1. PURPOSE

The purpose of this note is to summarise the trip distribution methodology adopted for the study as reported in technical note 11 of the Three Step Model, and to report on the calibration and validation of the distribution functions for the Four Step Model.

2. INTRODUCTION

2.1 Trip Distribution Model Form

The gravity model form chosen for this model was

$$T_{ij} = P_i.K_i\ A_j.L_i\ f(c_{ij})$$

subject to the double constraints of

$$i = \frac{P_i}{\Sigma_j\ T_{ij}}$$

$$L_j = \frac{A_j}{\Sigma_j\ T_{ij}}$$

Where:

T_{ij}	=	Trips between zones i and j
P_i	=	Productions at zone I
A_j	=	Attractions at zone j
$f(c_{ij})$	=	Some function of the impedance between zones i and j
$K_i\ L_j$	=	Balancing factors

The balancing factors are successively applied until there is convergence. The notation has been ignored in the rest of this note as it can be shown that ΣK_i and ΣL_j equals 1 over the balancing iterations.

2.2 The Distribution Function

The distribution function can be approximated to an exponential line of the form:

$$f(c_{ij}) = e^{-\alpha C_{ij}}$$

Where:

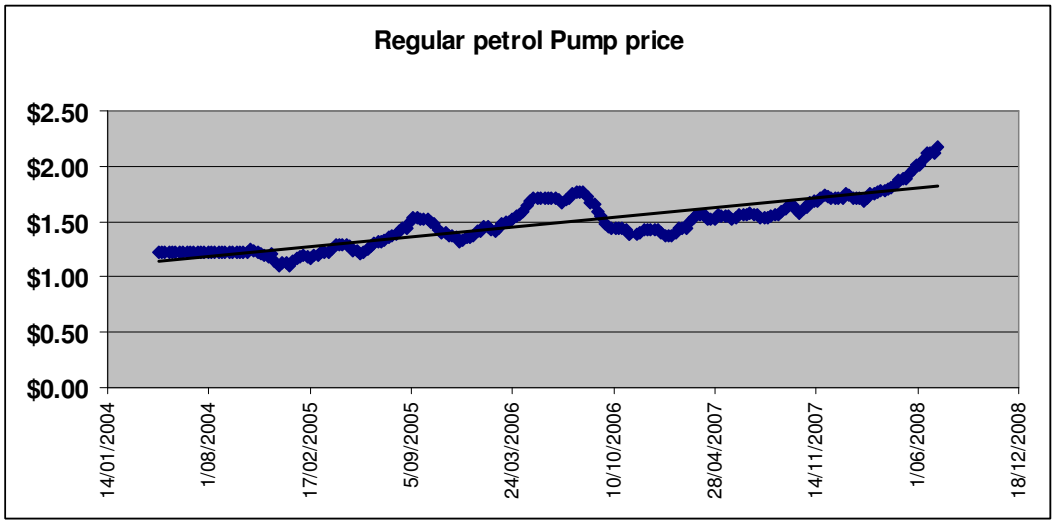
$f(c_{ij})$	=	function of cost of travel between zone i and zone j
C_{ij}	=	generalised cost of travel between zones i and j and is usually of the form $\beta t_{ij} + \gamma d_{ij}$ + tolls + parking charges
t_{ij}	=	time to travel between zone i and zone j (minutes)
d_{ij}	=	distance between zone i and zone j (kilometres)
β	=	generalised cost of travel per minute
γ	=	generalised cost of travel per kilometre
α	=	distribution model exponent to be calibrated

3. CALIBRATING THE GENERALISED COST COEFFICIENTS

The first step in the calibration is to evaluate the generalised cost coefficients, β and γ, for each purpose and time period. The time cost coefficient has been established using the values published in Table A4.1 of the New Zealand Transport Agency's (NZTA) Economic Evaluation Manual (EEM).

Only part of the running costs for cars is considered to be a perceived cost. It is assumed that most car drivers, when deciding to make a trip by car, consider as their vehicle operating costs only the cost of fuel. This is consistent with the guidelines for private vehicle operating costs in "Travel Behaviour Change Evaluation Procedures" prepared for Transfund NZ (now part of NZTA) in December 2004 by Maunsells Australia Pty Ltd.

Data from the Ministry of Economic Development of fuel prices over the past four years is shown on the diagram below. The trend line shows a price of around $1.70 for mid 2008 – the time when the HIS survey was carried out.



Accordingly, the distance cost for cars has been calculated as 17 cents per kilometre, which corresponds to 10 kilometres per litre at $1.70 per litre.

The resulting time and distance costs are detailed in **Table 1**.

Perceived Costs of Travel by Vehicle Class							Table 1
Vehicle Class	Work Travel Purpose		Commuting to/from work		Other Non-Work Travel Purposes		Distance Cost
	$/Hour	Cents/min	$/Hour	Cents/min	$/Hour	Cents/min	Cents/km
Car	23.85	39.75	7.80	13.00	6.90	11.50	17.00

The non work time values need to be factored by 1.15 to convert to perceived costs (Table A11.1 of EEM), and then by 1.19 to bring into mid 2008 values from 2002 (Table A12.2 of EEM).

The next stage was to determine the percentage of trips which fall into the broader work travel, commuting and non-work travel purposes by time of day for each modelled trip purpose, the average occupancy per vehicle, and then for assignment, the weighting of each purpose to form an overall generalised cost. It should be noted that Heavy Goods Vehicles have been dealt with separately as that model has been imported from the recent Christchurch Transport Model project.

A literature search to determine source the percentage breakdowns proved fruitless and in the absence of any such guidelines, the proportions in **Table 2** of trips classified as work, non work, and commuting have been assumed for this analysis. These proportions have been used in numerous New Zealand applications since the early 1980s including public transport models in North Shore, Hamilton, Christchurch, Timaru and Dunedin.

Proportion of Work and non work Trips				Table 2
	Period	***Work***	***Non Work***	***Commuting***
Home Based Work	All	0.0	0.0	1.0
Home Based Ed	All	0.0	1.0	0.0
Home Based Business	All	0.8	0.2	0.0
Home Based Shop	All	0.0	1.0	0.0
Home Based soc/rec	All	0.0	1.0	0.0
Home Based Other	All	0.2	0.8	0.0
Non Home Based	All	0.5	0.5	0.0

Table 3 includes the car occupancy values as calibrated from the Home Interview Survey. There is one anomaly in that Home Based Education is a trip to an education facility for the purpose of study. The car driver trip for the purpose of dropping a person off at school is classed as a Home Based Other trip.

For the purpose of calculating occupancies, the Home Based Work occupancy has been assumed for Home Based Education car drivers, and the Home Based Education passengers have been included in the home based other purpose.

Car Occupants by Time Period			Table 3
	Morning Peak	***Inter Peak***	***Evening Peak***
Home Based Work	1.08	1.05	1.09
Home Based Ed	1.08	1.05	1.09
Home Based Business	1.13	1.24	1.26
Home Based Shop	1.08	1.11	1.22
Home Based soc/rec	1.60	1.31	1.76
Home Based Other	2.33	2.92	1.90
Non Home Based	1.41	1.31	1.39
Total	**1.49**	**1.31**	**1.35**

Table 4 has the proportion of trips by purpose for the private purposes for each time period.

Purpose proportions by Time Period			Table 4
	Morning Peak	***Inter Peak***	***Evening Peak***
Home Based Work	24.48	11.38	27.19
Home Based Ed	21.25	2.66	3.66
Home Based Business	2.26	5.79	3.31
Home Based Shop	2.82	13.93	12.18
Home Based soc/rec	4.36	9.04	16.04
Home Based Other	23.49	9.76	12.74
Non Home Based	21.34	47.44	24.88
Total	**100.00**	**100.00**	**100.00**

Table 5 contains the resulting generalised costs coefficients for time and distance. The time costs are evaluated by multiplying the cost in **Table 1** out by the proportions in **Table 2**, adjusting for perceived costs (1.15 factor for non work-related), scaling up to July 2008 dollars (1.19 factor for all) and then multiplying each by the occupancy rates in **Table 3**. Subsequently it represents the aggregated perceived time cost for all vehicle occupants.

Generalised Costs by Time Period						Table 5
	Morning Peak		***Inter Peak***		***Evening Peak***	
	Time(c)	***Dist(c)***	***Time(c)***	***Dist(c)***	***Time(c)***	***Dist(c)***
Home Based Work	19.18	17.00	18.73	17.00	19.45	17.00
Home Based Ed	19.18	17.00	18.73	17.00	19.45	17.00
Home Based Business	46.37	17.00	57.71	17.00	51.76	17.00
Home Based Shop	16.96	17.00	17.53	17.00	19.16	17.00
Home Based soc/rec	25.22	17.00	20.64	17.00	27.75	17.00
Home Based Other	51.36	17.00	68.61	17.00	38.94	17.00
Non Home Based	44.53	17.00	45.82	17.00	43.86	17.00
Total	**32.96**	**17.00**	**38.71**	**17.00**	**30.37**	**17.00**

4. CALIBRATING THE DISTRIBUTION FUNCTIONS

The surveyed trip matrices were derived from the Household Interview Survey data for each purpose and time period. The purpose used were:

- Home to work
- Home to education
- Home to business
- Home to shop
- Home to soc/rec
- Home to other
- Non home based
- Work to home
- Education to home
- Business to home
- Shopping to home
- Soc/rec to home
- Other to home

The TRACKS program DISCAL has been used to calculate the distribution function coefficients. DISCAL uses as inputs a time and distance matrix with corresponding generalised cost coefficients (as derived above) and a trip matrix. To start the process the time and distance matrices were derived from the all day assignment of the surveyed trips matrix used to determine expansion factors (see Technical note 4).

The calibration process involves inverting the gravity model so that it is expressed in terms of the distribution function

$$f(C_{ij}) \quad = \quad T_{ij} \ / P_i A_j$$

The function value is calculated for each origin/destination pair, and allocated to a cost band k. The final value of the function in each cost band is the weighted average of the individual cells in that band.

The natural log of this average is then calculated and plotted against cost to calibrate the alpha value for use in the negative exponential function form.

It should be noted that the cost function can also be a function of travel time between zones rather than cost, and is the form that was adopted for the vehicle driver (three step) models and reported in Technical Note 11. The person models (four step) have used generalised cost because of the need to bring in the public transport travel cost components.

The **first** stage in the process was to calibrate the alpha exponent using the surveyed matrices and the period time and distance matrices derived from assignment of the surveyed matrices. The results from this analysis for each purpose and time period are shown in the Figures below, including the number of trips in each of the matrices and the regression r^2 values.

The results of the calibration for the person model (cost based) are included in **Figures 1a-3c** respectively. Where a purpose is not included, the number of observations for that purpose and time period is insufficient for calibration purposes. Note that although a 4-step evening peak model has not been developed, the calibrated alpha exponents have been presented here in Figure 3 for completeness sake.

Please see Table One of Technical Note 10 for a breakdown of the total number of expanded HIS trips for each purpose. This and the relevant discussion in the corresponding section of Technical Note 10 provides some perspective regarding the level of sampling for each.

The goal is to produce R-squared values of greater than 0.8 where possible, which implies that the calibrated function coefficient explains at least 80% of the surveyed data. In some cases this

has not been possible due to the low number of sampled and expanded households at a trip purpose by period level.

Note that the total expanded trips are included on each plot, with the number of sampled trips being approximately 1% of these values based on an average expansion factor of approx 100.

In general terms the standard deviations are higher in the 4-step model as there is more variability in the trip lengths when all modes are included in the analysis. Subsequently it may be more difficult to get as close a fit in terms of an R-squared statistic. For this reason the 4-step model R-squared values are generally lower than the 3-step model equivalents.

The second stage is to apply the gravity model using modelled trip ends, and confirm that the modelled and observed trip length frequencies still match. There is an iterative process between assignment and distribution that will eventually converge. Throughout this process the alpha values published in Figure 1 though Figure 3 are successively 'tuned' such that the modelled trip lengths match the HIS trip lengths as closely as possible. As such the alpha values in Figure 1 through Figure 3 are treated as a 'starting point' and the final validated alpha values, which are the outcome of this process are reported in **Table 6**.

Figure 4a through **Figure 9e** show the results of using the calibrated functions in the four-step morning peak and interpeak models. These figures show the trip length frequency plots for time and distance for each statistically significant trip purpose. For each purpose, both the modelled and HIS frequency plots have been provided along with statistical measures for both.

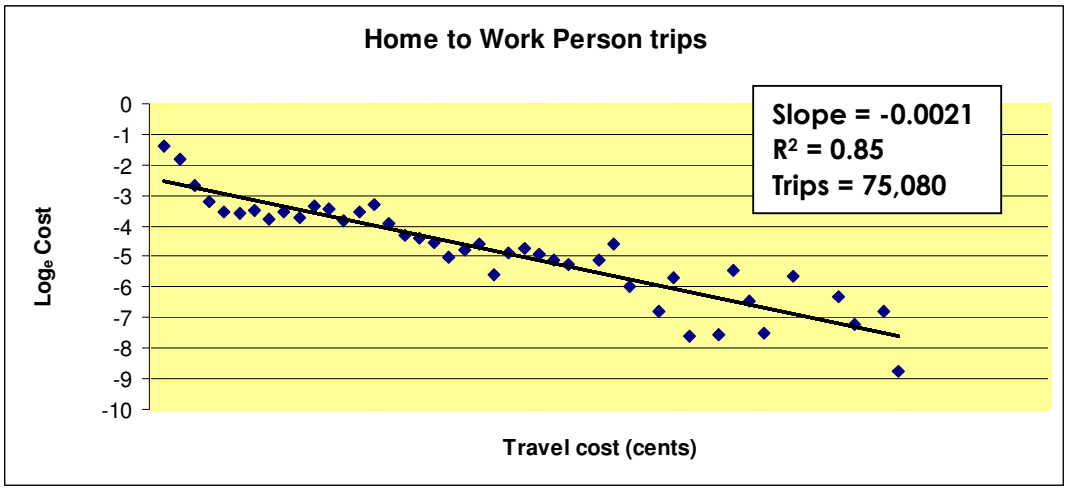
Again, in instances where the number of observations for a purpose was too small, plots have not been provided. A full table of HIS and modelled averages and standard deviations has been included here to summarise the results published in **Figure 4a** through **Figure 9e** as **Table 6** and summarised **in Table 7**.

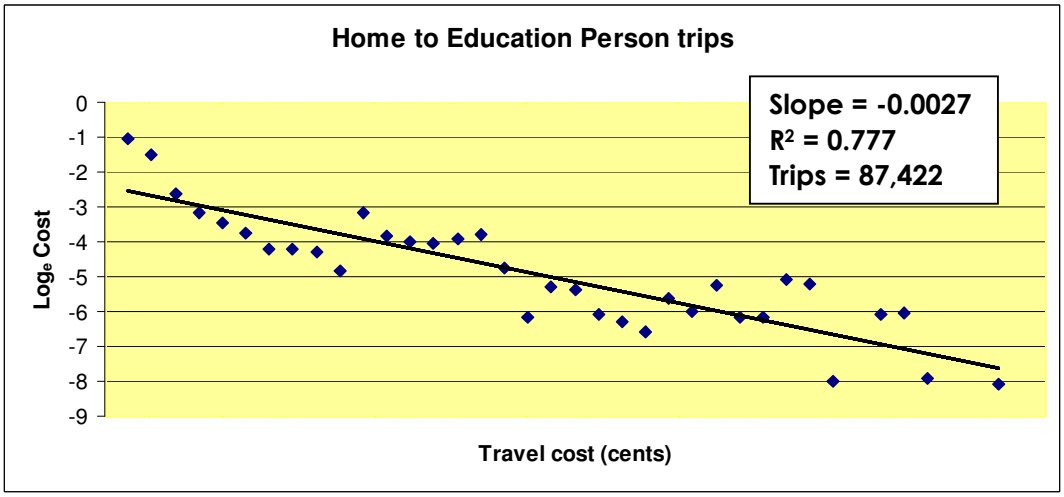
Note that trip chaining has not been taken into account in this analysis. The analysis focuses on trip legs only. This is consistent with all interpretation and analysis of the WRTM Household Interview Survey data.

