.94	2.01	2.51	1.24	1.73
25	1.89	1.32	1.48	1.71	1.25	1.92
26	4.43	1.60	1.31	0.61	1.42	1.64
27	2.43	2.44	2.24	1.83	3.17	1.73
28	2.88	3.10	2.59	2.24	1.72	1.91
29	1.66	1.79	2.84	1.81	2.56	2.49
30	1.23	2.38	1.58	1.83	1.42	1.21
31	2.60	2.82	1.63	1.26	1.19	3.11
32	1.60	2.67	1.70	3.41	1.84	3.11
33	1.22	1.89	2.89	1.01	1.53	2.65
34	1.85	1.99	1.61	1.61	1.88	2.08
35	1.49	1.31	2.00	1.72	2.97	0.67
36	1.49	3.08	1.84	1.88	2.52	1.41
37	3.24	1.34	2.56	3.16	1.24	1.66
38	1.63	1.18	2.69	1.86	1.44	1.88
39	1.55	2.13	1.70	2.50	1.62	1.38
40	2.42	1.98	1.12	2.36	2.32	1.42
41	0.61	1.33	3.14	0.78	2.03	1.35
42	1.40	1.28	1.86	3.36	2.26	1.33
43	2.22	2.75	1.54	2.59	1.41	1.77
44	1.37	1.77	1.32	1.86	3.03	1.65

45	1.28	1.30	1.12	2.30	1.43	2.80
46	1.08	2.37	1.43	1.99	1.95	2.06
47	1.36	2.37	2.93	1.73	0.80	1.52
48	3.49	1.16	2.11	1.50	2.94	1.76
49	1.76	3.34	2.97	1.85	1.61	1.94
50	1.84	1.88	2.40	2.07	2.13	2.17
51	0.74	1.70	1.64	1.59	1.57	2.51
52	1.53	1.93	1.86	2.18	1.63	2.25
53	1.87	2.07	2.43	1.53	2.18	2.19
54	1.16	2.53	1.43	2.17	2.43	1.18
55	1.81	1.03	1.81	1.49	2.02	1.12
56	2.11	2.29	0.77	1.99	1.01	2.57
57	1.80	2.62	1.37	1.58	1.74	5.27
58	2.26	2.56	2.24	1.39	1.02	1.82
59	1.79	3.22	1.67	1.94	2.40	3.54
60	1.22	1.66	2.26	1.95	1.93	2.07

	poor -7.2% 7	poor -7.2% 8	poor -7.2% 9	poor -7.2% 10	poor -7.2% 11	poor -7.2% 12
1	2.94	1.59	2.24	1.30	1.25	1.82
2	1.22	2.42	1.58	1.94	1.91	2.64
3	1.37	2.56	3.47	1.51	1.56	2.73
4	1.74	1.88	1.34	2.13	2.75	1.85
5	1.40	1.82	1.27	1.64	2.09	1.81
6	1.78	1.52	2.81	1.31	2.18	3.16
7	2.03	1.48	1.46	2.14	1.84	1.53
8	2.27	2.13	1.77	1.39	1.95	0.97
9	2.47	1.46	2.01	3.36	2.66	1.39
10	1.44	2.01	2.07	3.26	2.85	2.12
11	1.25	1.58	2.81	1.79	2.04	1.59
12	1.66	1.93	2.56	1.63	2.17	2.11
13	2.42	1.54	3.06	2.05	4.32	1.09
14	1.26	1.98	2.50	1.68	1.23	1.79
15	1.82	2.88	2.04	2.07	3.04	2.45
16	1.34	2.20	4.67	1.46	1.86	2.00
17	1.60	1.76	1.34	1.64	1.93	1.82
18	1.47	2.04	1.52	1.60	1.43	2.28
19	1.70	1.42	1.43	2.65	1.80	1.71
20	2.56	1.83	1.84	1.70	2.94	1.95
21	1.30	1.36	0.97	1.89	1.65	1.79
22	1.57	2.97	1.90	2.35	1.65	1.72
23	1.17	1.95	1.29	1.51	3.06	0.90
24	1.29	1.62	1.17	2.17	1.38	1.48
25	2.43	1.90	1.99	2.26	1.21	2.18
26	1.80	2.47	2.72	1.70	2.13	2.48

27	2.76	1.37	1.51	2.07	1.44	2.26
28	1.67	1.43	1.11	2.17	1.52	1.84
29	2.02	3.06	2.52	1.60	1.37	1.86
30	0.99	1.54	1.91	1.00	1.53	2.71
31	1.99	1.24	4.30	1.11	2.19	1.35
32	1.14	2.50	3.69	2.05	2.19	2.51
33	2.81	2.30	1.67	2.27	[illegible].90	2.59
34	1.20	1.22	1.93	1.91	2.84	1.48
35	1.34	2.91	1.16	1.64	1.34	3.12
36	1.80	1.64	1.47	1.26	1.23	2.81
37	1.64	1.52	1.83	1.46	2.58	1.76
38	3.74	2.20	2.38	3.11	1.99	1.35
39	1.58	2.43	1.54	2.01	1.54	3.04
40	1.67	2.53	2.60	1.59	1.88	1.72
41	1.57	1.27	2.15	1.85	1.19	2.90
42	1.89	1.30	2.74	1.29	0.83	4.17
43	2.38	2.00	1.47	2.72	1.26	1.49
44	2.24	2.77	2.16	2.60	0.97	2.11
45	1.77	1.80	1.11	1.92	1.54	2.08
46	1.28	2.58	1.20	3.95	1.65	1.55
47	1.81	2.63	1.67	1.45	1.89	2.43
48	1.16	1.40	2.24	3.27	1.03	1.65
49	2.52	2.12	1.62	1.46	2.11	1.78
50	2.94	1.35	1.69	1.34	1.45	2.01
51	2.49	1.36	1.41	2.02	2.71	1.74
52	2.60	5.35	1.18	1.74	2.11	1.89
53	2.23	3.32	2.31	1.47	1.21	3.33
54	1.63	1.83	1.47	2.34	2.31	2.08
55	2.02	1.56	2.25	1.77	1.04	1.30
56	4.27	1.85	1.11	1.64	1.42	2.99
57	1.83	3.56	1.67	3.24	2.39	1.71
58	2.15	1.01	2.50	1.04	2.10	2.58
59	1.73	2.79	1.47	1.38	2.50	2.36
60	2.48	2.41	1.41	1.08	1.52	2.48

	poor -0.7% 1	poor -0.7% 2	poor -0.7% 3	poor -0.7% 4	poor -0.7% 5	poor -0.7% 6
1	2.77	2.02	1.49	1.06	1.98	2.04
2	1.65	1.17	1.44	1.32	1.09	1.77
3	2.47	1.47	1.25	1.98	2.02	1.30
4	2.98	2.47	2.38	2.95	1.60	2.02
5	2.26	1.82	1.38	2.99	3.27	1.91
6	4.73	2.95	1.81	1.94	1.53	1.74
7	1.08	1.91	3.10	1.54	2.20	1.03
8	2.90	2.10	1.89	1.39	2.48	1.32

9	1.69	1.83	1.41	2.63	1.57	1.84
10	1.68	2.27	2.04	1.10	1.09	3.00
11	1.60	2.09	2.07	2.33	1.13	1.87
12	1.95	1.57	2.85	1.50	1.54	2.09
13	1.40	3.27	1.84	1.23	1.90	1.39
14	1.40	2.35	1.42	1.88	1.87	0.93
15	4.43	1.14	2.60	2.85	1.95	1.95
16	1.21	1.60	1.63	1.94	1.67	2.38
17	1.31	1.71	1.52	2.32	1.29	1.08
18	1.31	1.75	1.45	2.03	2.34	1.75
19	1.97	1.63	1.89	1.80	1.28	3.47
20	3.02	1.66	1.46	2.07	2.01	3.11
21	2.98	3.09	1.69	2.69	1.37	2.95
22	2.38	1.91	1.81	2.33	2.00	1.15
23	1.97	2.09	1.47	1.21	2.03	2.33
24	1.58	1.98	2.32	1.45	1.71	1.51
25	1.85	1.96	1.47	1.55	1.97	1.97
26	2.21	1.99	1.97	1.73	1.82	1.35
27	2.22	2.45	1.10	1.86	1.79	1.59
28	1.24	2.04	2.62	1.46	1.26	1.37
29	2.10	2.80	2.45	1.50	1.81	1.97
30	1.54	3.40	1.57	1.28	1.32	3.02
31	2.30	1.50	1.10	2.15	1.48	2.76
32	1.56	2.40	2.07	2.15	1.71	1.38
33	3.56	2.59	2.63	1.97	1.46	1.13
34	1.24	2.83	2.00	2.24	1.46	1.49
35	1.57	1.60	2.52	2.26	2.06	2.25
36	2.01	2.29	1.79	1.88	1.67	1.83
37	2.14	1.91	1.78	1.69	1.83	2.18
38	1.75	3.32	1.56	1.45	1.01	1.38
39	1.23	2.13	1.93	2.27	2.07	2.44
40	2.97	2.80	1.20	1.33	1.70	1.94
41	3.02	1.67	1.45	1.31	2.42	2.23
42	1.69	2.00	2.85	1.07	1.21	1.56
43	1.41	1.94	2.75	1.73	1.10	1.64
44	1.69	1.84	1.48	1.79	1.70	1.20
45	1.43	1.53	3.62	1.98	1.38	1.63
46	0.96	2.25	2.37	2.31	1.40	1.71
47	1.56	1.44	2.30	1.42	2.74	1.74
48	2.19	1.70	1.98	1.59	1.05	2.54
49	1.80	3.49	3.47	1.31	1.34	1.44
50	1.71	5.75	1.87	2.98	1.60	1.65
51	2.37	1.47	1.70	2.20	1.66	1.62
52	3.72	1.57	1.15	3.24	1.31	2.86
53	1.44	2.38	2.35	1.75	1.60	2.01
54	2.10	1.94	1.36	1.62	2.12	1.29
55	2.14	1.39	2.53	1.93	4.16	1.13
56	2.02	1.51	1.08	1.28	2.01	1.33
57	2.21	1.59	1.87	1.43	1.58	1.55
58	2.38	3.03	2.64	1.38	1.61	1.94
59	1.79	1.43	2.02	1.98	2.10	2.10
60	1.63	1.66	1.92	1.54	1.82	2.42

	poor -0.7% 7	poor -0.7% 8	poor -0.7% 9	poor -0.7% 10	poor -0.7% 11	poor -0.7% 12
1	1.54	1.68	3.40	1.43	3.81	2.40
2	1.24	1.19	2.07	1.59	1.18	1.47
3	1.45	1.83	1.85	1.37	1.16	1.59
4	1.89	2.09	1.53	0.93	1.29	2.78
5	1.56	2.94	1.68	2.54	1.80	2.23
6	1.73	3.55	2.05	1.40	1.60	1.76
7	1.87	1.96	2.70	2.20	2.38	2.21
8	2.50	1.96	1.81	1.65	2.71	1.50
9	3.42	2.47	2.16	1.59	1.46	1.34
10	1.52	2.36	1.83	2.76	1.49	2.14
11	1.73	2.11	1.42	2.03	1.41	2.18
12	1.26	1.74	2.43	1.54	0.95	3.19
13	1.33	3.58	1.79	1.46	1.39	2.27
14	3.34	2.27	1.88	2.50	1.30	4.63
15	2.32	1.66	2.59	1.75	2.22	2.65
16	1.41	1.28	2.96	3.02	2.13	1.51
17	3.43	2.37	1.59	1.37	1.99	1.14
18	1.25	2.76	1.38	2.46	4.11	2.13
19	1.66	1.69	1.80	2.83	1.86	1.65
20	1.53	2.34	3.79	2.84	3.48	3.44
21	1.97	1.90	2.66	1.31	2.91	2.00
22	1.80	0.95	2.12	1.53	1.74	0.90
23	2.02	2.59	2.55	1.74	1.33	1.77
24	2.94	1.65	2.70	1.44	1.80	2.72
25	1.61	1.33	2.25	3.17	2.95	2.02
26	1.43	3.07	2.23	2.34	1.50	2.60
27	2.60	1.53	1.13	3.74	2.24	2.30
28	2.86	1.68	1.78	1.87	1.62	1.29
29	2.02	3.34	1.87	2.80	1.59	1.56
30	2.06	1.04	2.95	1.73	1.14	1.84
31	1.48	1.28	1.75	2.22	2.17	1.50
32	1.68	1.66	1.62	2.30	2.07	2.87
33	1.24	1.60	1.91	2.83	1.87	1.59
34	2.17	1.36	2.81	2.35	2.45	1.58
35	1.66	1.69	1.69	2.37	1.88	2.02
36	1.37	1.23	1.98	0.90	1.29	2.23
37	1.86	2.41	1.87	2.76	1.54	1.57
38	1.37	1.96	1.68	2.62	2.12	2.79
39	1.06	1.33	1.67	1.83	4.34	1.86
40	1.54	1.39	1.65	2.39	1.59	3.06
41	2.76	1.77	1.96	1.34	2.71	3.56
42	2.54	2.22	3.58	2.08	2.03	3.34

43	1.30	1.29	2.37	1.86	1.65	2.50
44	2.37	1.57	2.27	2.99	1.37	2.94
45	1.56	2.02	2.38	1.55	1.88	1.40
46	2.38	1.61	1.68	1.80	3.10	1.24
47	1.20	1.74	1.59	2.56	1.51	1.51
48	1.90	1.44	1.57	2.15	4.91	1.02
49	1.78	2.28	2.31	1.23	1.92	4.68
50	1.24	1.70	3.05	1.38	1.89	1.63
51	1.42	2.72	2.05	1.15	1.75	3.19
52	2.21	1.52	1.61	2.88	1.96	1.39
53	1.31	2.06	1.61	1.71	1.90	1.30
54	2.45	1.28	1.27	2.43	4.47	1.03
55	2.00	2.18	3.32	1.42	2.91	1.12
56	1.50	1.49	2.02	1.84	2.12	2.58
57	2.07	2.15	1.21	1.01	1.24	2.03
58	2.14	1.71	1.86	1.42	1.86	2.04
59	1.28	1.58	1.07	1.22	1.61	1.60
60	1.57	3.36	1.40	1.50	1.96	3.78

	poor +3.0% 1	poor +3.0% 2	poor +3.0% 3	poor +3.0% 4	poor +3.0% 5	poor +3.0% 6
1	2.50	2.11	1.44	1.77	1.86	3.46
2	1.24	1.52	2.68	1.89	1.38	1.44
3	2.71	2.65	2.21	2.51	1.09	3.43
4	1.56	1.37	1.33	1.66	1.37	2.36
5	2.39	2.50	2.28	1.24	1.84	2.92
6	1.66	1.23	1.15	1.70	1.66	1.49
7	1.60	1.70	2.36	1.59	2.61	2.23
8	1.57	1.92	1.94	2.29	1.94	1.96
9	1.89	1.99	2.26	2.96	1.93	2.30
10	1.70	1.80	1.72	1.00	1.17	2.04
11	3.38	2.59	1.92	1.44	2.14	1.26
12	1.42	1.41	1.19	1.47	1.56	1.98
13	2.33	3.23	1.66	1.27	1.43	1.46
14	1.48	2.28	2.87	1.19	1.32	1.27
15	1.62	1.52	1.53	1.46	1.49	1.62
16	1.60	2.14	2.80	1.75	1.93	1.44
17	1.67	2.71	1.46	1.28	2.39	1.32
18	1.47	1.46	1.77	1.58	1.18	1.41
19	1.66	1.63	2.02	1.24	1.37	1.62
20	1.87	2.32	2.81	1.37	1.41	1.82
21	1.27	1.67	2.43	1.26	1.81	1.52
22	1.54	1.31	1.43	3.88	1.91	1.48
23	1.41	2.23	1.92	1.22	1.83	1.34
24	1.84	2.01	1.41	1.22	2.26	1.70