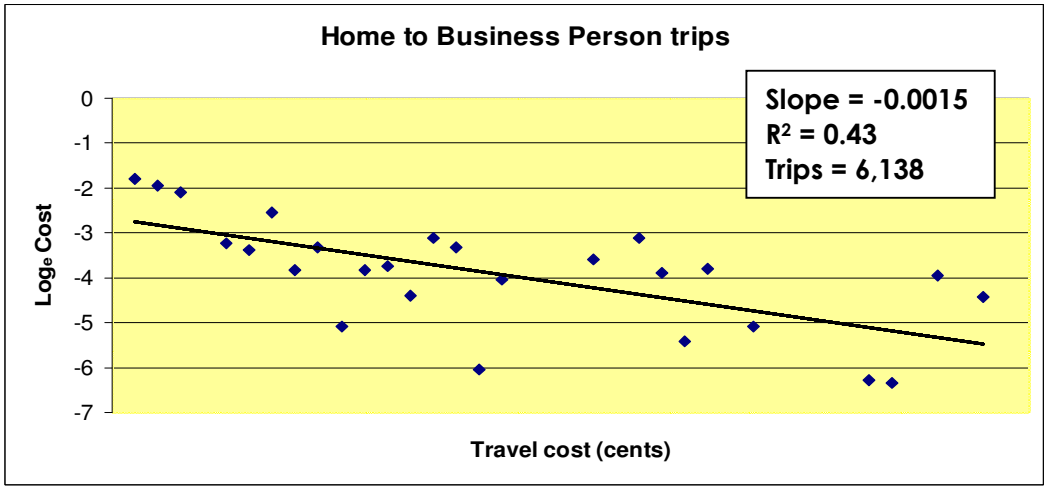
Validated Distribution Model Coefficients		Table 6
	Morning Peak	***Inter Peak***
Home To Work	.0031	.0032
Home To Ed	.0097	.0190
Home To Business	.0161	.0012
Home To Shop	.0255	.0120
Home To soc/rec	.0045	.0026
Home To Other	.0034	.0023
Non Home Based	.0019	.0018
Work To Home	.0110	.0034
Ed To Home	.0036	.0230
Business To Home	.0034	.0090
Shop To Home	.0350	.0087
Soc/rec To Home	.0099	.0035
Other To Home	.0045	.0023

Comparison of HIS and Modelled Trip Length											Table 7
Period	Purpose	Figure	Trip Time				Figure	Trip Distance			
			HIS		Model			HIS		Model	
			Mean	SD	Mean	SD		Mean	SD	Mean	SD
Morning Peak	Home to Work	4A	12.43	13.31	12.56	11.17	5A	11.58	16.10	11.24	13.43
	Home to Education	4A	6.86	8.34	7.26	7.71	5A	5.95	9.48	5.89	8.38
	Home to Business	4A	10.98	8.79	10.90	12.77	5A	10.14	10.50	10.09	15.67
	Home to Shop	4B	8.13	9.15	8.32	10.28	5B	7.39	11.71	7.35	12.40
	Home to Social/Rec	4B	7.31	12.68	7.80	7.46	5B	6.52	16.23	6.29	8.13
	Home to Other	4B	7.80	8.57	7.95	8.05	5B	6.82	9.92	6.63	9.21
	Non Home Based	4C	9.52	13.42	9.79	9.42	5C	8.95	17.01	8.40	10.99
	Other to Home	4C	6.58	7.20	6.53	6.96	5C	5.61	8.33	5.39	7.96
	Work to Home	4C	6.29	9.40	6.60	6.88	5C	5.54	11.10	5.36	8.07
	Education to Home	4D	10.97	4.37	11.11	10.35	5D	10.30	5.80	10.07	12.41
	Business to Home	4D	13.69	26.13	14.11	15.65	5D	14.18	32.56	14.10	19.95
	Shop to Home	4D	5.54	7.03	6.84	9.06	5D	4.02	6.74	6.12	11.07
	Soc/Rec to Home	4E	4.19	6.37	4.40	4.57	5E	3.35	6.67	3.16	4.65
Interpeak	Home to Work	6A	10.90	14.19	11.56	10.33	7A	10.59	18.59	10.48	12.38
	Home to Education	6A	6.69	8.25	6.73	7.85	7A	5.37	8.22	5.81	9.00
	Home to Business	6A	17.85	27.10	18.24	18.84	7A	18.56	32.73	18.53	23.72
	Home to Shop	6B	9.83	10.94	9.75	11.63	7B	8.93	13.25	9.10	14.48
	Home to Social/Rec	6B	11.98	15.75	12.61	11.72	7B	11.59	17.84	11.82	14.27
	Home to Other	6B	9.75	8.84	8.51	8.41	7B	9.19	10.32	7.37	9.88
	Non Home Based	6C	9.14	14.78	9.80	9.61	7C	8.53	18.08	8.50	11.27
	Other to Home	6C	9.83	8.18	8.48	8.35	7C	9.17	9.54	7.28	9.72
	Work to Home	6C	10.57	13.00	11.16	9.98	7C	9.78	16.79	9.94	11.82
	Education to Home	6D	7.08	7.04	6.43	7.38	7D	5.22	6.53	5.49	8.49
	Business to Home	6D	12.33	10.31	10.80	13.48	7D	11.39	11.41	10.38	16.72
	Shop to Home	6D	10.51	13.25	10.45	12.08	7D	9.73	15.48	9.70	15.07
	Soc/Rec to Home	6E	9.37	11.81	9.99	9.19	7E	8.63	14.82	8.74	10.66

It is interesting to note that there are differences between trip lengths for 'home to' and 'to home' trip purposes. In all cases any such variability is not significant due to the high standard deviations relative to the means. This implies that there is a wide spread of trip lengths for each purpose and period, and therefore any minor differences between the 'home to' and 'to home' are negligible.







Waikato Regional Model	**Distribution Functions** **Morning Peak Person Trips**	**Figure 1a**
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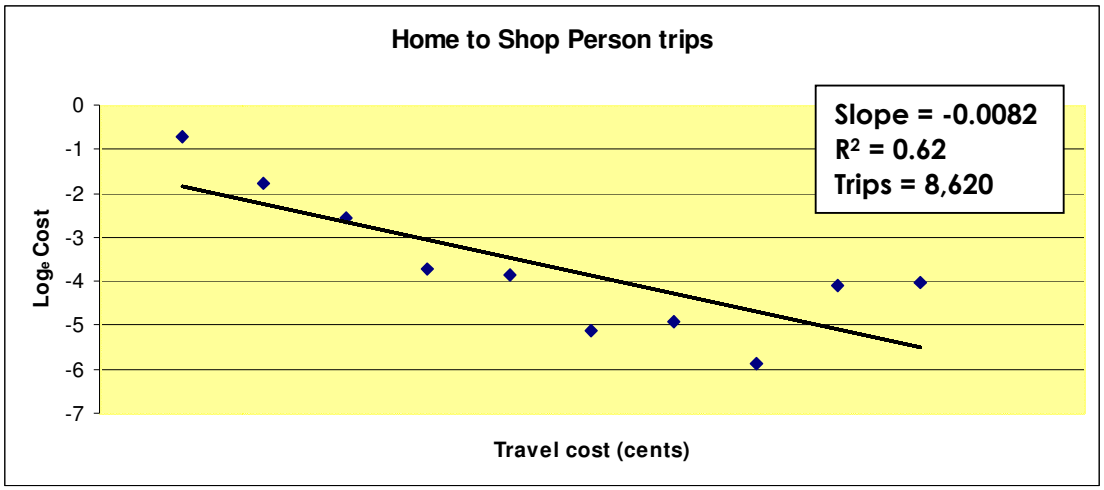

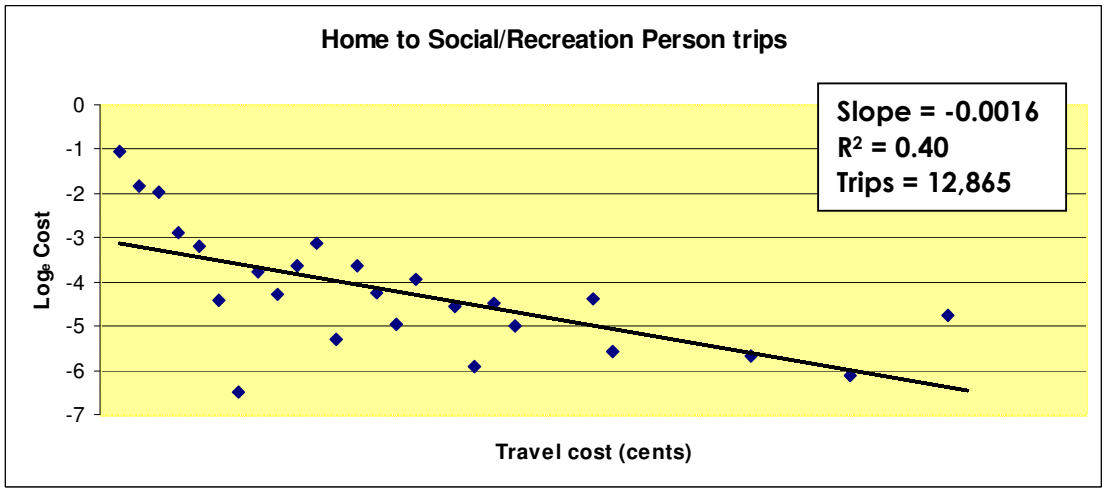

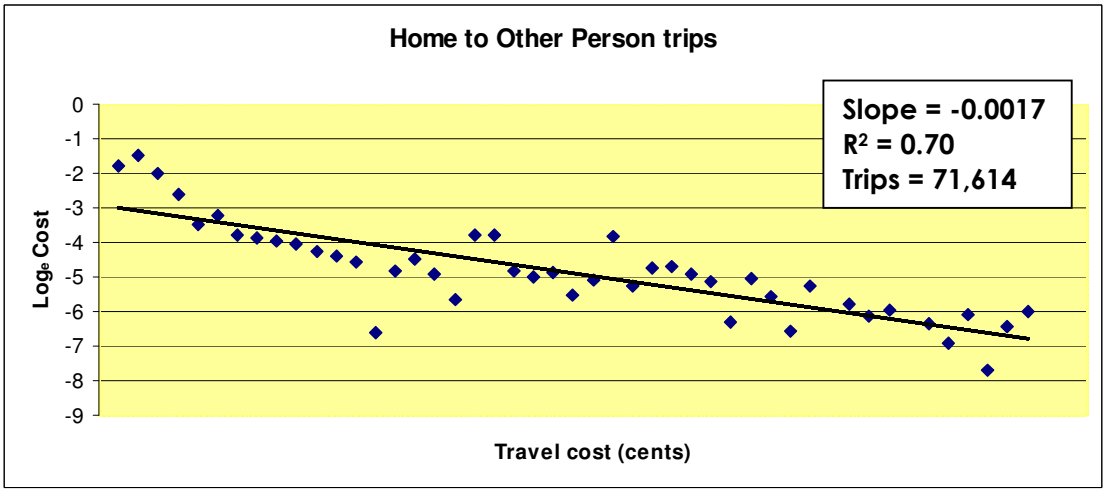

Waikato Regional Model	**Distribution Functions** **Morning Peak Person Trips**	**Figure 1b**
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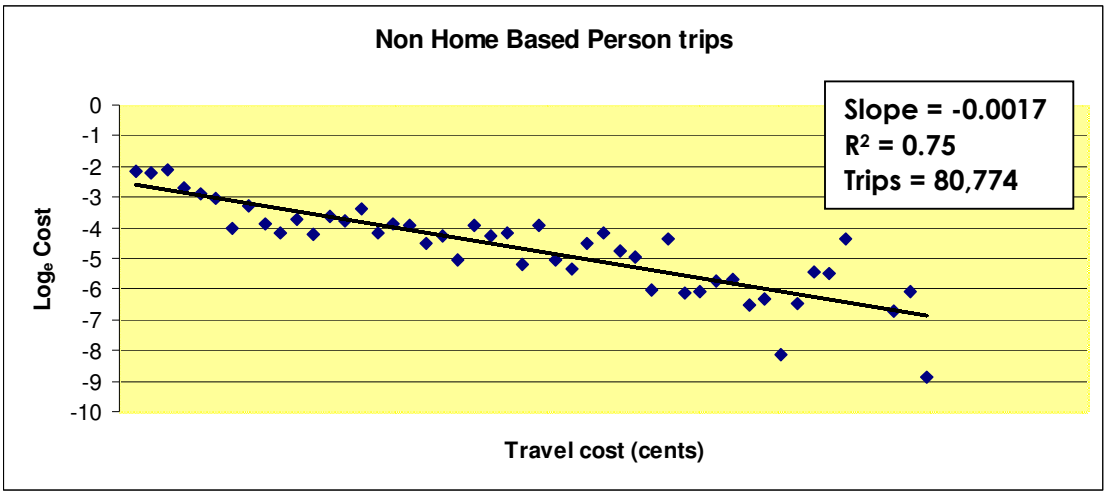

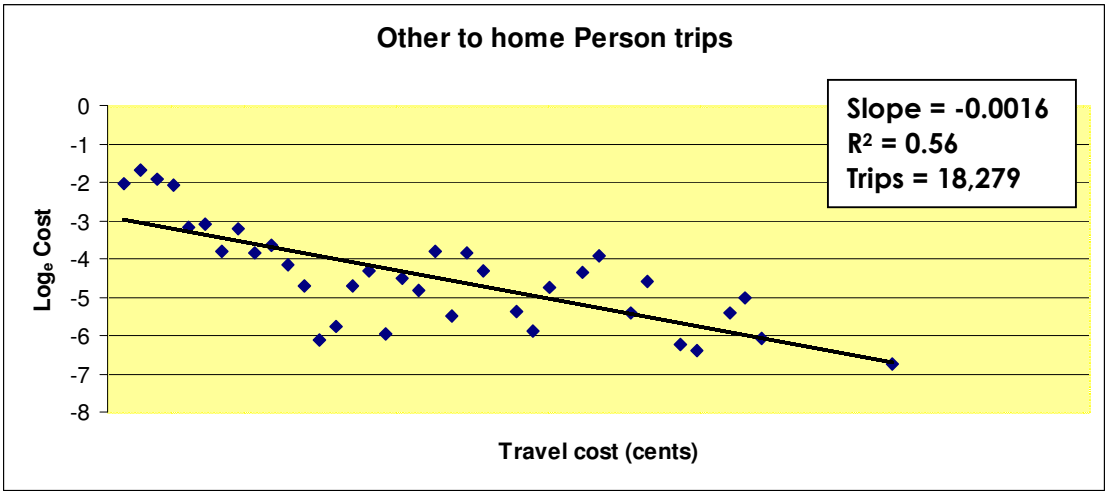

Waikato Regional Model	**Distribution Functions** **Morning Peak Person trips**	**Figure 1c**
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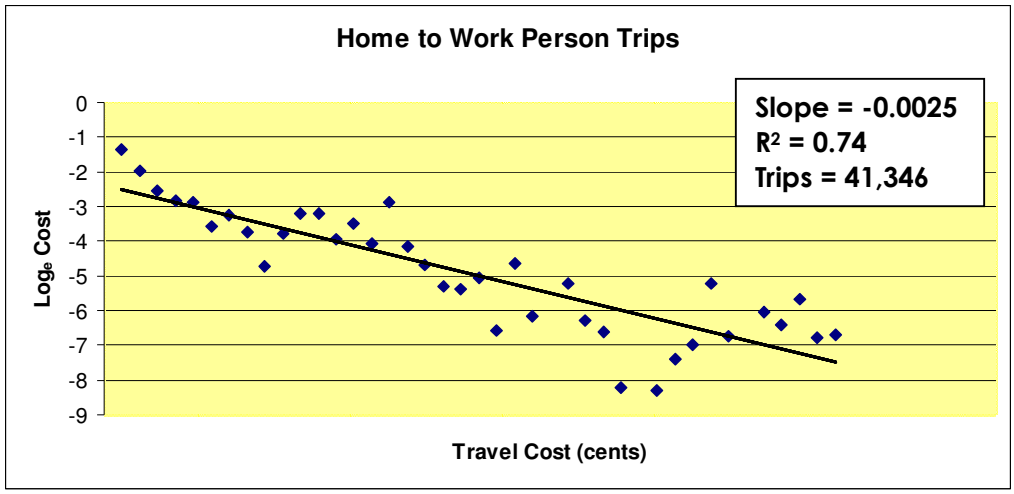

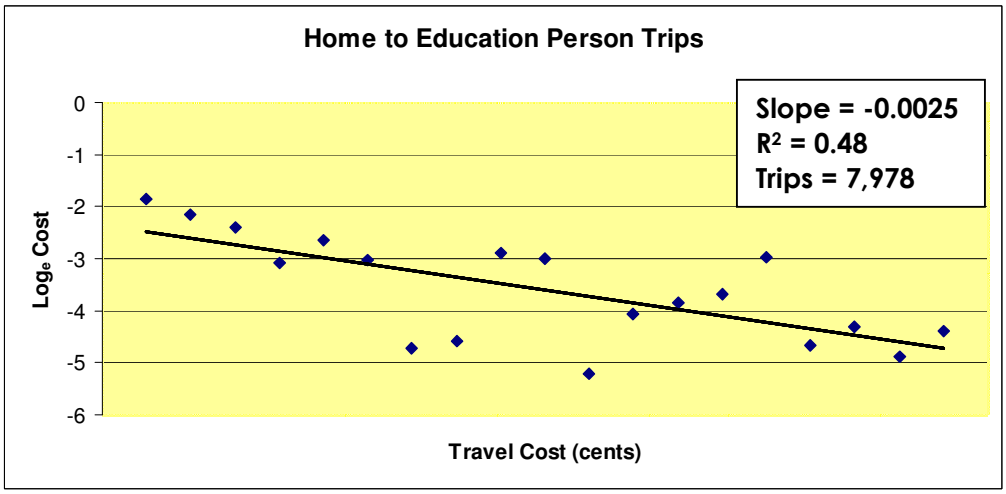

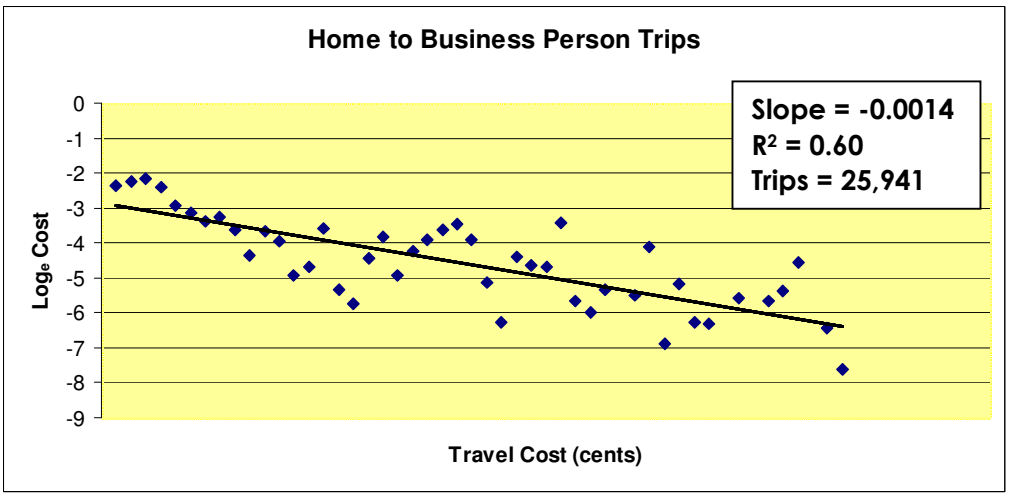

Waikato Regional Model	**Distribution Functions** **Inter Peak Person Trips**	**Figure 2a**
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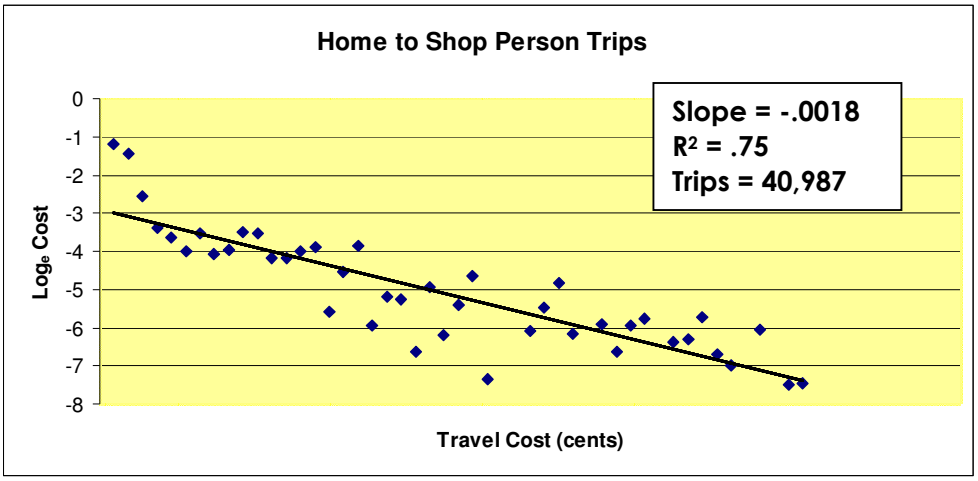