25	1.74	1.53	1.56	1.95	1.59	2.25
26	2.95	1.67	1.83	2.83	1.47	1.70
27	2.11	0.91	1.23	1.21	1.25	3.25
28	1.29	2.31	1.57	1.95	1.10	1.54
29	1.01	1.52	1.64	2.52	1.82	2.74
30	2.17	1.73	2.33	1.63	1.46	2.24
31	1.46	4.17	1.70	1.39	1.97	2.02
32	2.14	1.88	1.54	1.50	1.18	2.59
33	1.06	3.60	1.27	1.63	1.50	1.42
34	1.76	1.74	1.13	1.48	1.55	1.46
35	1.90	2.42	1.74	1.49	1.50	1.44
36	1.87	2.21	2.47	1.48	2.05	2.40
37	1.59	3.54	1.04	1.85	2.40	1.59
38	2.02	1.51	1.42	1.40	1.28	1.57
39	1.20	1.33	1.56	2.05	2.33	1.50
40	2.04	2.29	1.31	1.45	2.58	2.31
41	1.72	2.15	2.33	2.19	1.65	1.96
42	2.23	1.42	1.73	2.11	1.15	1.26
43	1.73	1.76	1.51	2.03	1.49	2.01
44	2.03	2.05	3.46	1.45	1.56	2.50
45	1.34	1.20	1.29	1.42	2.71	1.84
46	1.55	2.17	1.36	1.54	1.80	1.06
47	1.93	1.78	1.32	2.75	1.54	1.86
48	2.39	1.43	1.66	1.91	1.99	3.46
49	3.21	1.55	1.40	1.38	1.29	1.68
50	1.73	1.72	1.56	2.74	2.60	1.22
51	2.32	1.94	2.92	1.51	3.00	1.59
52	1.64	1.85	1.77	4.46	1.33	1.67
53	3.16	2.85	1.22	1.74	1.81	3.34
54	1.63	1.98	1.50	2.65	1.55	1.66
55	1.42	1.86	1.97	1.56	2.52	3.09
56	1.83	1.40	1.86	2.09	2.01	1.90
57	1.52	2.12	1.49	0.95	1.62	1.68
58	1.77	1.81	1.34	1.18	1.49	1.42
59	4.07	1.59	2.01	1.53	1.22	0.78
60	3.17	1.40	1.82	1.47	1.19	1.90

	poor +3.0% 7	poor +3.0% 8	poor +3.0% 9	poor +3.0% 10	poor +3.0% 11	poor +3.0% 12
1	1.50	1.19	1.69	3.30	1.46	1.70
2	1.63	1.23	2.15	2.22	1.43	1.23
3	1.52	1.13	3.23	1.43	1.72	2.66
4	1.94	2.37	1.63	2.09	1.62	1.90
5	1.25	1.27	1.14	1.68	1.36	2.64
6	2.22	1.54	2.27	1.38	2.22	1.65

7	2.77	2.57	1.24	2.74	1.47	2.11
8	1.95	1.51	1.08	1.84	1.48	2.36
9	1.47	1.61	2.04	1.20	1.45	1.25
10	2.12	1.36	1.45	2.18	1.44	2.11
11	1.43	1.75	2.15	1.53	1.48	1.27
12	2.14	1.45	2.83	1.48	2.00	1.88
13	0.99	2.93	0.84	1.16	1.69	1.63
14	2.05	1.27	1.96	1.46	4.95	2.78
15	2.58	0.98	1.09	2.48	2.21	1.50
16	1.66	1.88	1.95	1.39	1.61	1.71
17	1.33	1.58	1.73	1.17	2.88	1.40
18	1.33	3.13	3.20	1.91	2.38	1.35
19	1.13	1.79	1.75	2.05	1.49	0.94
20	1.29	1.38	1.56	1.82	1.65	1.41
21	1.76	1.69	1.41	1.24	1.57	0.91
22	1.76	1.68	1.74	1.18	1.71	1.42
23	1.61	1.32	1.13	2.73	1.40	1.52
24	3.01	1.14	1.27	1.69	1.40	1.82
25	1.74	2.37	1.46	2.21	1.78	1.34
26	1.80	4.10	1.70	2.15	1.97	1.38
27	1.43	1.86	2.07	2.64	1.76	2.82
28	1.39	2.56	1.21	1.38	1.55	2.10
29	2.07	1.43	1.53	3.53	1.57	1.31
30	1.63	1.37	2.07	1.51	1.65	1.72
31	1.74	1.48	1.76	1.23	3.28	1.69
32	2.86	2.43	1.76	1.96	1.41	1.84
33	1.52	1.59	1.39	2.57	2.31	1.78
34	1.57	2.42	1.53	1.35	2.16	3.28
35	1.44	1.59	2.48	1.66	1.66	1.95
36	1.67	2.23	1.36	1.47	1.64	1.60
37	2.23	1.56	1.27	1.25	1.06	1.71
38	1.29	1.42	1.86	1.87	1.13	1.47
39	1.44	1.51	2.64	1.55	2.16	1.55
40	1.18	1.70	0.97	2.78	1.28	1.77
41	2.38	1.67	1.58	1.92	1.23	1.58
42	2.34	1.41	3.25	2.03	2.37	0.96
43	1.35	1.55	1.60	1.15	1.58	2.00
44	2.56	1.74	2.30	1.46	1.23	1.19
45	1.88	1.51	1.61	0.84	3.19	1.46
46	1.50	1.46	2.12	1.15	1.94	2.11
47	1.25	1.00	1.45	1.39	2.16	1.89
48	1.02	1.33	2.05	1.30	1.38	1.49
49	1.44	1.77	2.96	1.70	2.42	2.04
50	1.53	1.36	1.64	2.13	2.09	1.43
51	2.20	2.27	1.16	1.90	1.97	1.59
52	2.22	1.33	1.35	1.20	2.31	1.89
53	2.53	3.41	1.48	1.47	1.21	2.31
54	1.90	1.62	1.83	2.80	1.55	1.25
55	1.54	1.47	1.59	0.95	1.19	2.05
56	1.40	1.33	1.55	3.31	1.15	1.52
57	1.69	2.19	2.15	1.67	1.44	1.76
58	1.54	2.11	1.81	2.06	2.18	1.75

59	1.49	1.68	1.80	1.45	2.58	1.93
60	1.74	1.32	1.80	1.01	2.22	1.90

	poor -3.0% 1	poor -3.0% 2	poor -3.0% 3	poor -3.0% 4	poor -3.0% 5	poor -3.0% 6
1	2.16	2.62	2.58	1.62	1.68	1.62
2	1.13	2.19	1.42	1.75	2.09	1.61
3	1.28	1.42	2.40	1.98	1.54	2.12
4	2.59	2.85	2.89	2.02	1.39	1.87
5	1.93	1.60	2.19	2.09	2.14	1.86
6	2.35	1.20	1.23	1.61	2.44	1.34
7	1.52	1.58	1.59	2.56	1.32	2.84
8	1.68	2.99	1.17	1.92	1.73	1.94
9	1.62	1.47	1.56	1.97	1.65	1.36
10	1.68	1.58	1.80	1.70	1.94	2.33
11	1.73	2.04	1.79	1.44	2.90	1.67
12	2.70	1.85	3.12	1.96	1.52	2.42
13	1.19	2.10	1.91	1.96	1.58	1.87
14	2.98	2.27	1.75	1.52	3.15	2.34
15	1.79	2.14	1.13	1.43	1.85	1.56
16	2.66	1.78	1.45	2.19	2.33	1.63
17	1.52	1.85	1.83	1.76	1.68	2.15
18	1.76	1.32	1.78	1.77	1.33	2.03
19	2.39	1.78	1.81	1.41	1.76	2.73
20	1.31	2.20	2.00	2.00	2.51	2.05
21	2.42	1.13	2.96	1.19	1.09	1.43
22	1.41	3.54	2.40	1.40	1.17	1.32
23	1.52	1.62	2.15	1.45	1.09	1.61
24	2.53	1.81	1.72	1.35	1.82	1.83
25	1.87	1.46	2.63	1.81	1.82	1.67
26	2.53	1.48	1.31	2.55	1.13	1.67
27	1.75	2.21	1.23	2.12	1.83	1.34
28	1.49	2.43	1.78	1.32	1.52	1.91
29	1.17	1.69	2.91	1.56	2.07	2.20
30	2.46	1.19	1.58	3.17	1.50	1.19
31	1.78	1.72	2.56	1.86	1.49	1.43
32	2.49	1.67	1.69	2.31	2.12	1.57
33	1.65	1.63	1.10	1.76	1.11	1.56
34	1.05	2.00	1.72	1.78	1.90	2.45
35	1.52	1.70	2.03	1.05	1.75	1.41
36	3.77	2.14	1.57	1.93	1.76	1.60
37	1.46	2.72	1.51	1.67	2.47	1.83
38	1.40	1.97	1.52	2.19	2.00	1.68
39	1.72	1.97	2.31	1.39	1.90	1.95
40	2.81	1.17	1.42	1.53	1.62	1.25

41	1.23	1.77	0.95	4.96	2.31	1.40
42	1.23	1.35	1.25	2.55	1.69	3.61
43	2.40	1.76	2.03	1.97	1.67	1.95
44	1.42	1.66	1.57	1.47	1.86	1.48
45	1.05	2.52	1.88	1.89	1.49	3.27
46	1.29	1.61	2.00	1.68	2.61	2.90
47	2.17	1.75	1.65	1.43	2.06	1.41
48	1.69	1.37	1.77	3.90	1.64	2.12
49	1.17	1.67	2.01	2.21	1.33	1.51
50	1.20	2.54	1.47	1.61	2.65	1.77
51	1.78	1.95	1.26	0.97	1.01	1.39
52	2.16	1.70	1.98	1.26	1.61	1.86
53	2.38	1.99	1.43	1.87	1.38	2.14
54	2.89	1.62	1.84	1.36	1.55	1.50
55	1.28	1.58	1.97	1.68	1.95	1.83
56	2.19	1.91	2.08	3.50	1.63	1.13
57	1.81	1.30	3.17	1.97	2.40	2.17
58	2.63	1.66	2.05	2.40	1.47	2.73
59	1.62	2.22	1.54	2.38	1.43	1.14
60	1.79	2.14	1.50	1.82	3.31	1.40

	poor -3.0% 7	poor -3.0% 8	poor -3.0% 9	poor -3.0% 10	poor -3.0% 11	poor -3.0% 12
1	2.76	1.84	1.20	1.24	1.30	2.30
2	2.54	1.74	1.11	2.02	2.08	1.40
3	2.53	1.72	1.62	1.81	1.72	1.47
4	1.75	2.01	1.14	1.76	1.28	1.33
5	2.29	2.21	2.62	2.07	1.74	2.23
6	3.13	1.50	1.50	1.58	1.59	1.40
7	1.45	1.88	1.33	2.33	1.07	1.23
8	1.93	1.96	1.74	1.60	1.79	1.45
9	1.19	1.60	1.59	1.19	3.01	1.99
10	1.67	2.16	2.22	1.62	1.17	1.27
11	1.29	1.82	2.05	2.07	1.98	1.58
12	2.70	1.33	1.57	1.79	1.71	1.54
13	1.48	2.90	1.24	1.20	1.43	1.14
14	1.57	1.75	1.35	1.51	1.72	1.50
15	1.96	1.46	2.74	1.55	1.17	2.23
16	1.73	1.54	1.02	1.57	1.78	1.66
17	4.06	1.57	1.79	2.33	1.90	1.18
18	1.14	2.28	1.72	2.66	1.81	2.09
19	1.20	2.68	2.20	2.34	2.08	2.13
20	1.51	1.31	1.62	1.66	1.74	2.13
21	1.80	2.43	2.43	1.62	1.49	1.92
22	1.46	1.23	1.91	2.53	1.72	1.30

23	1.58	1.20	1.48	1.83	3.88	1.33
24	1.60	1.64	2.48	2.28	1.55	1.78
25	1.62	1.23	2.69	2.04	1.53	1.90
26	2.39	1.83	1.95	1.43	1.16	1.97
27	1.02	1.10	0.96	2.68	1.35	1.34
28	2.37	2.23	1.58	2.35	2.17	1.54
29	1.90	2.64	2.31	2.58	2.12	2.32
30	1.61	0.64	1.55	1.23	1.14	2.77
31	1.06	1.98	2.24	1.97	2.55	1.33
32	1.19	1.58	2.10	1.44	1.36	2.19
33	2.31	2.00	1.76	1.73	1.72	1.29
34	1.33	1.43	2.23	2.36	1.43	1.76
35	3.33	1.56	1.63	1.74	0.91	1.30
36	1.48	1.81	1.48	1.32	1.65	1.40
37	2.44	1.41	1.81	2.30	1.26	1.40
38	1.74	1.99	1.76	1.56	2.31	1.47
39	1.81	2.90	2.08	1.73	3.35	1.33
40	2.55	2.00	1.98	2.17	2.20	2.13
41	1.58	1.25	1.62	1.81	2.24	3.11
42	1.61	2.21	1.48	2.37	2.11	1.30
43	1.41	1.74	1.50	1.57	1.71	2.45
44	1.74	1.83	1.76	1.72	2.49	1.94
45	1.29	1.27	1.24	2.40	1.08	1.91
46	1.23	1.77	1.71	1.00	2.48	2.05
47	1.38	1.85	1.47	1.37	2.45	2.75
48	1.56	1.58	2.18	2.15	2.15	1.65
49	2.03	1.41	2.19	1.86	1.62	2.49
50	2.01	1.83	1.63	2.86	1.71	2.10
51	1.01	2.16	2.50	2.90	1.43	3.12
52	2.20	1.93	1.45	1.56	1.00	3.39
53	1.31	1.60	0.66	2.35	1.45	1.89
54	1.17	2.10	2.10	3.01	1.50	1.54
55	1.17	2.20	1.57	1.56	2.41	1.80
56	1.78	1.64	1.08	1.63	2.07	1.42
57	1.23	3.19	1.39	1.45	5.20	2.19
58	1.47	1.61	1.94	1.40	1.35	2.31
59	1.39	1.70	1.38	2.86	2.65	1.33
60	1.35	1.55	1.48	1.17	1.49	1.26

Appendix F

Output from CELL MEANS procedure of SPSS/X software

This Appendix contains the results produced by the CELL MEANS procedure of SPSS/X software. Included are the total population mean, the mean headway for each level of the approach gradient factor, the mean headway for each level of the weather factor and the mean headway for each level of the queue position factor. Also included are the mean headways of the cells developed by the two-way interactions of weather/gradient, position/gradient and position/weather, and by the three-way interaction of position/weather/gradient.

Following are the results produced by the CELL MEANS procedure of SPSS/X software. Included are the total population mean, the mean headway for each level of the approach gradient factor, the mean headway for each level of the weather factor and the mean headway for each level of the queue position factor. Also included are the mean headways of the cells developed by the two-way interactions of weather/gradient, position/gradient and position/weather, and by the three-way interaction of position/weather/gradient.