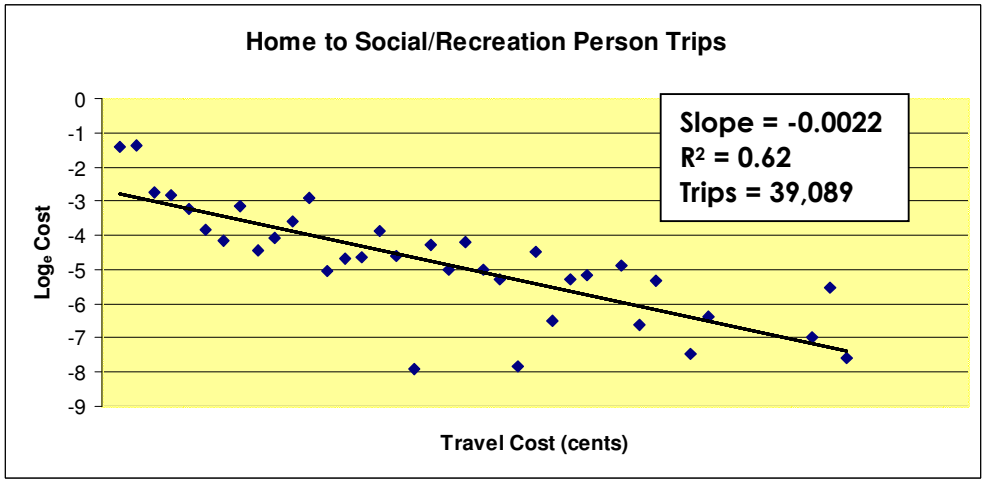

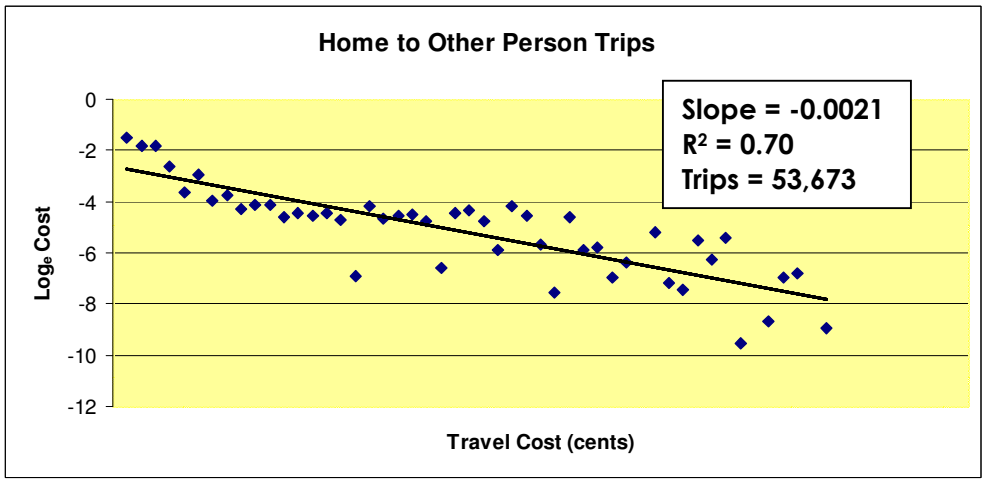

Waikato Regional Model	**Distribution Functions** **Inter Peak person Trips**	**Figure 2b**
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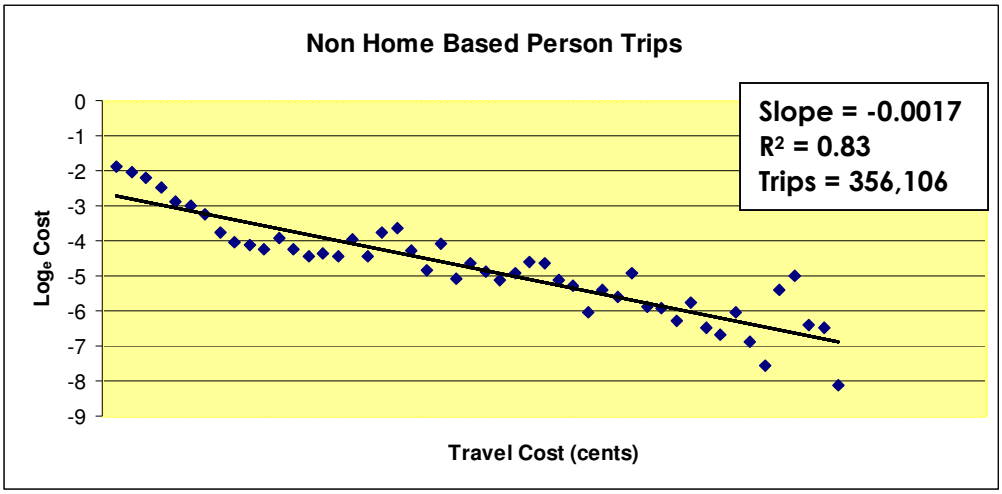

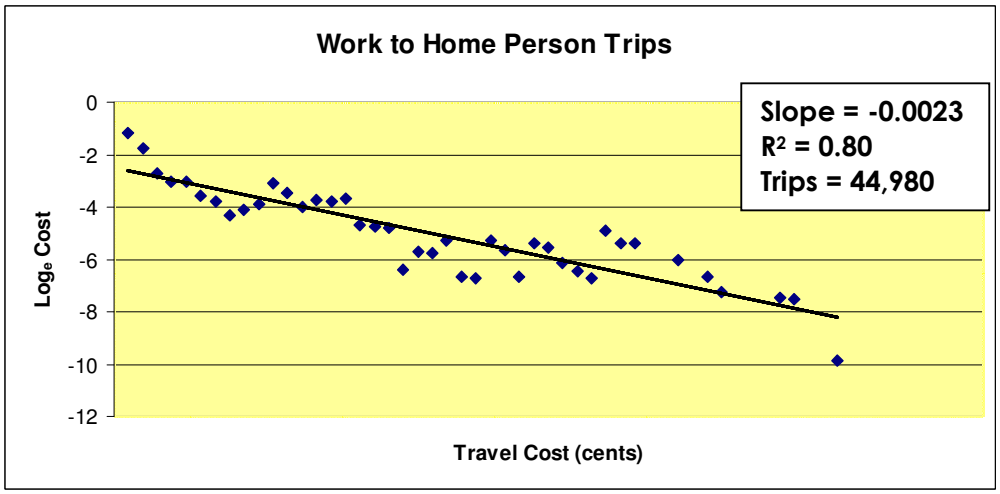

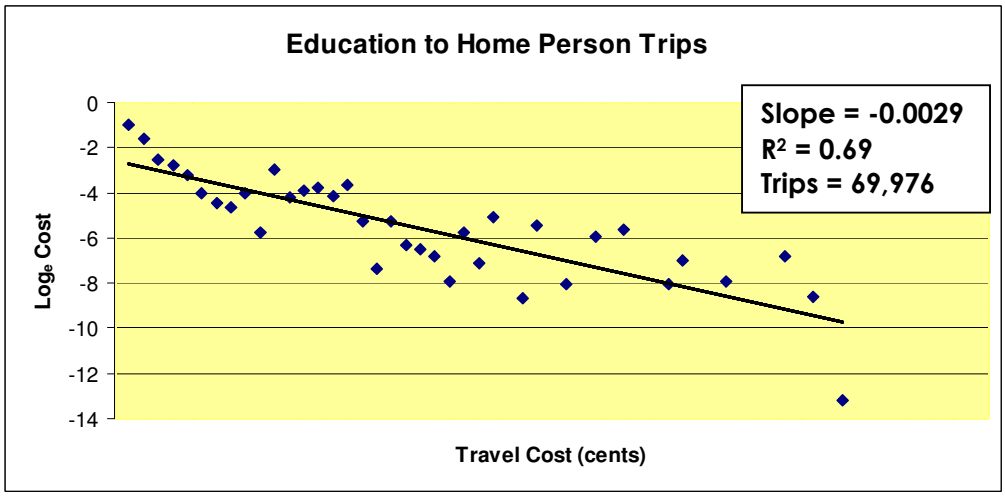

Waikato Regional Model	**Distribution Functions Inter Peak Person Trips**	**Figure 2c**
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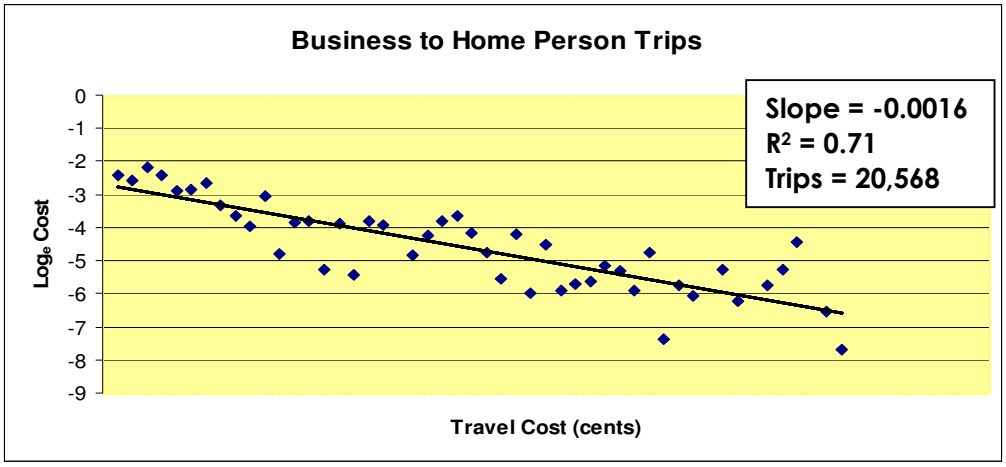

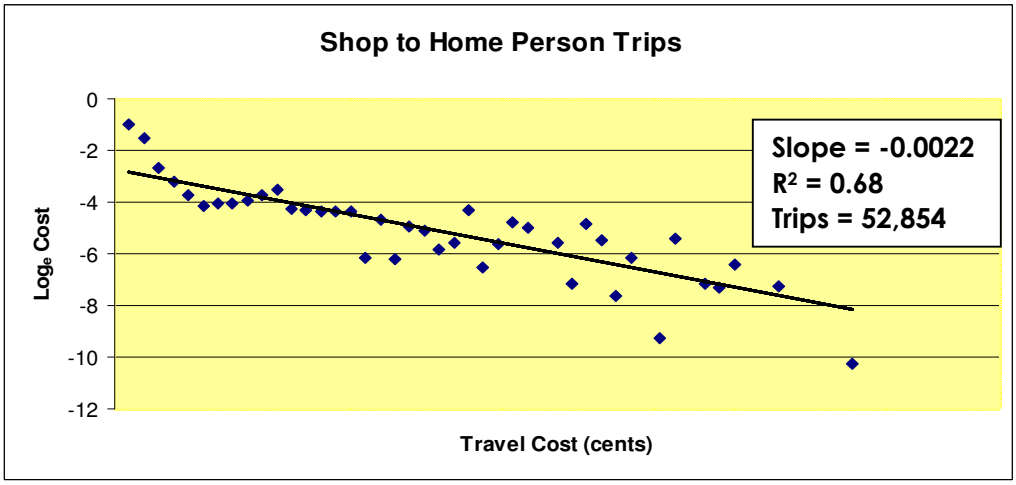

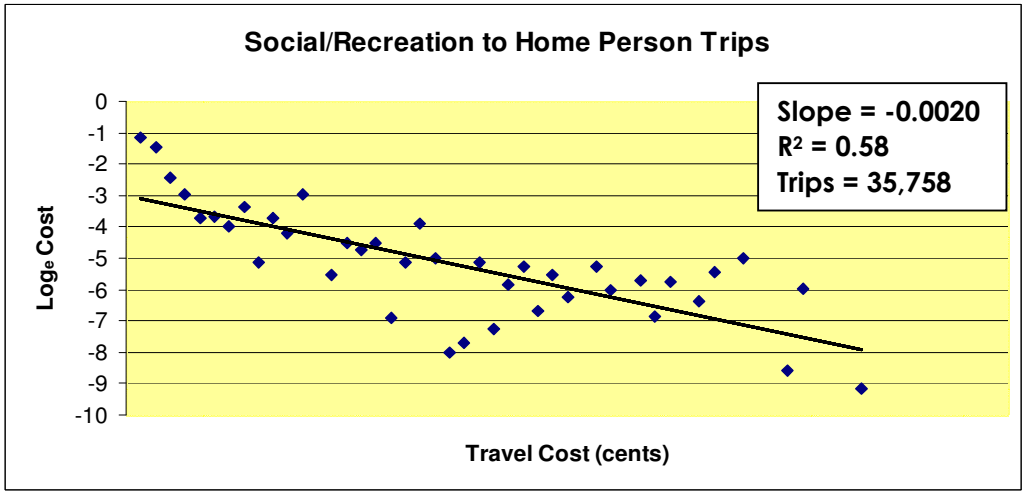

Waikato Regional Model	**Distribution Functions Inter Peak Person Trips**	**Figure 2d**
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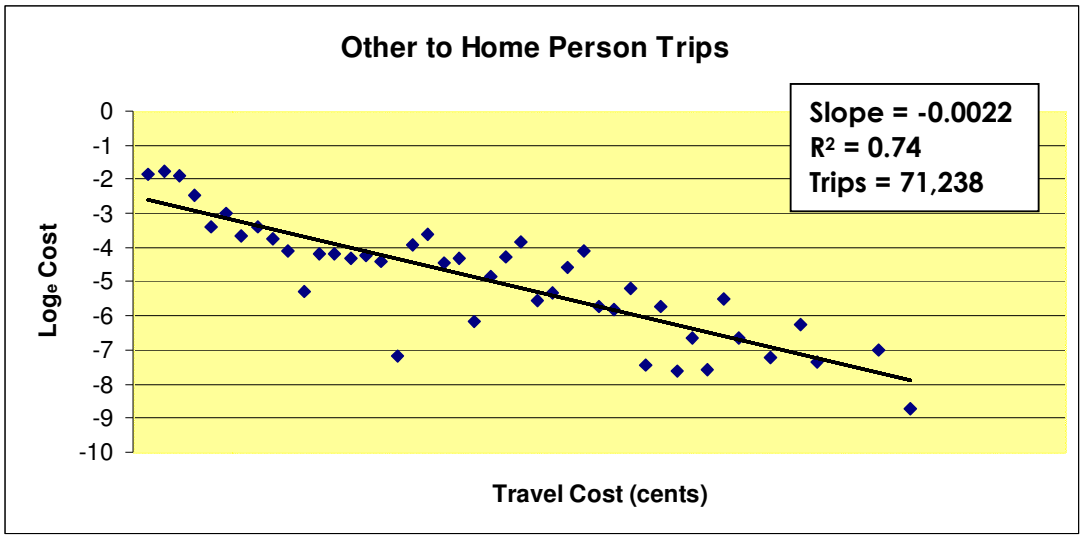

Waikato Regional Model	**Distribution Functions** **Inter Peak Person Trips**	**Figure 2e**
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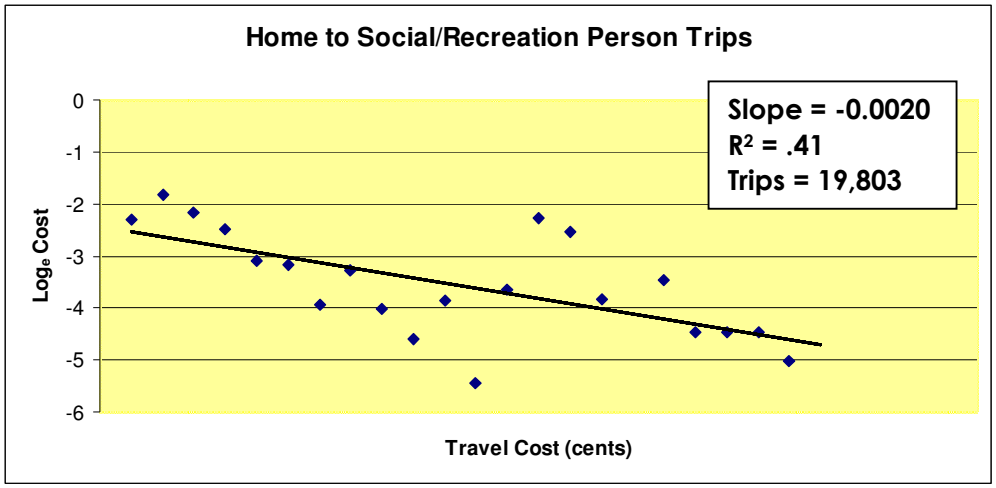
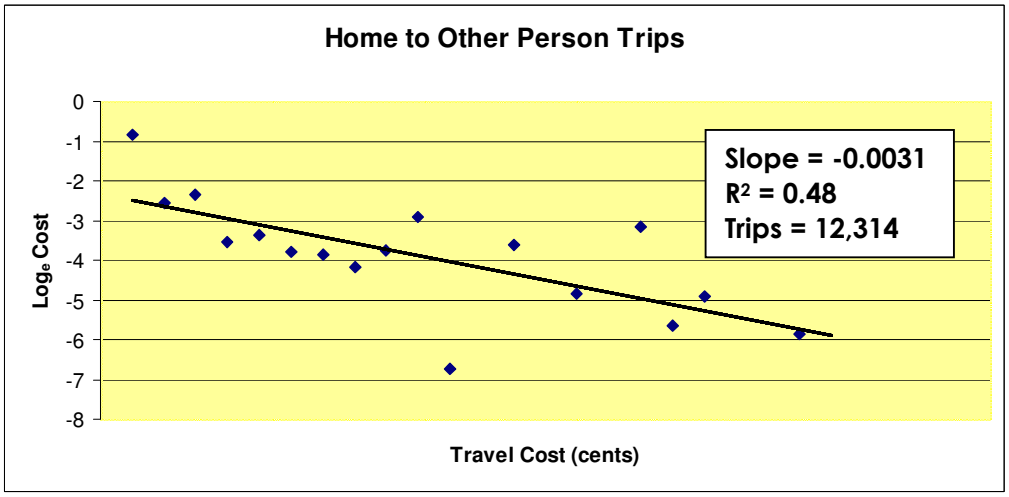
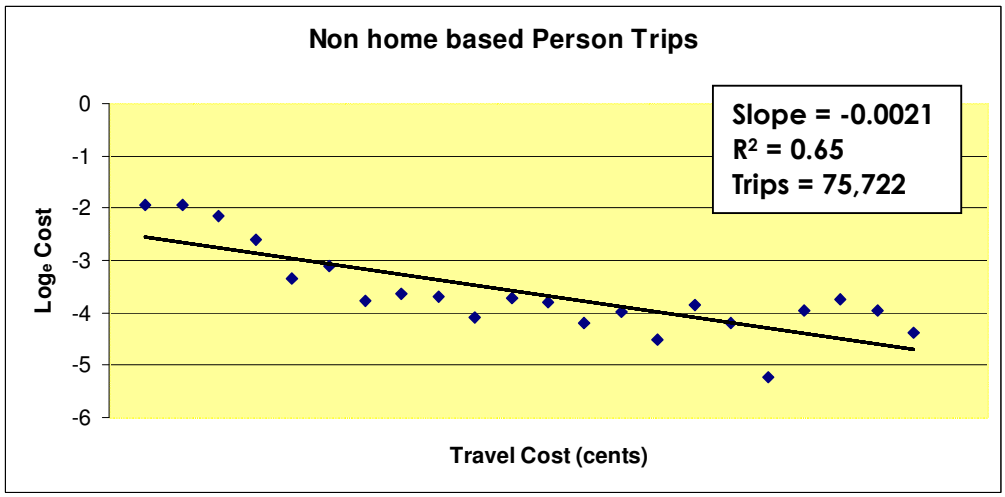
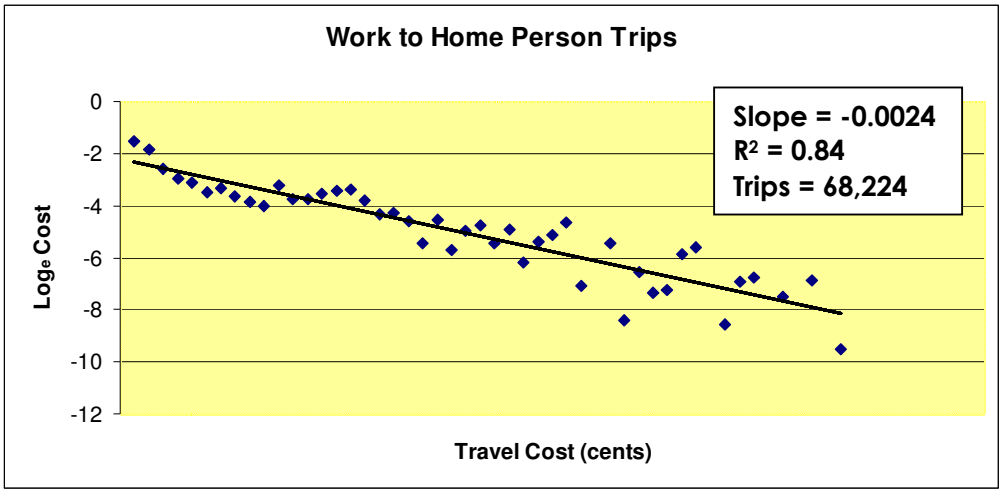
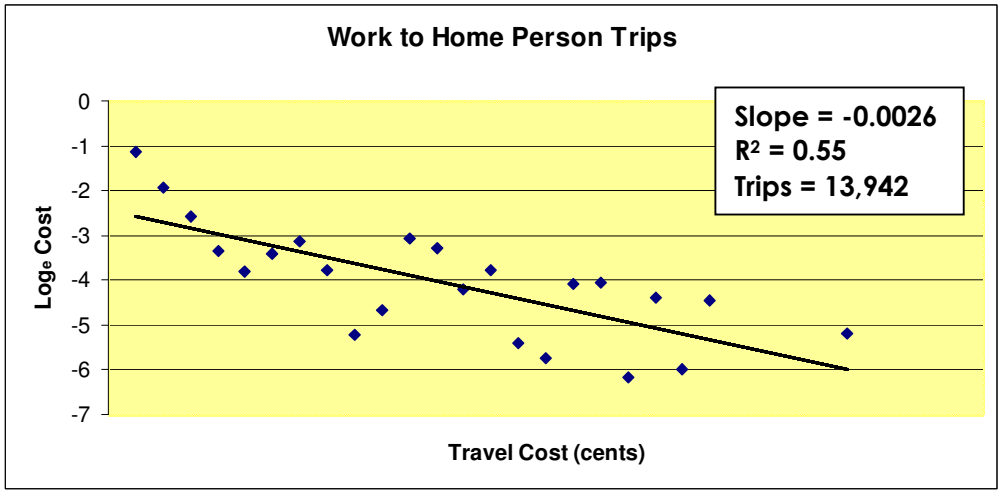


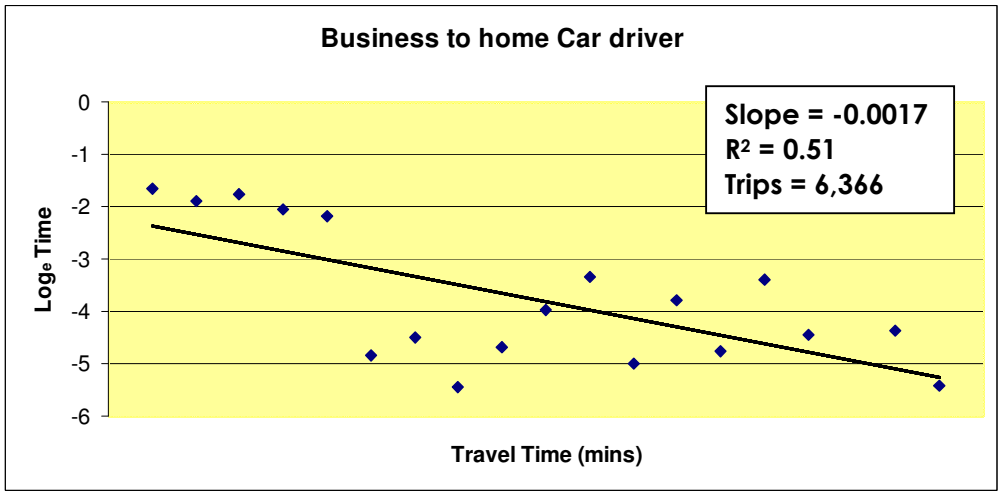




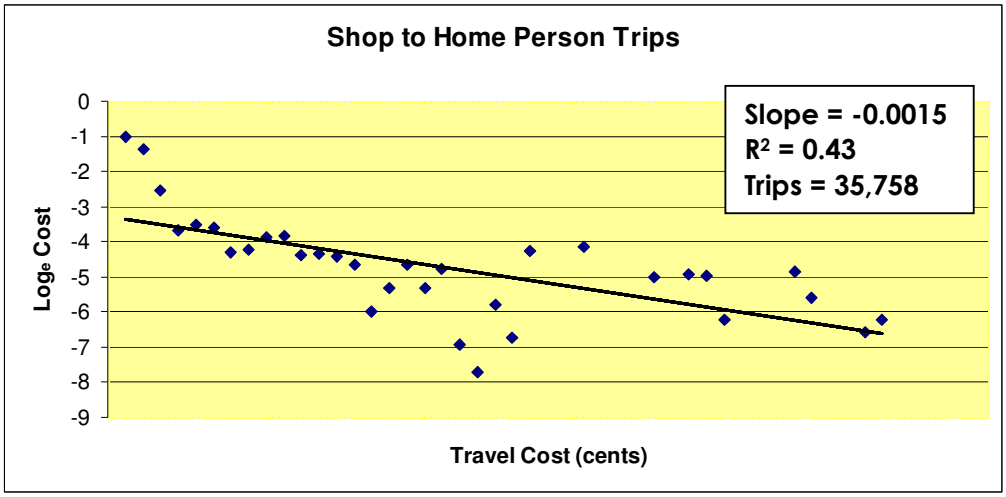
Waikato Regional Model	**Distribution Functions** **Evening Peak Person Trips**	**Figure 3a**
Gabites Porter Traffic Design Group		

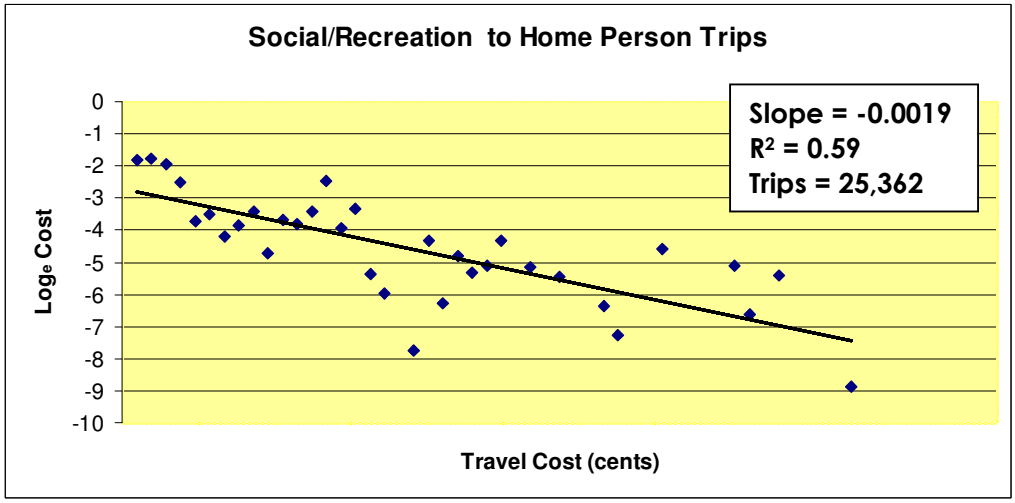


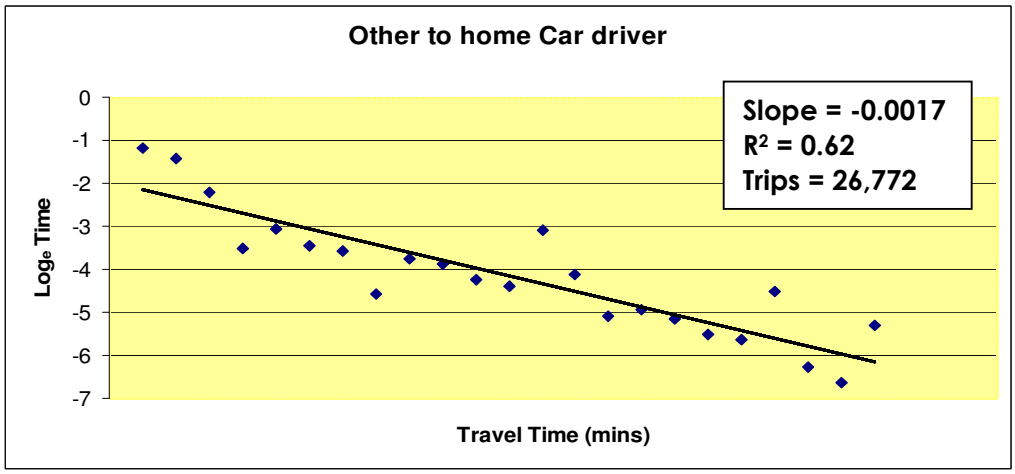




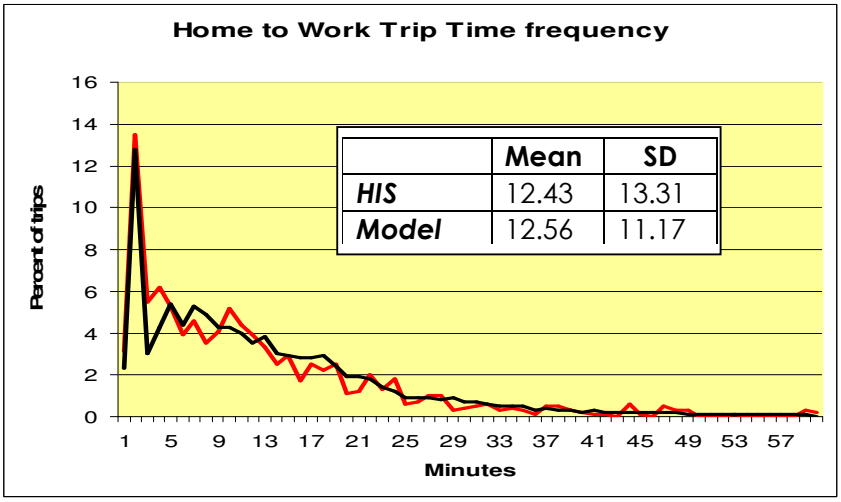
Waikato Regional Model	**Distribution Functions** **Evening Peak Person Trips**	**Figure 3b**
Gabites Porter Traffic Design Group		

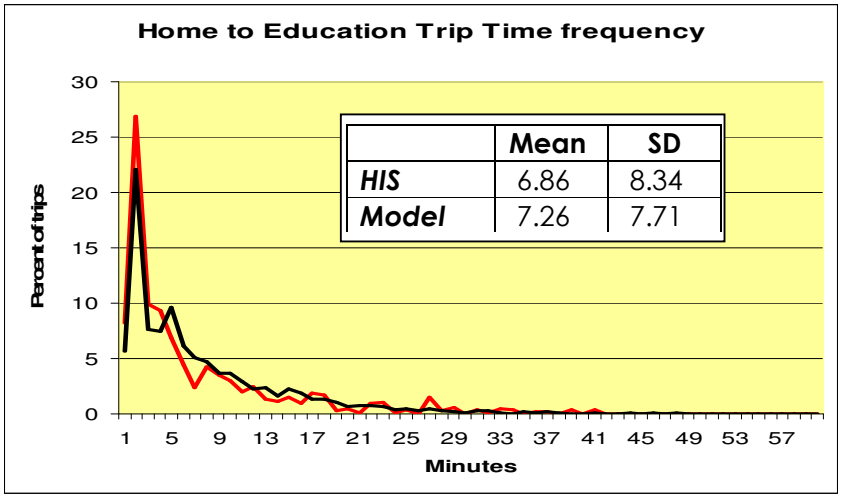


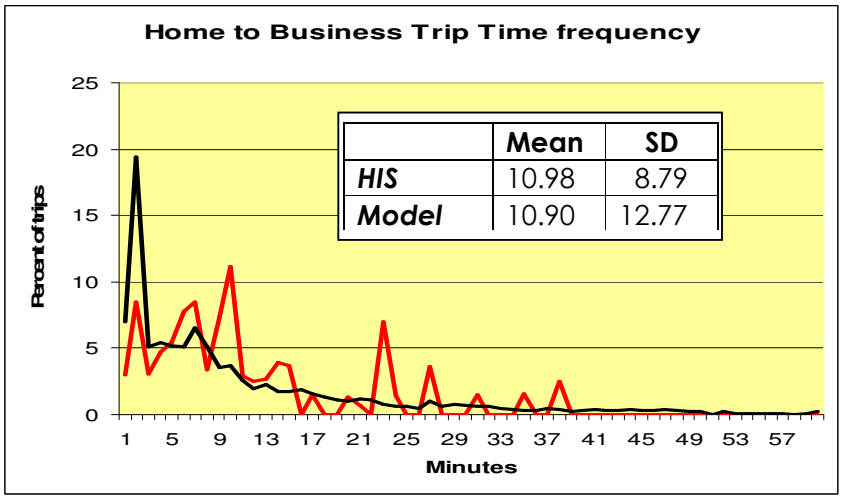




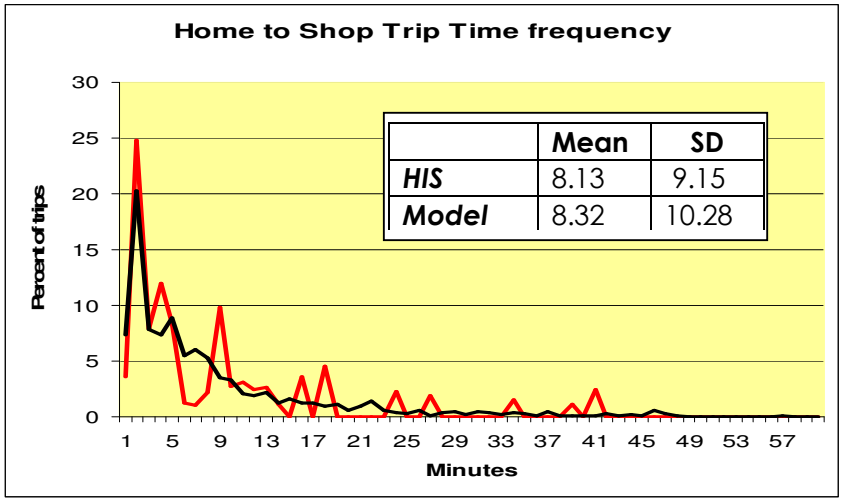
Waikato Regional Model	**Distribution Functions** **Evening Peak Person Trips**	**Figure 3c**
Gabites Porter Traffic Design Group		