Total Population Mean		1.88s
Gradient	+7.2%	1.86s
	+3.0%	1.81s
	+0.6%	1.96s
	-3.0%	1.86s
	-7.2%	1.94s
Weather	fair	1.86s
	poor	1.91s
Position	1	1.96s
	2	1.98s
	3	1.89s
	4	1.88s
	5	1.85s
	6	1.85s

Position		
	7	1.82s
	8	1.87s
	9	1.87s
	10	1.85s
	11	1.93s
	12	1.86s

Weather/Gradient		fair	poor
	+7.2%	1.78s	1.94s
	+3.0%	1.81s	1.81s
	+0.6%	1.94s	1.98s
	-3.2%	1.88s	1.84s
	-7.2%	1.91s	1.96s

Position/Gradient

	+7.2%	+3.0%	+0.6%	-3.2%	-7.2%
1	2.05	1.89	2.06	1.97	1.84
2	1.89	1.95	2.08	1.97	2.02
3	1.88	1.81	1.99	1.85	1.94
4	1.97	1.74	1.84	1.93	1.93
5	1.76	1.85	1.85	1.87	1.92
6	1.83	1.84	1.83	1.83	1.91
7	1.73	1.82	1.89	1.76	1.88
8	1.80	1.81	1.97	1.76	2.00
9	1.86	1.78	1.96	1.81	1.93
10	1.83	1.74	1.92	1.89	1.88

Position/Gradient

	+7.2%	+3.0%	+0.6%	-3.2%	-7.2%
11	1.92	1.76	2.09	1.88	2.02
12	1.82	1.73	2.00	1.78	1.97

Position/Weather

	fair	poor
1	1.97	1.95
2	1.96	2.00
3	1.89	1.90
4	1.86	1.91
5	1.89	1.81
6	1.78	1.91
7	1.82	1.82
8	1.86	1.88
9	1.84	1.90
10	1.82	1.88
11	1.92	1.95
12	1.78	1.94

Position/Weather/Gradient

Position 1		fair	poor
	+7.2%	2.03	2.07
	+3.0%	1.87	1.90
	+0.6%	2.06	2.06
	-3.0%	2.06	1.87
	-7.2%	1.81	1.87

Position/Weather/Gradient

Position 2		fair	poor
	+7.2%	1.83	1.95
	+3.0%	1.94	1.96
	+0.6%	2.03	2.12
	-3.0%	2.06	1.87
	-7.2%	1.94	2.10

Position 3		fair	poor
	+7.2%	1.83	1.93
	+3.0%	1.83	1.79
	+0.6%	2.03	1.95
	-3.0%	1.85	1.85
	-7.2%	1.91	1.96

Position 4		fair	poor
	+7.2%	1.87	2.07
	+3.0%	1.70	1.78
	+0.6%	1.83	1.85
	-3.0%	1.95	1.92
	-7.2%	1.95	1.92

Position/Weather/Gradient

		fair	poor
Position 8		fair	poor
	+7.2%	1.73	1.86
	+3.0%	1.88	1.75
	+0.6%	1.99	1.94
	-3.0%	1.71	1.81
	-7.2%	1.96	2.04
Position 9		fair	poor
	+7.2%	1.75	1.97
	+3.0%	1.79	1.78
	+0.6%	1.87	2.06
	-3.0%	1.88	1.74
	-7.2%	1.89	1.97
Position 10		fair	poor
	+7.2%	1.82	1.84
	+3.0%	1.70	1.79
	+0.6%	1.85	1.98
	-3.0%	1.89	1.90
	-7.2%	1.84	1.92
Position 11		fair	poor
	+7.2%	1.80	2.04
	+3.0%	1.69	1.83
	+0.6%	2.06	2.13
	-3.0%	1.91	1.86
	-7.2%	2.15	1.89

Position/Weather/Gradient

Position 5

	fair	poor
+7.2%	1.65	1.88
+3.0%	1.98	1.72
+0.6%	1.94	1.75
-3.0%	1.93	1.81
-7.2%	1.94	1.90

Position 6

	fair	poor
+7.2%	1.70	1.96
+3.0%	1.77	1.91
+0.6%	1.81	1.86
-3.0%	1.82	1.85
-7.2%	1.83	1.99

Position 7

	fair	poor
+7.2%	1.67	1.79
+3.0%	1.89	1.75
+0.6%	1.92	1.86
-3.0%	1.76	1.77
-7.2%	1.85	1.91

Position/Weather/Gradient

Position 12		fair	poor
	+7.2%	1.69	.95
	+3.0%	1.72	1.74
	+0.6%	1.86	2.14
	-3.0%	1.74	1.82
	-7.2%	1.87	2.07

Appendix G

Output from ANOVA procedure of SPSS/X software

This Appendix contains the results produced by the ANOVA procedure of SPSS/X software. Among the parameters included are the source of variation and for each source of variation the sum of squares, degrees of freedom, mean square, calculated F-test statistic and the significance of the F-test statistic.

This Appendix contains the results produced by the ANOVA procedure of SPSS/X software. Among the parameters included are the source of variation and for each source of variation the sum of squares, degrees of freedom, mean square, calculated F-test statistic and the significance of the F-test statistic.

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Main Effects	39.924	16	2.495	6.767	0.000
Gradient	20.947	4	5.237	14.202	0.000
Weather	3.010	1	3.010	8.164	0.004
Position	15.968	11	1.452	3.937	0.000
2-way Interactions	38.001	59	0.644	1.747	0.000
Gradient/Weather	8.400	4	2.100	5.695	0.000
Gradient/Position	22.676	44	0.515	1.398	0.042
Weather/Position	6.925	11	0.630	1.707	0.065
3-way Interactions	13.807	44	0.314	0.851	0.746
Gradient/Weather/Position	13.807	44	0.314	0.851	0.746
Explained	91.733	119	0.771	2.091	0.000
Residual	2610.674	7080	0.369		
Total	2702.406	7199	0.375		

Appendix H

Excerpt from database of residuals resulting from initial ANOVA procedure

This Appendix contains an excerpt of 120 residuals produced by the first ANOVA procedure that was run on the original headway database.

This Appendix contains an excerpt of 120 residuals produced by the first ANOVA procedure that was run on the original headway database.

-0.25	0.24	0.78	-0.79	-0.54	-0.52
0.67	0.09	0.31	-0.53	-0.78	2.10
-0.98	-0.09	-0.24	0.13	-0.12	-0.56
-0.25	0.41	0.59	1.10	-0.06	-0.56
-0.21	0.67	-0.21	1.14	0.13	0.17
-1.11	-0.12	-1.31	0.09	0.46	1.05
-0.37	0.03	-0.09	-0.31	-0.43	-0.57
0.67	0.25	0.32	-0.46	-0.26	0.17
-0.21	-0.01	-0.11	0.78	-0.54	0.74
-1.04	-0.56	-0.09	-0.75	1.13	-0.15
-0.67	-0.84	-0.66	0.48	0.35	-0.39
1.44	0.25	1.49	-0.35	1.39	-0.28
-0.12	-0.87	-0.91	-0.62	-0.10	-0.15
0.01	0.02	-0.31	0.03	-0.23	-0.30
-0.29	0.22	-0.20	1.00	0.08	-0.29
-0.37	1.02	-0.04	0.09	-0.57	-0.30
0.20	-0.05	1.24	0.47	-0.42	0.07
0.81	-0.14	-0.06	0.18	-0.47	-0.38
1.32	0.66	0.58	-0.05	0.13	0.27
1.22	-0.75	0.44	0.22	-0.31	-0.33

Appendix I

Cochran's Test for variance homogeneity

This Appendix contains the calculations used to perform Cochran's Test for variance homogeneity after the original ANOVA procedure. Also contained are the results of that test.

A method of testing the hypothesis of variance homogeneity is Cochran's Test. This is a computationally simple procedure, but is restricted to situations in which the sample sizes are equal. Cochran's Test is used to test the hypothesis

$$H_o : s_1^2 = s_2^2 = s_3^2 = \ldots = s_k^2$$

against the alternative

H_1 : the variances are not equal

The statistic for Cochran's Test is given by

$$G = (\text{largest } s_i^2) \,/\, (\text{sum of } s_i^2)$$

and the hypothesis of equality of variances is rejected if g is greater than g_a where g_a is obtained from statistical tables.

		variance	calc. g	tabulated g_a (0.05)
weather	fair	0.37	0.50	0.58
	poor	0.38		
gradient	+7.2%	0.33	0.24	0.25
	-7.2%	0.46		
	+0.6%	0.43		
	+3.0%	0.35		
	-3.0%	0.30		
position	1	0.42	0.10	0.11
	2	0.41		
	3	0.33		
	4	0.38		
	5	0.35		
	6	0.36		
	7	0.36		
	8	0.34		
	9	0.36		
	10	0.33		
	11	0.46		
	12	0.39		

Because the value of g is less than the value of g_a for all cases we accept the hypthesis that the variances are homogeneous.

Appendix J

Output from REGRESSION procedure of SPSS/X software

This Appendix contains the results produced by the REGRESSION procedure of SPSS/X software. There are two sets of results, one for each of the two weather conditions. Among the parameters included are the value of R-square, the standard error of the estimate, the F-test statistic, the regression constant, the slope of the regression line, the sum of squares due to error and the sum of squares due to regression.

This Appendix contains the results produced by the REGRESSION procedure of SPSS/X software. There are two sets of results, one for each of the two weather conditions. Among the parameters included are the value of R-square, the standard error of the estimate, the F-test statistic, the regression constant, the slope of the regression line, the sum of squares due to error and the sum of squares due to regression.

Regression of HEADWAY on GRADIENT under FAIR WEATHER

Multiple R	0.06149
R Square	0.00378
Adjusted R Square	0.00365
Standard Error	0.61298

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	1	11.04408	11.0.4408
Residual	7744	2909.79780	0.37575

F = 29.39220 Signif F = 0.0000

Variables in the Equation

Variable	B	SE B	Beta	T	Sig T
GRADIENT	-0.736697	0.135885	-0.061491	-5.421	0.000
(Constant)	1.866878	0.006966		267.992	0.000

Regression of HEADWAY on GRADIENT under POOR WEATHER

Multiple R	0.02583
R Square	0.00067
Adjusted R Square	0.00054
Standard Error	0.61540

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	1	1.99048	1.99048
Residual	7870	2980.54722	0.37872

F = 5.25577 Signif F = 0.0219

Variables in the Equation

Variable	B	SE B	Beta	T	Sig T
GRADIENT	-0.332267	0.144933	-0.025834	-2.293	0.0219
(Constant)	1.893831	0.006940		272.891	0.000

Appendix K

Examination of residuals for autocorrelation after first regression procedure

This Appendix contains a random sample of 120 residuals generated by the first regression procedure.

This Appendix contains a random sample of 120 residuals generated by the first regression procedure.

-0.05	-0.09	0.44	-0.32	0.78	-1.14
0.87	0.43	0.29	-0.16	0.31	1.44
-0.78	0.00	0.11	-0.69	-0.24	0.67
-0.05	-0.67	0.61	0.08	0.59	-0.06
-0.01	0.06	0.87	-0.88	-0.21	0.38
-0.91	0.36	0.08	-0.07	-1.31	0.07
-0.17	0.72	0.23	-0.82	-0.09	-0.19
0.87	1.14	0.45	0.08	0.32	-0.42
-0.01	-0.39	0.19	0.01	-0.11	-0.07
-0.84	-0.48	-0.36	0.48	-0.09	0.15
-0.47	0.33	-0.64	0.58	-0.66	-0.33
1.64	0.29	0.45	-0.75	1.49	0.26
0.08	-0.01	-0.67	-0.12	-0.91	-0.39
0.21	0.03	0.22	-0.12	-0.31	0.25
-0.09	0.17	0.42	-0.22	-0.20	-0.43
-0.17	0.77	1.22	0.82	-0.04	0.07
0.40	-0.02	0.15	-0.48	1.24	-0.34
1.01	0.48	0.06	2.09	-0.06	-0.53
1.52	0.07	0.86	0.03	0.58	0.02
1.42	-0.28	-0.55	-0.33	0.44	0.03

Appendix L

Output from ANOVA procedure of SPSS/X software on transformed database

This Appendix contains the results produced by the ANOVA procedure of SPSS/X software on the transformed database. Among the parameters included are the source of variation and for each source of variation the sum of squares, degress of freedom, mean square, calcilated F-test statistic and the significance of the F-test statistic.

This Appendix contains the results produced by the ANOVA procedure of SPSS/X software on the transformed database. Among the parameters included are the source of variation and for each source of variation the sum of squares, degress of freedom, mean square, calcilated F-test statistic and the significance of the F-test statistic.

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Main Effects	1.803	16	0.113	6.523	0.000
Gradient	0.852	4	0.213	12.327	0.000
Weather	0.165	1	0.165	9.534	0.002
Position	0.786	11	0.071	4.137	0.000
2-way Interactions	1.981	59	0.034	1.944	0.000
Gradient/Weather	0.481	4	0.120	6.956	0.000
Gradient/Position	1.114	44	0.025	1.466	0.024
Weather/Position	0.387	11	0.035	2.036	0.022
3-way Interactions	0.563	44	0.013	0.741	0.897
Gradient/Weather/ Position	0.563	44	0.013	0.741	0.897
Explained	4.347	119	0.037	2.115	0.000
Residual	122.297	7080	0.017		
Total	126.644	7199	0.018		

Appendix M

Excerpt from database of residuals resulting from ANOVA procedure on transformed database

This Appendix contains an excerpt of 100 residuals produced by the ANOVA procedure that was run on the transformed headway database.

This Appendix contains an excerpt of 100 residuals produced by the ANOVA procedure that was run on the transformed headway database.

0.03	0.00	0.05	-0.04	-0.05
0.00	0.11	-0.15	0.14	0.06
0.04	-0.09	-0.12	-0.26	-0.03
0.01	-0.20	0.04	-0.04	-0.22
0.03	-0.17	-0.15	-0.03	-0.01
-0.33	0.03	-0.10	-0.32	0.05
0.03	-0.24	-0.10	-0.07	0.12
-0.18	-0.06	0.24	0.14	0.18
-0.07	0.18	-0.11	-0.03	-0.13
-0.03	0.16	-0.23	-0.29	-0.15
0.09	-0.13	0.38	-0.15	0.04
-0.18	0.04	-0.15	0.25	0.04
-0.07	0.25	0.20	-0.01	-0.03
0.11	0.07	-0.07	0.02	-0.02
0.08	0.00	0.14	-0.05	0.01
0.04	-0.18	-0.08	-0.07	0.12
0.04	0.08	0.03	0.06	-0.03
0.01	0.15	0.05	0.16	0.07
0.1[illegible]	0.13	0.30	0.23	-0.01
-0.04	-0.09	0.08	0.22	-0.10

Appendix N

Cochran's Test for variance homogeneity after data tranformation

This Appendix contains the calculations used to perform Cochran's Test for variance homogeneity after the ANOVA procedure was performed on the transformed database. Also contained are the results of that test.

A method of testing the hypothesis of variance homogeneity is Cochran's Test. This is a computationally simple procedure, but is restricted to situations in which the sample sizes are equal. Cochran's Test is used to test the hypothesis

$$H_o : s_1^2 = s_2^2 = s_3^2 = \ldots = s_k^2$$

against the alternative

H_1 : the variances are not equal

The statistic for Cochran's Test is given by

$$G = (\text{largest } s_i^2) \;/\; (\text{sum of } s_i^2)$$

and the hypothesis of equality of variances is rejected if g is greater than g_a where g_a is obtained from statistical tables.

		variance	calc. g	tabulated g_a (0.05)
weather	fair	0.018	0.50	0.58
	poor	0.017		
gradient	+7.2%	0.017	0.24	0.25
	-7.2%	0.021		
	+0.6%	0.019		
	+3.0%	0.017		
	-3.0%	0.014		
position	1	0.018	0.10	0.11
	2	0.017		
	3	0.017		
	4	0.017		
	5	0.018		
	6	0.018		
	7	0.016		
	8	0.016		
	9	0.018		
	10	0.017		
	11	0.020		
	12	0.019		

Because the value of g is less than the value of g_a for all cases we accept the hypthesis that the variances are homogeneous.