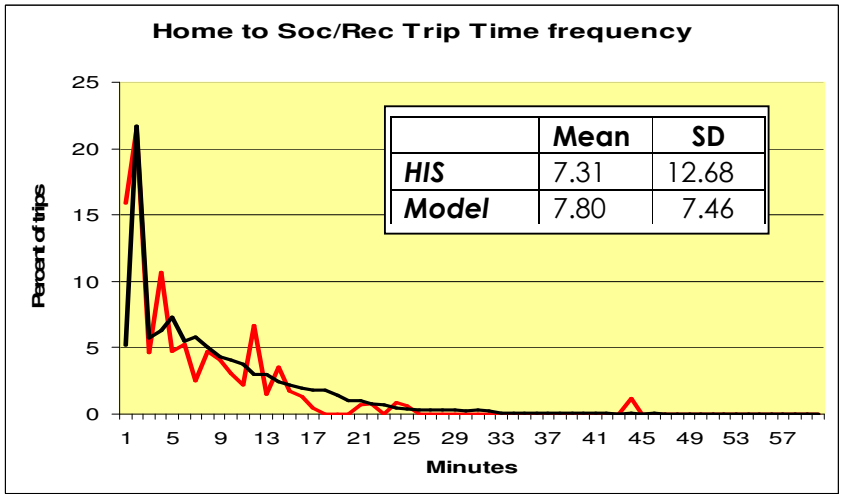


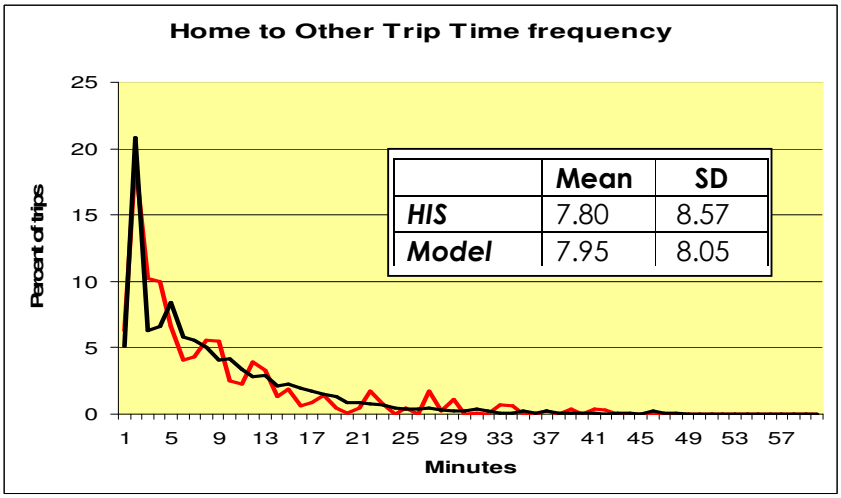




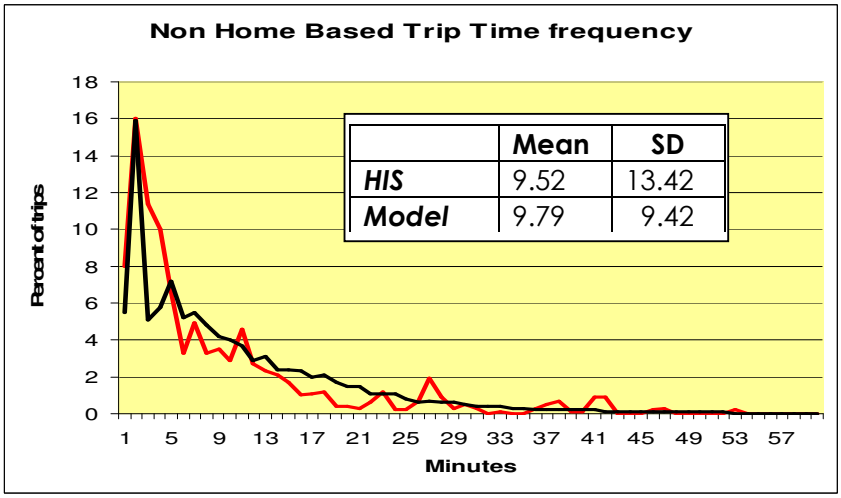
Waikato Regional Model	**Trip Time Frequency Plots (HTW/HTEd/HTB) Morning Peak Person Trips**	**Figure 4a**
Gabites Porter Traffic Design Group		

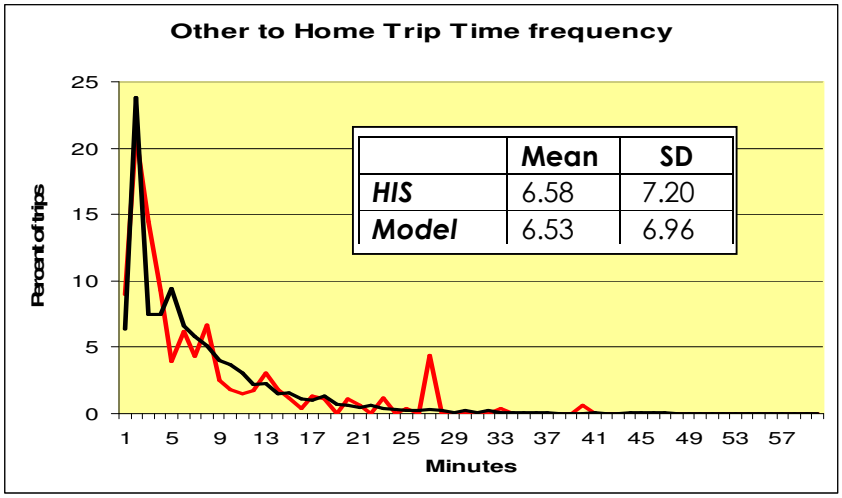


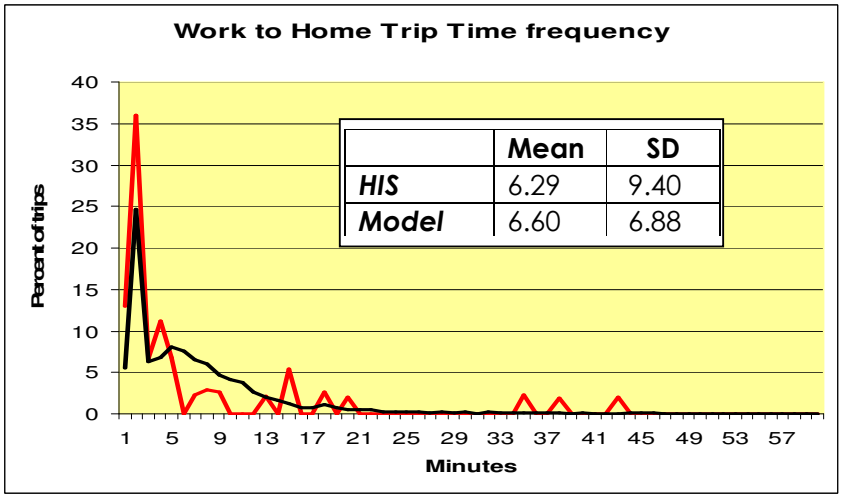




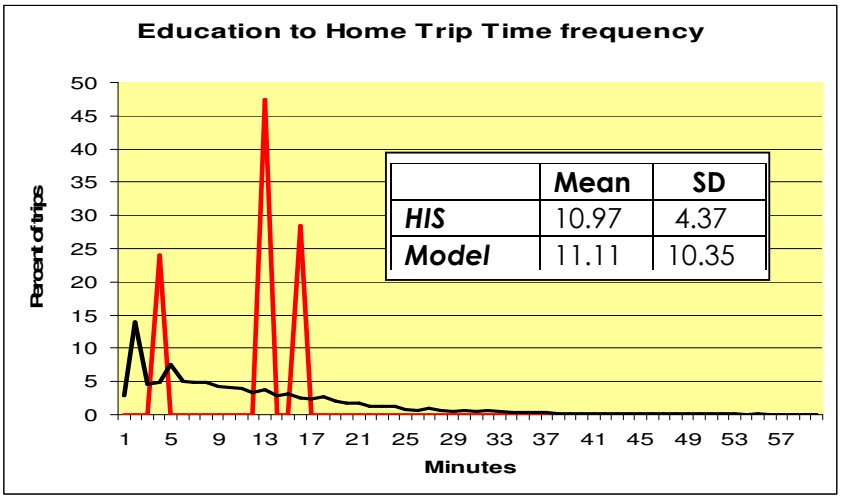
Waikato Regional Model	**Trip Time Frequency Plots (HTS/HSR/HTO) Morning Peak Person Trips**	**Figure 4b**
Gabites Porter Traffic Design Group		

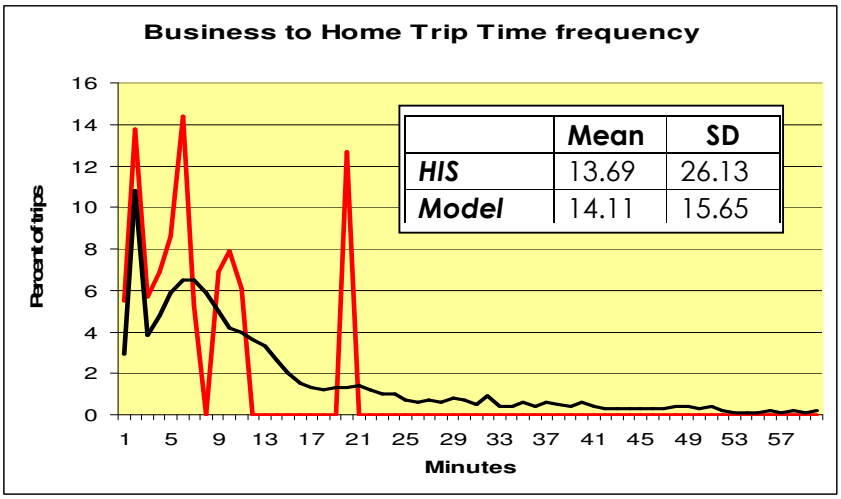


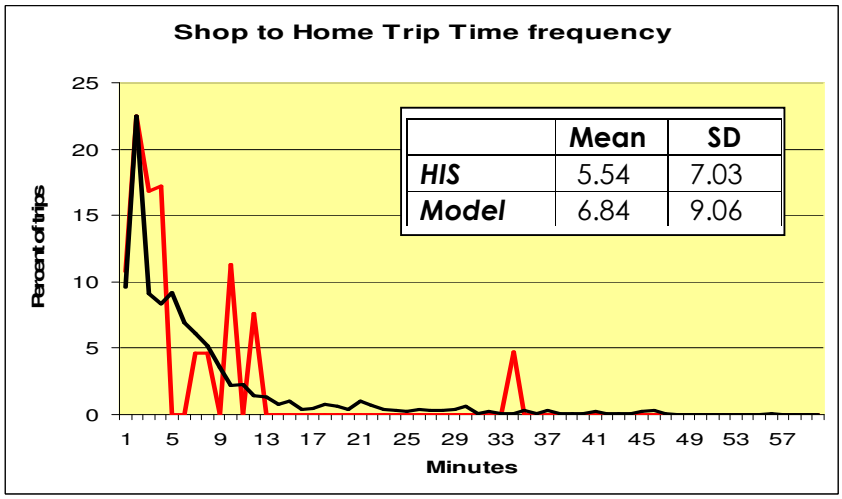




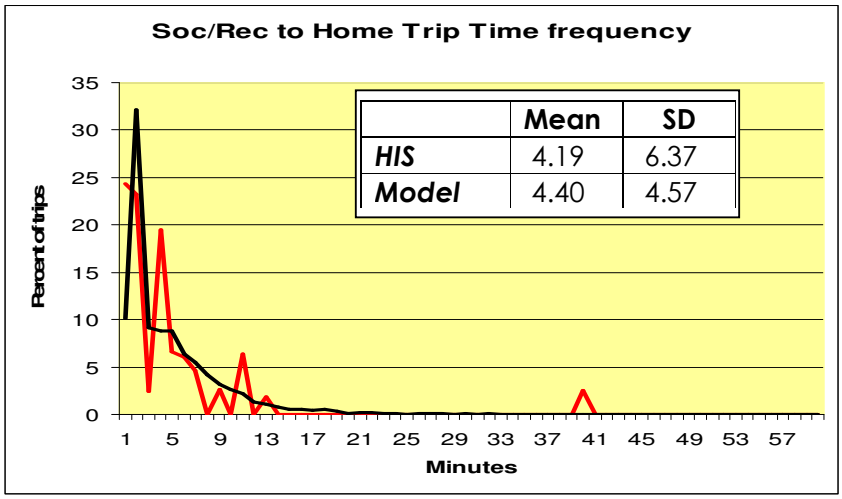
Waikato Regional Model	**Trip Time Frequency Plots (NHB/OTH/WTH) Morning Peak Person Trips**	**Figure 4c**
Gabites Porter Traffic Design Group		



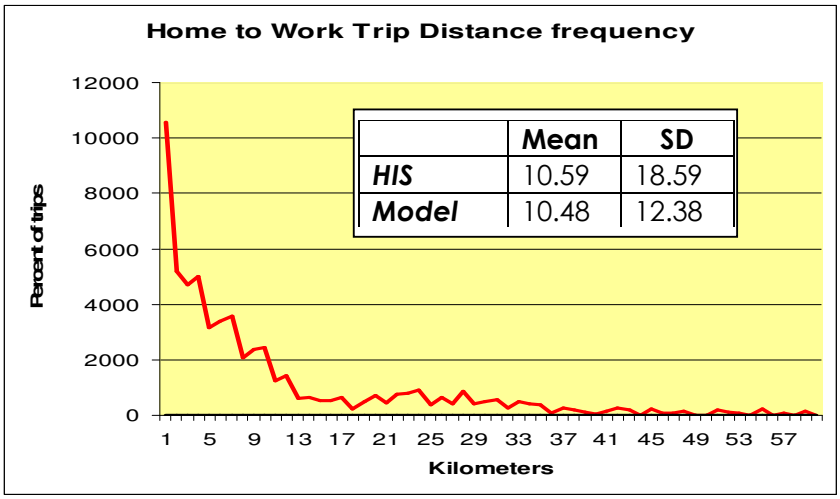


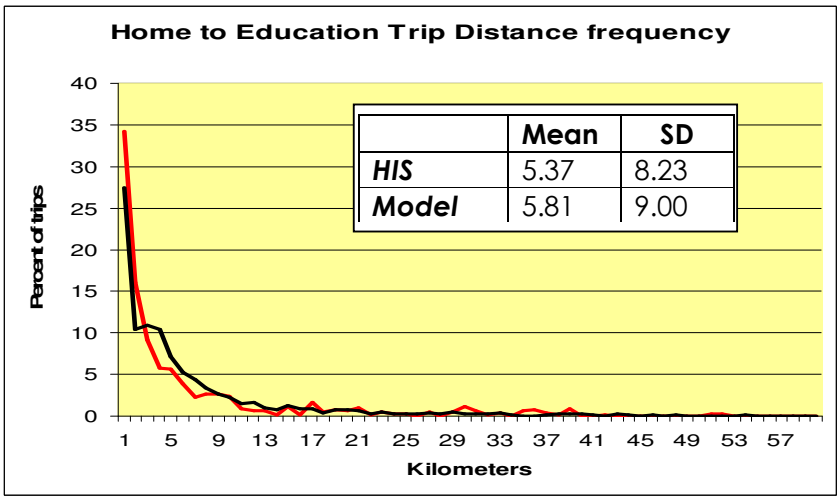


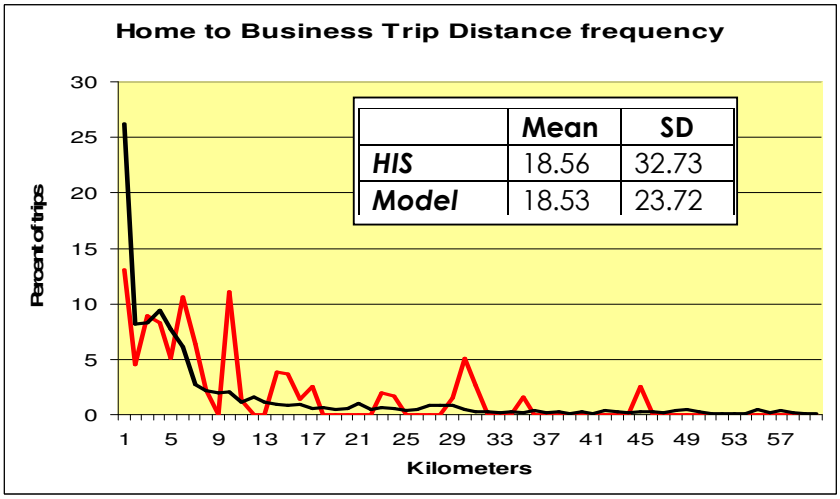
Waikato Regional Model	**Trip Time Frequency Plots (ETH/BTH/STH) Morning Peak Person Trips**	**Figure 4d**
Gabites Porter Traffic Design Group		



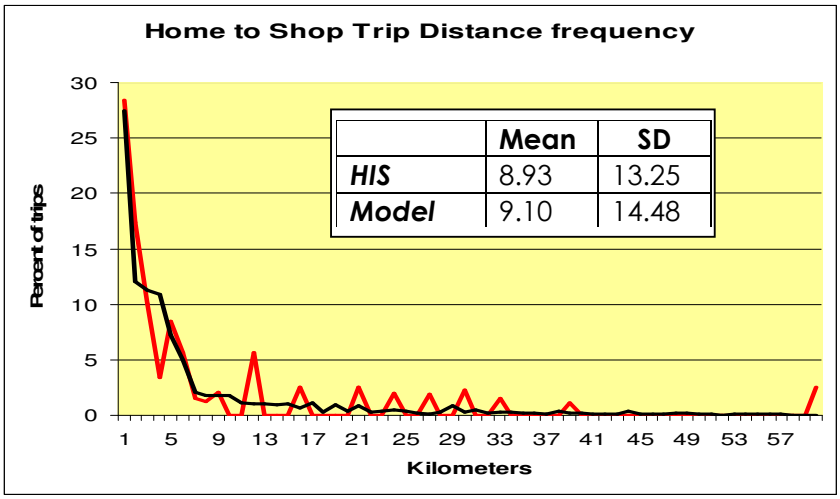
Waikato Regional Model	**Trip Time Frequency Plots (SRH)** **Morning Peak Person Trips**	**Figure 4e**
Gabites Porter Traffic Design Group		