Appendix O

Output from Regression procedure of SPSS/X software on transformed database

This Appendix contains the results produced by the REGRESSION procedure of SPSS/X software on the transformed database. There are two sets of results, one for each of the two weather conditions. Among the parameters included are the value of R-square, the standard error of the estimate, the F-test statistic, the regression constant, the slope of the regression line, the sum of squares due to error and the sum of squares due to regression.

This Appendix contains the results produced by the REGRESSION procedure of SPSS/X software. There are two sets of results, one for each of the two weather conditions. Among the parameters included are the value of R-square, the standard error of the estimate, the F-test statistic, the regression constant, the slope of the regression line, the sum of squares due to error and the sum of squares due to regression.

Regression of logarithm of HEADWAY on GRADIENT under FAIR WEATHER

Multiple R	0.06033
R Square	0.00364
Adjusted R Square	0.00351
Standard Error	0.13381

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	1	0.50636	0.50636
Residual	7743	138.63223	0.01790

F = 28.28149 Signif F = 0.0000

Variables in the Equation

Variable	B	SE B	Beta	T	Sig T
GRADIENT	-0.157748	0.029663	-0.060326	-5.318	0.000
	0.249921	0.001521		164.343	0.000

Regression of logarithm of HEADWAY on GRADIENT under POOR WEATHER

Multiple R	Ø.Ø2635
R Square	Ø.ØØØ69
Adjusted R Square	Ø.ØØØ57
Standard Error	Ø.13284

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	1	Ø.Ø965Ø	Ø.Ø965Ø
Residual	787Ø	138.88443	Ø.Ø1765

F = 5.46829 Signif F = Ø.Ø194

Variables in the Equation

Variable	B	SE B	Beta	T	Sig T
GRADIENT	-Ø.Ø7316Ø	Ø.Ø31286	-Ø.Ø2635Ø	-2.338	Ø.Ø194
(Constant)	Ø.256572	Ø.ØØ1498		171.269	Ø.ØØØ

Appendix P

Examination of residuals for autocorrelation after second regression procedure

This Appendix contains a random sample of 120 residuals generated by the second regression procedure.

This Appendix contains a random sample of 120 residuals generated by the second regression procedure.

0.04	0.01	0.06	0.01	0.00	0.11
0.01	0.12	-0.14	0.19	0.11	0.08
0.05	-0.08	-0.11	-0.21	0.02	0.05
0.02	-0.19	0.05	0.01	-0.17	0.14
0.04	-0.16	-0.15	0.02	0.03	0.19
-0.32	0.04	-0.09	-0.27	0.10	0.04
0.04	-0.23	-0.09	-0.02	0.16	0.07
-0.17	-0.05	0.25	0.19	0.23	0.11
-0.06	0.19	-0.11	0.02	-0.08	0.06
-0.02	0.17	-0.22	-0.24	-0.11	-0.07
0.09	-0.12	0.39	-0.11	0.09	-0.16
-0.17	0.05	-0.15	0.29	0.08	0.11
-0.06	0.26	0.21	0.04	0.02	-0.17
0.12	0.08	-0.06	0.07	0.03	0.07
0.09	0.01	0.15	0.00	0.06	0.11
0.05	-0.17	-0.07	-0.02	0.17	0.24
0.05	0.09	0.04	0.10	0.02	0.05
0.02	0.16	0.06	0.21	0.12	0.03
0.14	0.14	0.31	0.28	0.04	0.18
-0.03	-0.08	0.09	0.27	-0.05	-0.13

Appendix Q

SPSS/PC REGRESSION procedure outputs for fair and poor weather conditions

This Appendix contains the results produced by the REGRESSION procedure of the SPSS/PC software. Included for both weather conditions are the coefficient of determination, the analysis of variance sub-routine, and information on the variables in the prediction equation.

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	1	7.09575	7.09575
Residual	3598	1309.57911	.36397

F = 19.49520 Signif F = .0000

* * * * M U L T I P L E   R E G R E S S I O N * * * *

Equation Number 1 Dependent Variable.. HEADWAY

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
GRADIENT	-8.98897E-03	2.03585E-03	-.07341	-4.415	.0000
(Constant)	1.86527	.01006		185.451	.0000

End Block Number 1 All requested variables entered.

*** * * * M U L T I P L E   R E G R E S S I O N * * * ***

FAIR WEATHER CONDITION

Listwise Deletion of Missing Data

Equation Number 1   Dependent Variable..   HEADWAY

Beginning Block Number 1. Method: Enter

*** * * * M U L T I P L E   R E G R E S S I O N * * * ***

Equation Number 1   Dependent Variable..   HEADWAY

Variable(s) Entered on Step Number

1..   GRADIENT   APPROACH GRADIENT IN PERCENT

Multiple R	.07341
R Square	.00539
Adjusted R Square	.00511
Standard Error	.60330

* * * * M U L T I P L E   R E G R E S S I O N * * * *

POOR WEATHER CONDITION

Listwise Deletion of Missing Data

Equation Number 1   Dependent Variable..   HEADWAY

Beginning Block Number 1. Method: Enter

* * * * M U L T I P L E   R E G R E S S I O N * * * *

Equation Number 1   Dependent Variable..   HEADWAY

Variable(s) Entered on Step Number
   1..   GRADIENT APPROACH GRADIENT IN PERCENT

Multiple R	.01260
R Square	.00016
Adjusted R Square	-.00012
Standard Error	.61987

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	1	.21942	.21942
Residual	3598	1382.50195	.38424

F = .57105 Signif F = .4499

*** * * * M U L T I P L E R E G R E S S I O N * * * ***

Equation Number 1 Dependent Variable.. HEADWAY

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
GRADIENT	-1.58070E-03	2.09177E-03	-.01260	-.756	.4499
(Constant)	1.90528	.01033		184.365	.0000

End Block Number 1 All requested variables entered.

This procedure was completed at 22:16:05

Appendix R

SPSS-X REGRESSION procedure outputs for fair and poor weather conditions

This Appendix contains the results produced by the REGRESSION procedure of the SPSS-X software. Included for both weather conditions are the coefficient of determination, the analysis of variance sub-routine, and information on the variables in the prediction equation.

FAIR WEATHER CONDITION

Regression of HEADWAY on GRADIENT

Multiple R	0.06149
R Square	0.00378
Adjusted R Square	0.00365
Standard Error	0.61298

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	1	11.04408	11.0.4408
Residual	7744	2909.79780	0.37575

F = 29.39220 Signif F = 0.0000

Variables in the Equation

Variable	B	SE B	Beta	T	Sig T
GRADIENT	-0.736697	0.135885	-0.061491	-5.421	0.000
(Constant)	1.866878	0.006966		267.992	0.000

POOR WEATHER CONDITION

Regression of HEADWAY on GRADIENT

Multiple R	0.02583
R Square	0.00067
Adjusted R Square	0.[illegible]054
Standard Error	0.61540

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	1	1.99048	1.99048
Residual	7870	2980.54722	0.37872

F = 5.25577 Signif F = 0.0219

Variables in the Equation

Variable	B	SE B	Beta	T	Sig T
GRADIENT	-0.332267	0.144933	-0.025834	-2.293	0.0219
(Constant)	1.893831	0.006940		272.891	0.000

Appendix S

Excerpt from database of residuals resulting from ANOVA procedure on elapsed time database

This Appendix contains an excerpt of 100 residuals produced by the ANOVA procedure that was run on the elapsed time database.

This Appendix contains an excerpt of 100 residuals produced by the ANOVA procedure that was run on the elapsed time database.

-0.29	-0.64	0.88	-0.92	1.26
0.58	-0.02	0.83	-1.39	1.22
1.65	0.86	1.06	-0.03	-0.28
-0.48	-0.67	-2.04	-0.58	-1.83
-0.17	0.59	-1.59	-2.18	1.07
1.42	-0.91	-2.42	1.11	-1.58
-0.57	-1.36	-0.24	0.07	0.11
-1.00	0.52	-1.42	0.25	0.93
-0.03	0.26	-0.56	0.39	0.58
-0.31	0.32	-2.35	-0.35	0.76
1.27	-0.18	0.74	1.41	-0.99
-1.07	-0.71	1.28	0.67	-0.21
0.69	1.05	0.02	-0.37	0.00
-0.52	-1.24	0.58	0.16	0.39
1.28	1.48	0.12	-0.19	-0.93
-1.09	-0.84	0.51	0.72	1.10
0.06	0.80	-2.11	0.14	0.57
0.44	0.91	0.43	-2.82	-3.64
1.61	2.45	-0.75	0.92	-1.32
-0.78	0.68	0.80	-0.58	2.29

Appendix T

Cochran's Test of elapsed time data for variance homogeneity

This Appendix contains the calculations used to perform Cochran's Test for variance homogeneity after the ANOVA procedure was performed on the elapsed time database. Also contained are the results of that test.

A method of testing the hypothesis of variance homogeneity is Cochran's Test. This is a computationally simple procedure, but is restricted to situations in which the sample sizes are equal. Cochran's Test is used to test the hypothesis

$$H_o : s_1^2 = s_2^2 = s_3^2 = \ldots = s_k^2$$

against the alternative

H_1 : the variances are not equal

The statistic for Cochran's Test is given by

$$G = (\text{largest } s_i^2) \; / \; (\text{sum of } s_i^2)$$

and the hypothesis of equality of variances is rejected if g is greater than g_a where g_a is obtained from statistical tables.

		variance	calc. g	tabulated g_a (0.05)
weather	**fair**	42.966	0.51	0.58
	poor	44.675		
gradient	**+7.2%**	42.094	0.21	0.25
	-7.2%	46.931		
	+0.6%	46.934		
	+3.0%	40.856		
	-3.0%	42.034		
position	**1**	0.408	0.16	0.11
	2	0.774		
	3	1.080		
	4	1.315		
	5	1.630		
	6	1.954		
	7	2.287		
	8	2.717		
	9	3.151		
	10	3.407		
	11	3.935		

12	4.349

Because the value of g is greater than the value of g_a for the variable of queue position, we reject the hypothesis that the variances are homogeneous, and accept the hypothesis that the variances are not equal.

Appendix U

Output from ANOVA procedure of SPSS/PC software on transformed elapsed time database

This Appendix contains the results produced by the ANOVA procedure of SPSS/PC software on the transformed elapsed time database. Among the parameters included are the source of variation and for each source of variation the sum of squares, degress of freedom, mean square, calcilated F-test statistic and the significance of the F-test statistic.

This Appendix contains the results produced by the ANOVA procedure of SPSS/PC software on the transformed elapsed time database. Among the parameters included are the source of variation and for each source of variation the sum of squares, degress of freedom, mean square, calcilated F-test statistic and the significance of the F-test statistic.

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig of F
Main Effects	7434.473	16	464.655	11020.983	0.000
GRADIENT	9.137	4	2.284	54.182	0.000
POSITION	7424.668	11	674.970	16009.378	0.000
WEATHER	0.668	1	0.668	15.843	0.000
2-way Interactions	11.331	59	0.192	4.555	0.000
GRADIENT/POSITION	3.275	44	0.074	1.765	0.001
GRADIENT/WEATHER	7.615	4	1.904	45.154	0.000
POSITION/WEATHER	0.441	11	0.040	0.950	0.490
3-way Interactions	1.199	44	0.027	0.647	0.966
GRADIENT/POSITION/ WEATHER	1.199	44	0.027	0.647	0.966
Explained	7447.003	119	62.580	1484.310	0.000
Residual	298.499	7080	0.042		
Total	7745.503	7199	1.076		

Appendix V

Excerpt from database of residuals resulting from ANOVA procedure on transformed elapsed time database

This Appendix contains an excerpt of 100 residuals produced by the ANOVA procedure that was run on the transformed elapsed time database.

This Appendix contains an excerpt of 100 residuals produced by the ANOVA procedure that was run on the transformed elapsed time database.

-0.15	-0.01	-0.16	0.10	0.32
-0.12	0.24	0.02	0.07	0.13
-0.39	0.21	-0.14	0.23	0.21
0.15	0.24	0.56	0.02	0.21
-0.42	-0.09	0.01	-0.11	-0.27
-0.17	-0.11	-0.05	-0.14	0.06
0.24	0.13	-0.26	0.03	0.11
-0.22	-0.06	-0.38	-0.27	0.06
-0.24	-0.01	0.30	0.01	-0.12
0.01	-0.34	-0.13	-0.15	0.05
0.12	-0.39	0.27	-0.03	0.09
0.02	-0.04	-0.21	0.11	-0.39
0.04	0.06	0.04	-0.04	0.22
0.26	0.05	0.13	-0.09	0.13
0.06	0.18	0.12	0.24	-0.01
-0.25	0.01	0.06	-0.02	0.18
-0.02	-0.04	0.07	-0.19	0.11
0.19	0.19	-0.05	0.15	-0.11
0.07	-0.05	0.05	-0.13	-0.15
-0.23	0.07	-0.04	-0.04	-0.21

Appendix W

Cochran's Test of transformed elapsed time data for variance homogeneity

This Appendix contains the calculations used to perform Cochran's Test for variance homogeneity after the ANOVA procedure was performed on the transformed elapsed time database. Also contained are the results of that test.

A method of testing the hypothesis of variance homogeneity is Cochran's Test. This is a computationally simple procedure, but is restricted to situations in which the sample sizes are equal. Cochran's Test is used to test the hypothesis

$$H_o : s_1^2 = s_2^2 = s_3^2 = \ldots = s_k^2$$

against the alternative

H_1 : the variances are not equal

The statistic for Cochran's Test is given by

$$G = (\text{largest } s_i^2) \;/\; (\text{sum of } s_i^2)$$

and the hypothesis of equality of variances is rejected if g is greater than g_a where g_a is obtained from statistical tables.

		variance	calc. g	tabulated g_a (0.05)
weather	fair	1.062	0.51	0.58
	poor	1.090		
gradient	+7.2%	1.037	0.21	0.25
	-7.2%	1.145		
	+0.6%	1.108		
	+3.0%	1.038		
	-3.0%	1.048		
position	1	0.047	0.09	0.11
	2	0.047		
	3	0.045		
	4	0.041		
	5	0.042		
	6	0.042		
	7	0.042		
	8	0.044		
	9	0.046		
	10	0.045		
	11	0.047		

12 0.048

Because the value of g is less than the value of g_a for all cases we accept the hypothesis that the variances are homogeneous.

Appendix X

SPSS/PC REGRESSION procedure output for regression of the square root of elapsed time on queue position

This Appendix contains the results produced by the REGRESSION procedure of the SPSS/PC software. Included are the coefficient of determination, the analysis of variance subroutine, and information on the variables in the prediction equation.

*** * * * M U L T I P L E   R E G R E S S I O N * * * ***

Multiple R	.96690
R Square	.93490
Adjusted R Square	.93489
Standard Error	.26468

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	1	7241.24240	7241.24240
Residual	7198	504.26011	.07006

F = 103364.23847   Signif F = .0000

------------------ Variables in the Equation ------------

Variable	B	SE B	95% Con. Int. B		Beta
POSITION	0.29051	9.03E-04	0.28874	0.29228	0.96690
(Const)	1.466	0.0066	1.453	1.479	

----------- in ------------

Variable	T	Sig T
POSITION	321.503	.0000
(Constant)	220.451	.0000

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