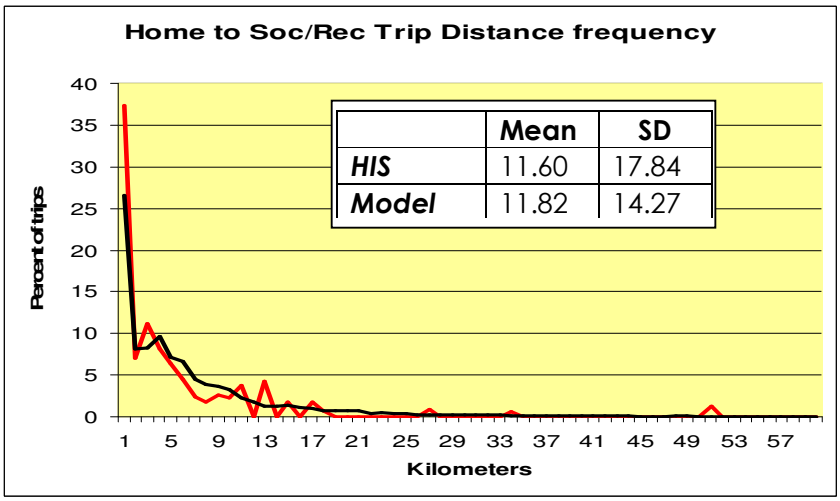


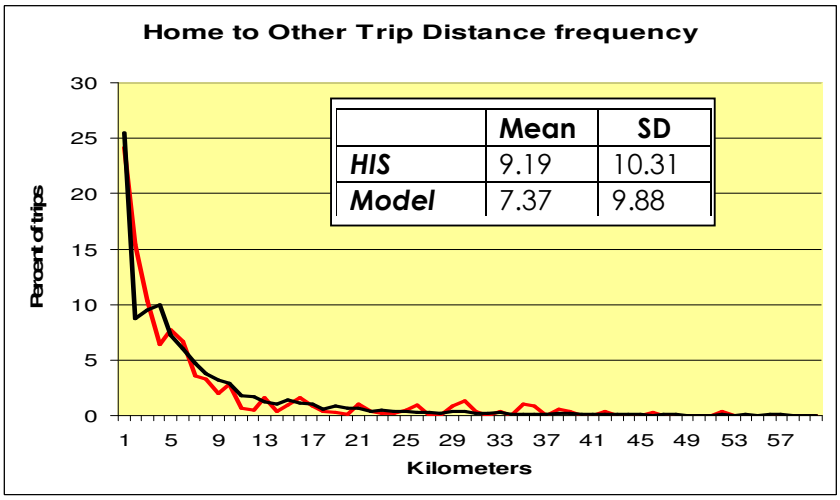




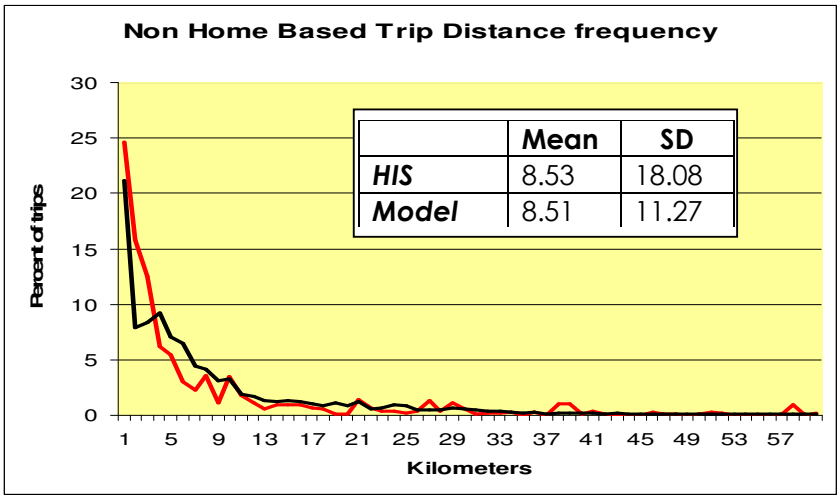
Waikato Regional Model Gabites Porter Traffic Design Group	**Trip Distance Frequency Plots (HTW/HTE/HTB) Morning Peak Person Trips**	**Figure 5a**

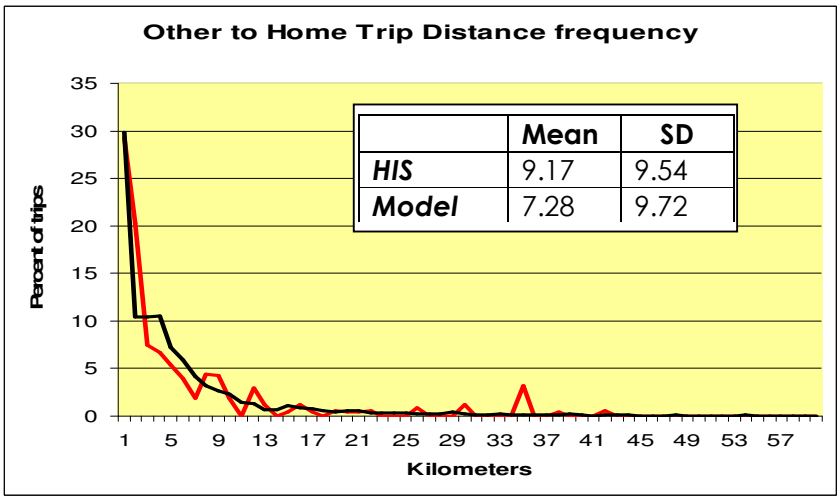


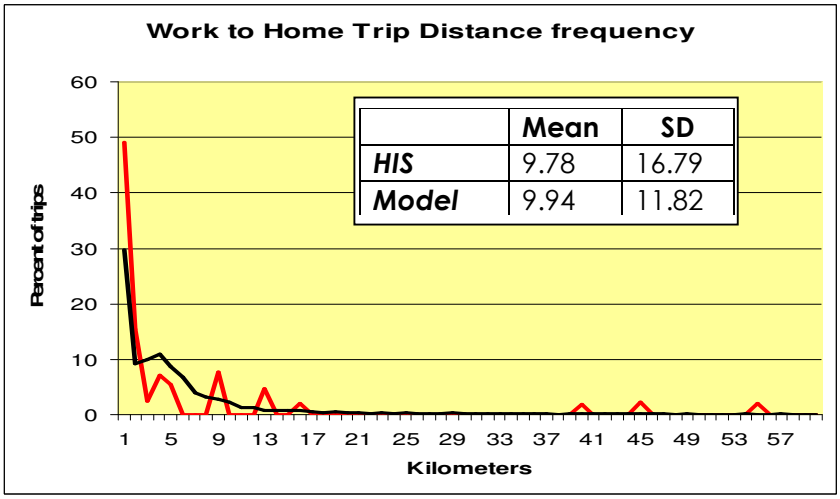




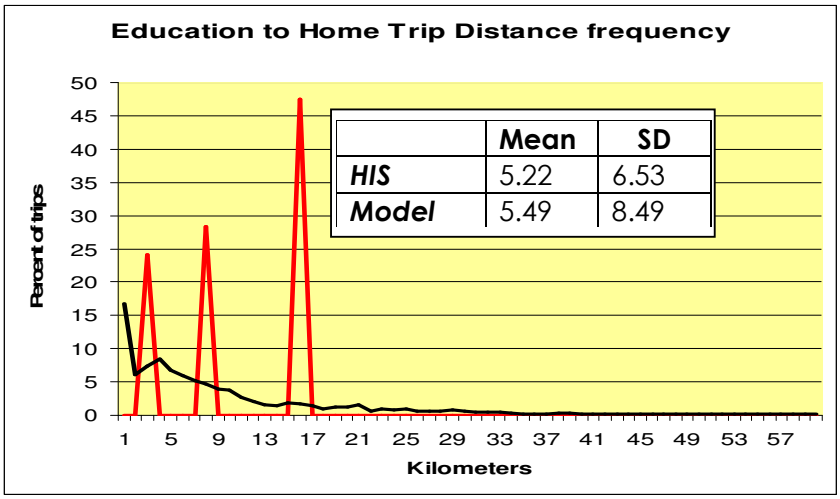
Waikato Regional Model	**Trip Distance Frequency Plots (HTS/HSR/HTO) Morning Peak Person Trips**	**Figure 5b**
Gabites Porter Traffic Design Group		

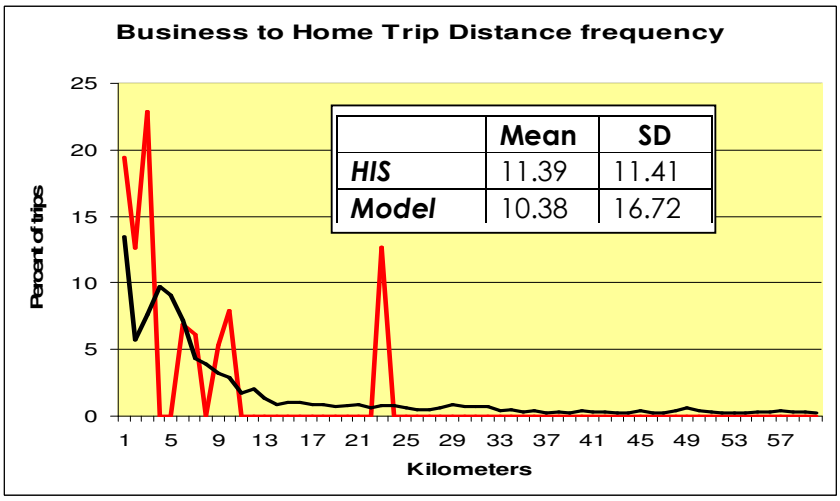


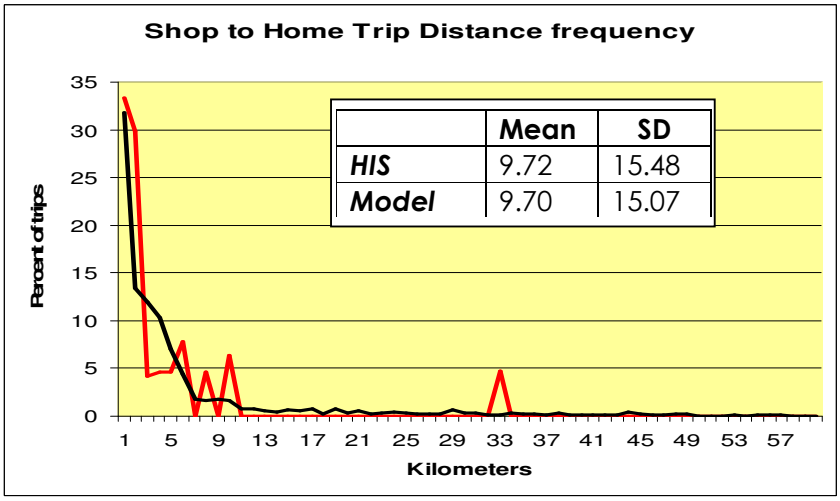




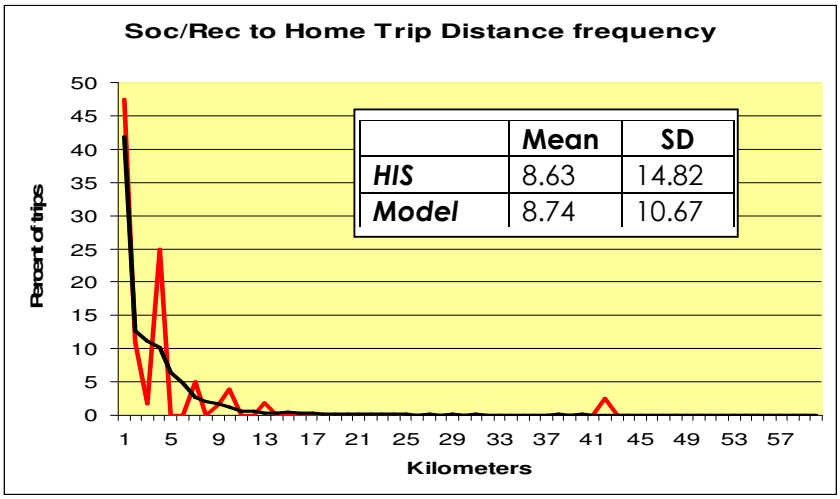
Waikato Regional Model	**Trip Distance Frequency Plots (NHB/OTH/WTH) Morning Peak Person Trips**	**Figure 5c**
Gabites Porter Traffic Design Group		



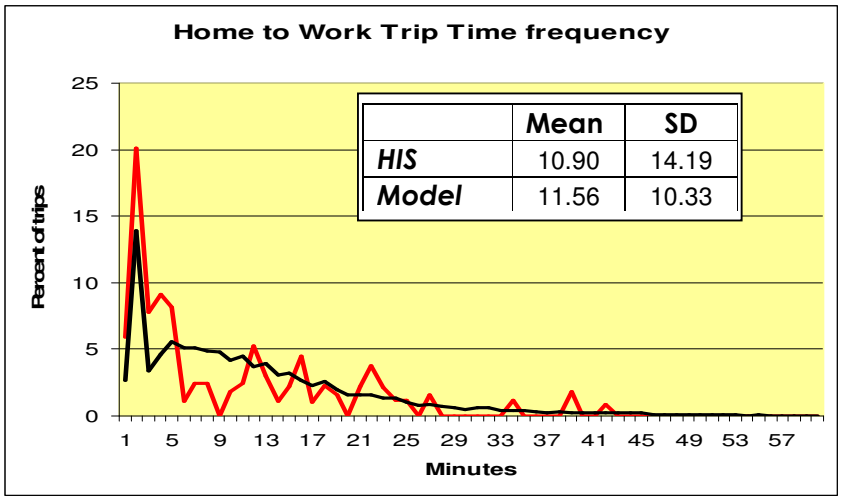


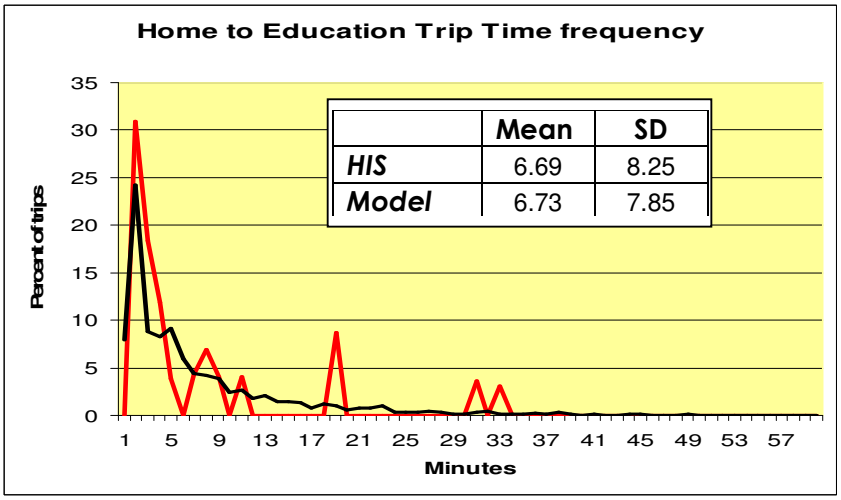


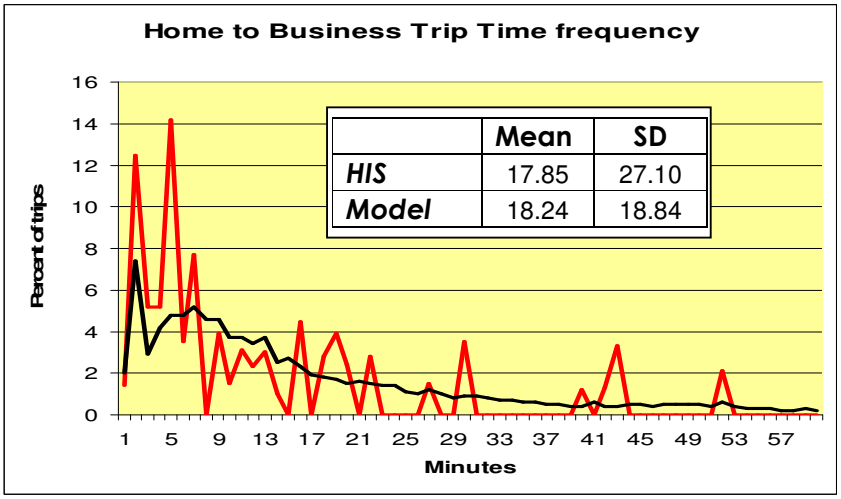
Waikato Regional Model	**Trip Distance Frequency Plots (ETH/BTH/STH) Morning Peak Person Trips**	**Figure 5d**
Gabites Porter Traffic Design Group		



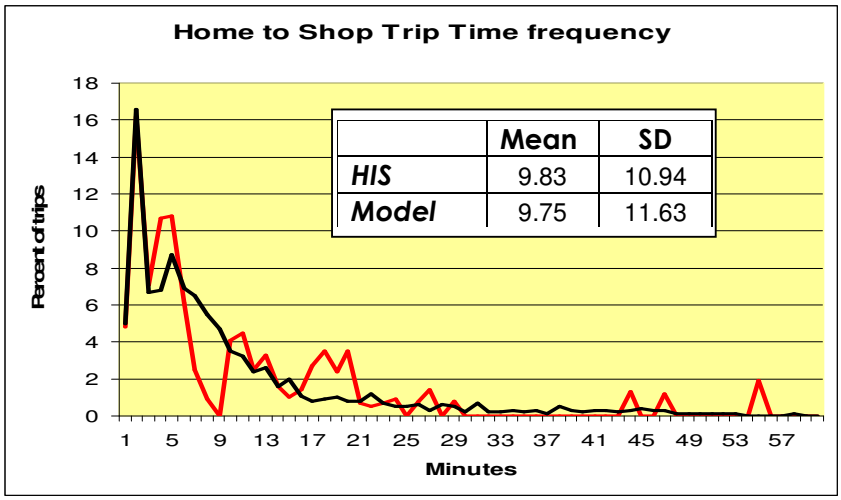
Waikato Regional Model	**Trip Distance Frequency Plots (SRH)** **Morning Peak Person Trips**	**Figure 5e**
Gabites Porter Traffic Design Group		

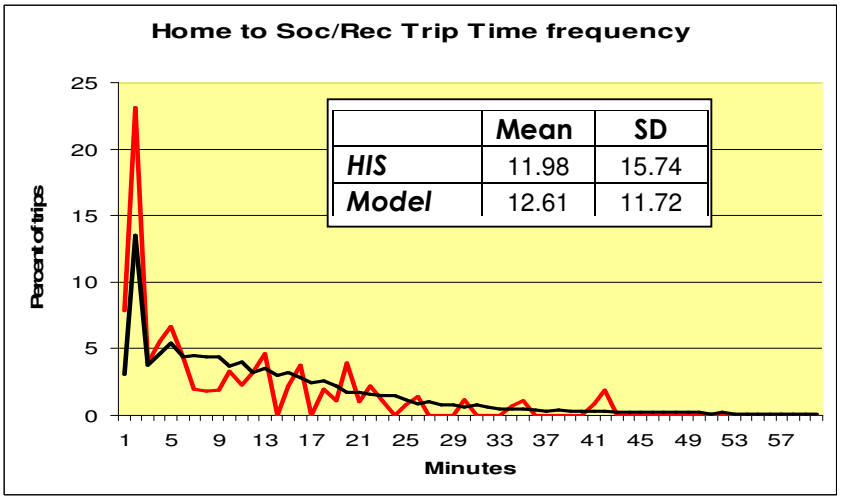


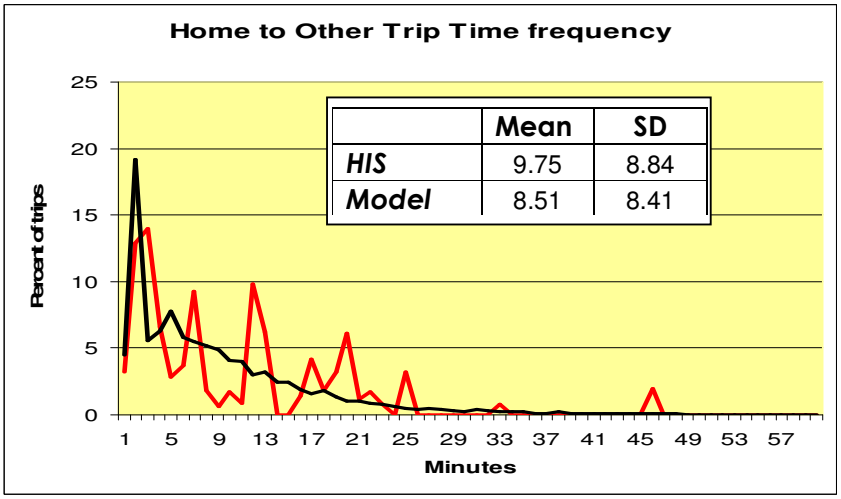




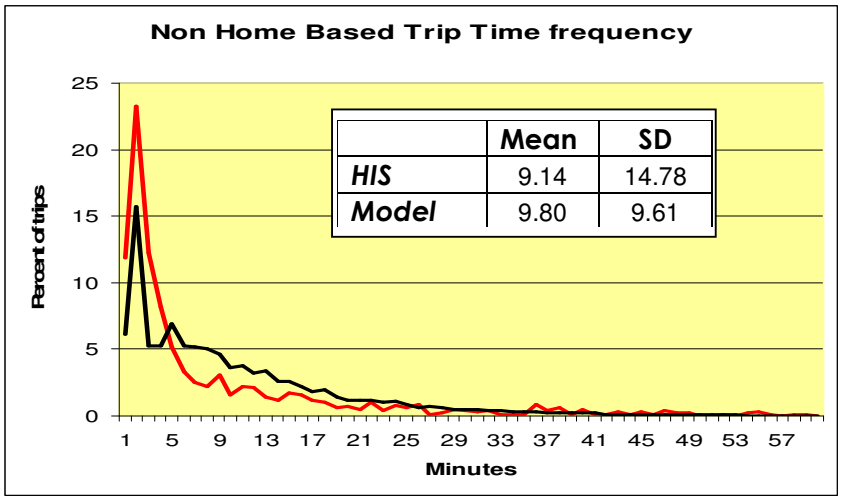
Waikato Regional Model	**Trip Time Frequency Plots (HTW/HTE/HTB) Inter Peak Person Trips**	**Figure 6a**
Gabites Porter Traffic Design Group		

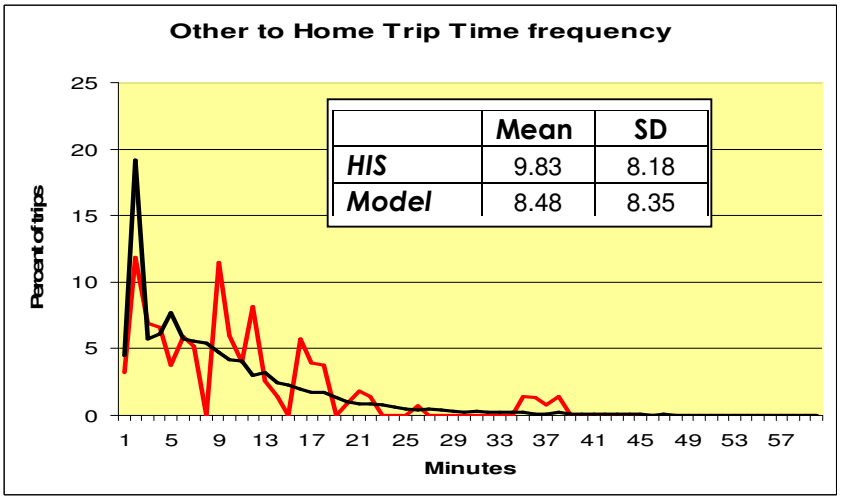


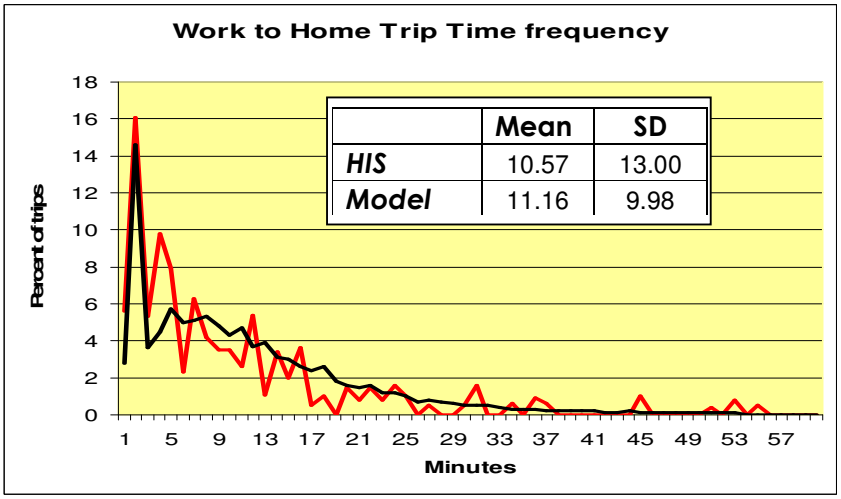




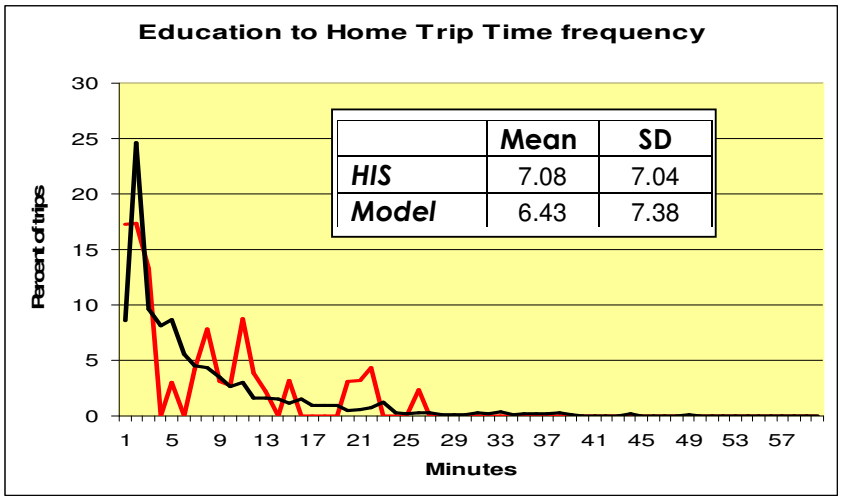
Waikato Regional Model	**Trip Time Frequency Plots (HTS/HSR/HTO) Inter Peak Person Trips**	**Figure 6b**
Gabites Porter Traffic Design Group		

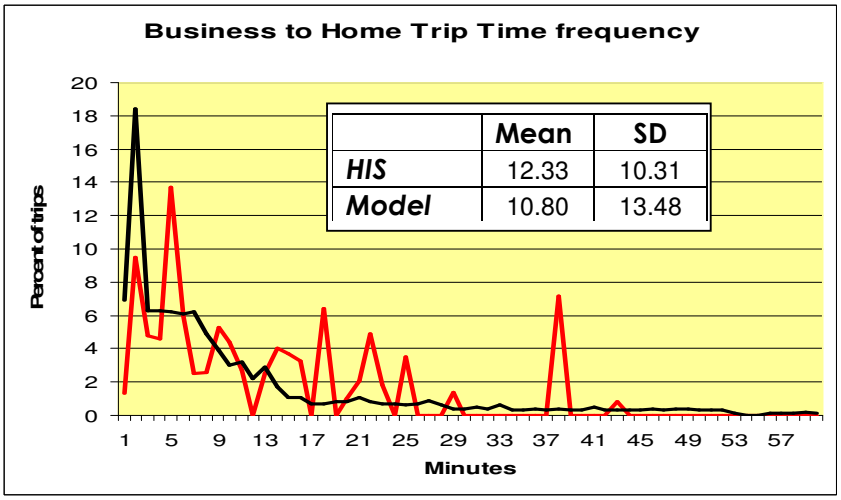


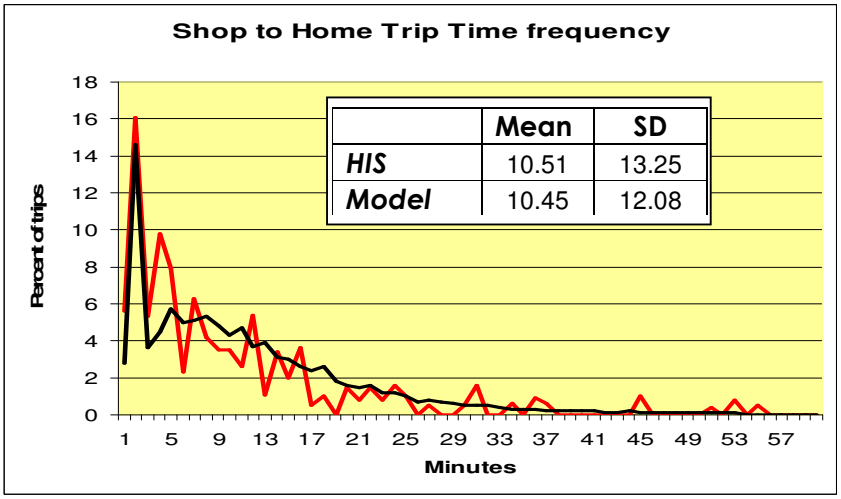




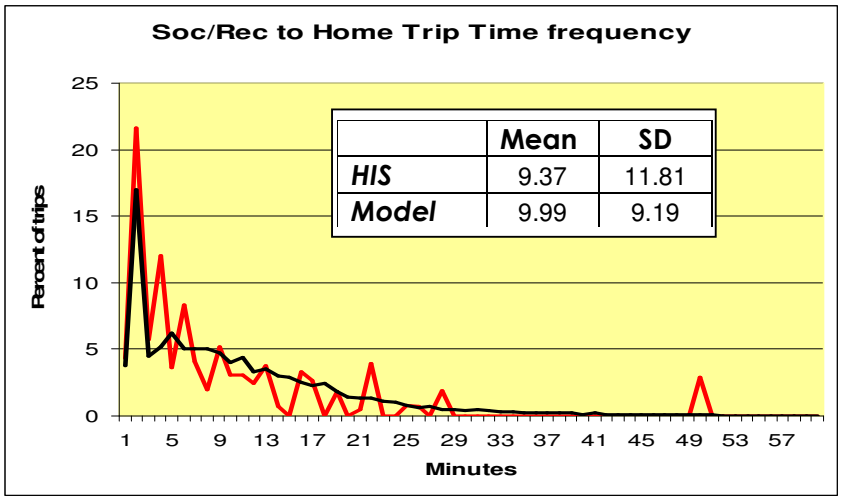
Waikato Regional Model	**Trip Time Frequency Plots (NHB/OTH/WTH) Inter Peak Person Trips**	**Figure 6c**
Gabites Porter Traffic Design Group		



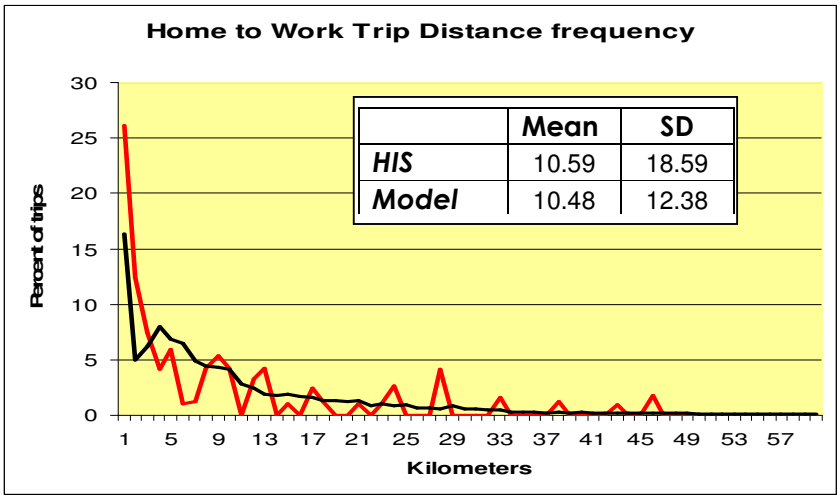


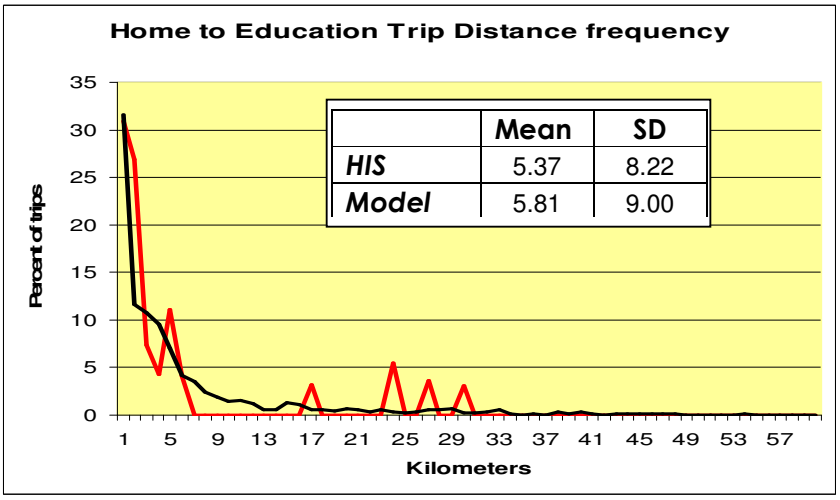


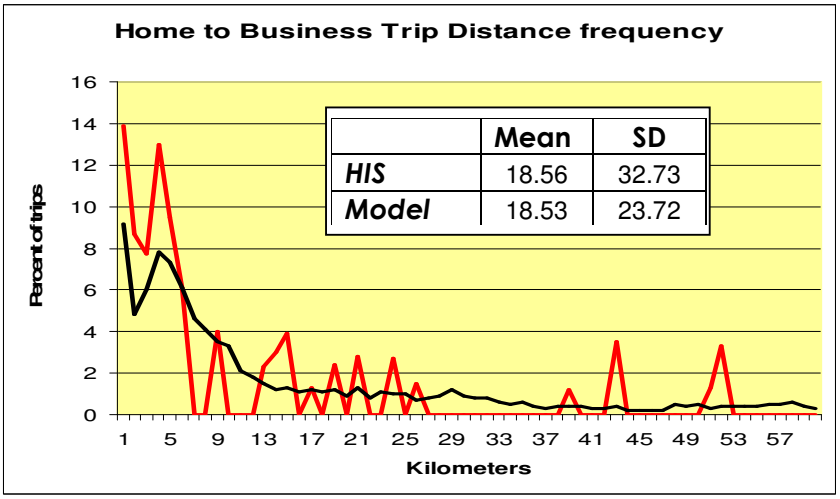
Waikato Regional Model	**Trip Time Frequency Plots (ETH/BTH/STH)** **Inter Peak Person Trips**	**Figure 6d**
Gabites Porter Traffic Design Group		



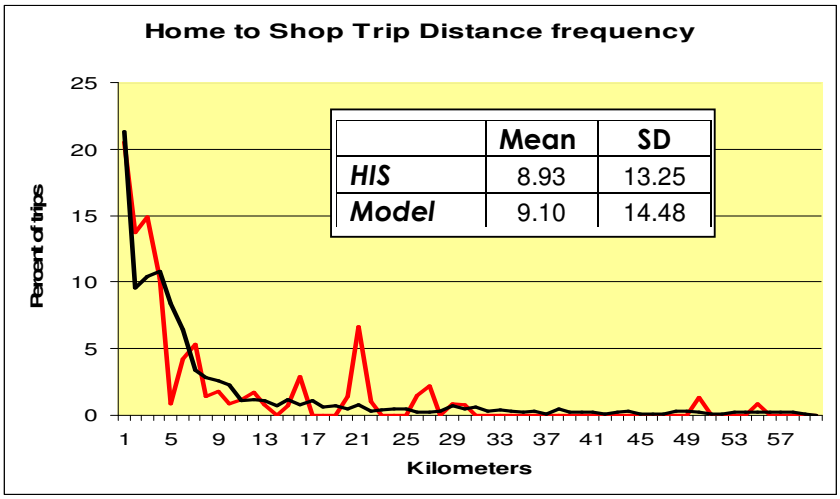
Waikato Regional Model	**Trip Time Frequency Plots (SRH)** **Inter Peak Person Trips**	**Figure 6e**
Gabites Porter Traffic Design Group		

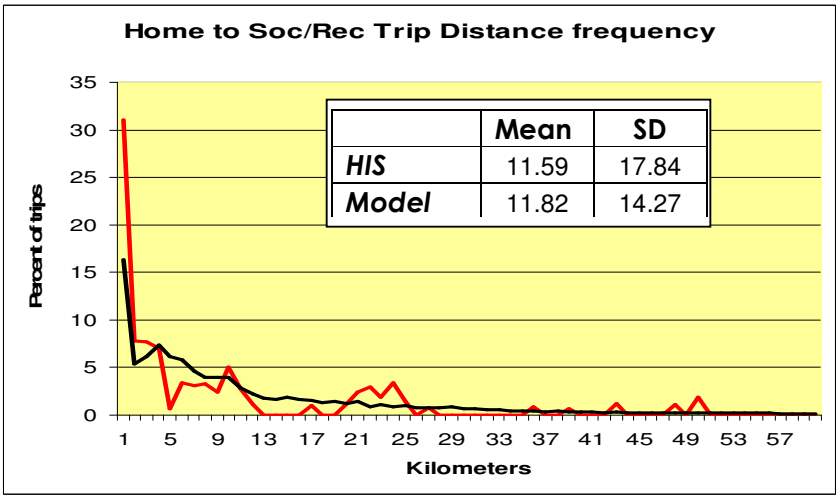


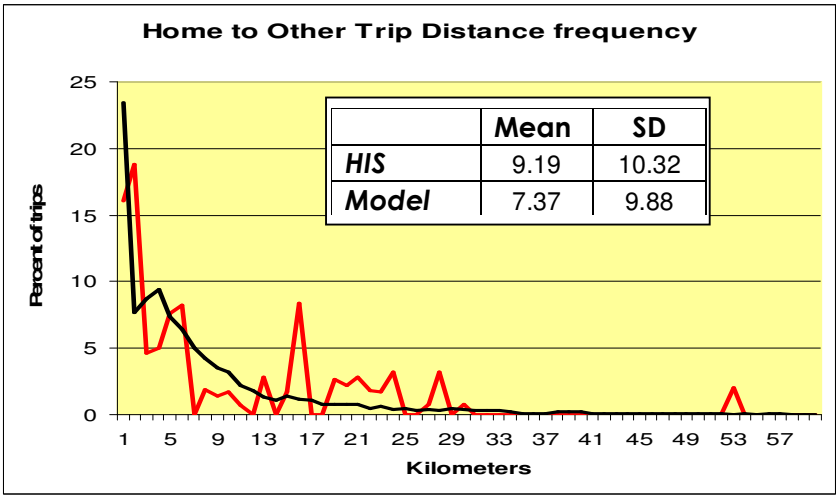




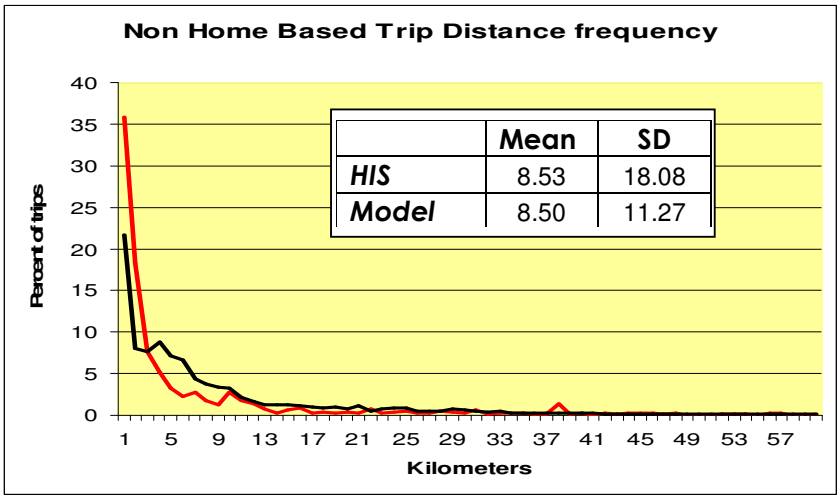
Waikato Regional Model	**Trip Distance Frequency Plots (HTW/HTE/HTB) Inter Peak Person Trips**	**Figure 7a**
Gabites Porter Traffic Design Group		

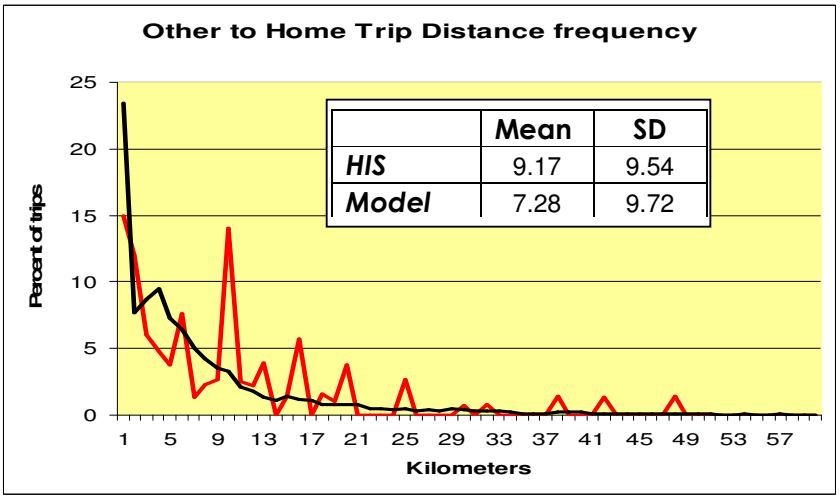


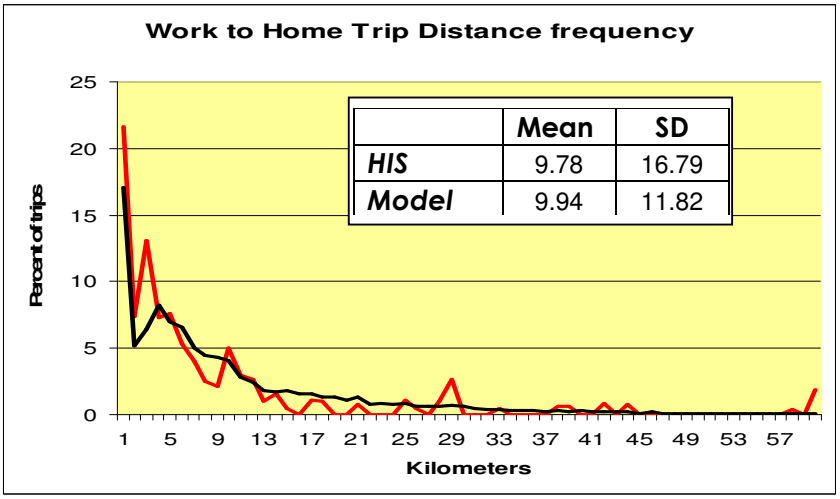




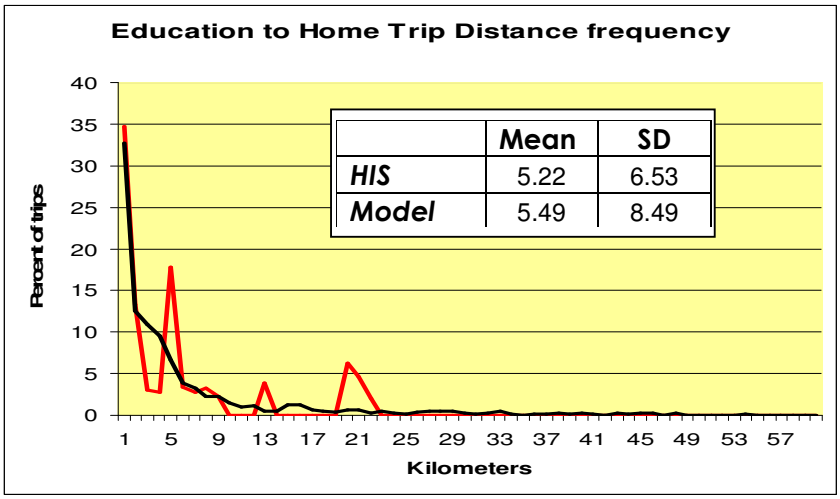
Waikato Regional Model	**Trip Distance Frequency Plots (HTS/HSR/HTO) Inter Peak Person Trips**	**Figure 7b**
Gabites Porter Traffic Design Group		

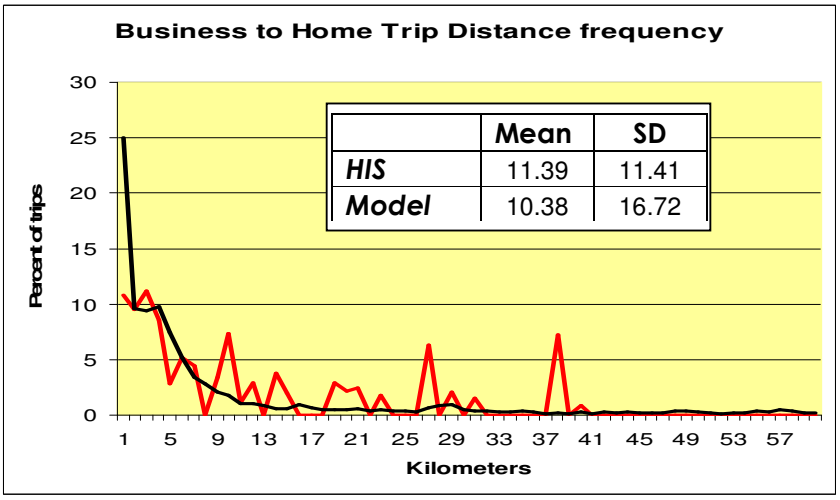


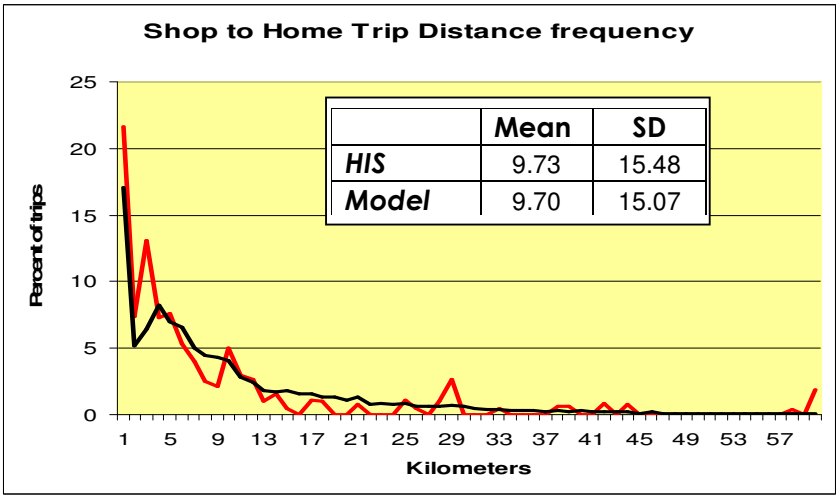




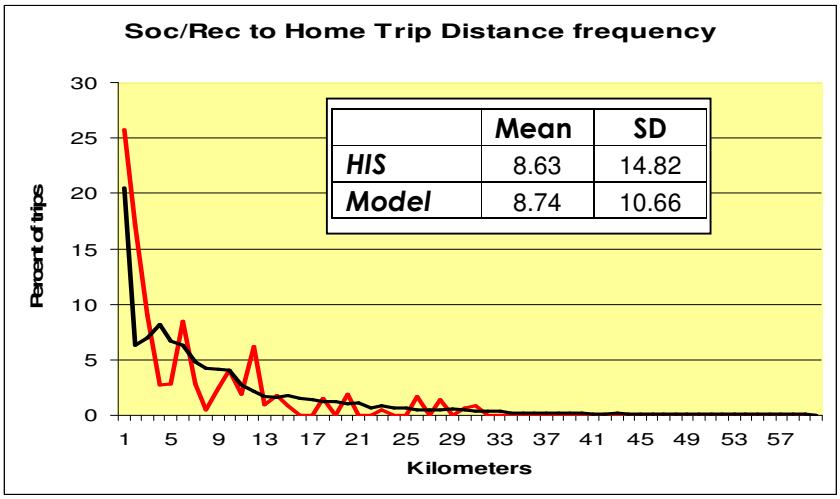
Waikato Regional Model	**Trip Distance Frequency Plots (NHB/OTH/WTH) Inter Peak Person Trips**	**Figure 7c**
Gabites Porter Traffic Design Group		







Waikato Regional Model	**Trip Distance Frequency Plots (ETH/BTH/STH) Inter Peak Person Trips**	**Figure 7d**
Gabites Porter Traffic Design Group		



Waikato Regional Model	**Trip Distance Frequency Plots (SRH)** **Inter Peak Person Trips**	**Figure 7e**
Gabites Porter Traffic Design Group		

5. COMPARISON OF 3 STEP AND 4 STEP MODELLED TRIP LENGTHS

Table 8 shows a comparison of the 3 and 4 step modelled trip times for each trip purpose. It highlights whether the 4-step model trips are less than the 3-step model trips.

Modelled Time Comparisons between 3 and 4 Step — **Table 8**

	Purpose	3-step Trip Time Model		4-step Trip Time Model		
		Mean	SD	Mean	SD	4 step < 3 step?
Morning Peak	Home to Work	13.9	12.6	12.6	11.2	yes
	Home to Education	10.7	13.0	7.3	7.7	yes
	Home to Business	10.8	12.9	10.9	12.8	**NO**
	Home to Shop	9.9	11.5	8.3	10.3	yes
	Home to Social/Rec	9.3	9.0	7.8	7.5	yes
	Home to Other	8.4	8.1	8.0	8.1	yes
	Non Home Based	10.3	10.1	9.8	9.4	yes
	Other to Home	7.5	7.4	6.5	7.0	yes
	Work to Home	8.5	8.0	6.6	6.9	yes
	Education to Home	12.7	15.5	11.1	10.4	yes
	Business to Home	15.2	15.3	14.1	15.7	yes
	Shop to Home	7.7	10.0	6.8	9.1	yes
	Soc/Rec to Home	6.7	6.8	4.4	4.6	yes
Interpeak	Home to Work	11.9	10.9	11.6	10.3	yes
	Home to Education	11.6	16.2	6.7	7.9	yes
	Home to Business	17.2	17.5	18.2	18.8	**NO**
	Home to Shop	9.9	11.6	9.8	11.6	yes
	Home to Social/Rec	14.1	13.4	12.6	11.7	yes
	Home to Other	7.1	6.9	8.5	8.4	**NO**
	Non Home Based	11.2	11.3	9.8	9.6	yes
	Other to Home	8.0	7.6	8.5	8.4	**NO**
	Work to Home	10.5	9.6	11.2	10.0	**NO**
	Education to Home	11.6	15.5	6.4	7.4	yes
	Business to Home	9.8	12.3	10.8	13.5	**NO**
	Shop to Home	9.7	11.5	10.5	12.1	**NO**
	Soc/Rec to Home	10.0	9.5	10.0	9.2	yes

Table 9 shows a comparison of the 3 and 4 step modelled trip distances for each trip purpose. It highlights whether the 4-step model trips are less than the 3-step model trips, and also provides an indication of the percentage of drivers for each trip purpose.

Modelled Distance Comparisons between 3 and 4 step						Table 9
		3-step Trip Distance Model		4-step Trip Distance Model		
	Purpose	Mean	SD	Mean	SD	4 step < 3 step?
Morning Peak	Home to Work	13.7	16.4	11.2	13.4	yes
	Home to Education	11.1	17.5	5.9	8.4	yes
	Home to Business	10.5	16.5	10.1	15.7	yes
	Home to Shop	9.4	14.9	7.4	12.4	yes
	Home to Social/Rec	8.5	11.1	6.3	8.1	yes
	Home to Other	7.5	9.8	6.6	9.2	yes
	Non Home Based	9.4	12.6	8.4	11.0	yes
	Other to Home	6.6	9.0	5.4	8.0	yes
	Work to Home	7.5	9.9	5.4	8.1	yes
	Education to Home	13.7	21.2	10.1	12.4	yes
	Business to Home	15.6	20.4	14.1	20.0	yes
	Shop to Home	7.4	13.2	6.1	11.1	yes
	Soc/Rec to Home	5.7	8.3	3.2	4.7	yes
Interpeak	Home to Work	11.7	14.0	10.5	12.4	yes
	Home to Education	12.9	22.0	5.8	9.0	yes
	Home to Business	18.4	23.5	18.5	23.7	**NO**
	Home to Shop	9.8	15.3	9.1	14.5	yes
	Home to Social/Rec	14.6	17.7	11.8	14.3	yes
	Home to Other	6.2	8.4	7.4	9.9	**NO**
	Non Home Based	11.3	14.5	8.5	11.3	yes
	Other to Home	7.2	9.3	7.3	9.7	**NO**
	Work to Home	10.0	12.1	9.9	11.8	yes
	Education to Home	12.8	21.1	5.5	8.5	yes
	Business to Home	9.7	15.7	10.4	16.7	**NO**
	Shop to Home	9.6	15.1	9.7	15.1	**NO**
	Soc/Rec to Home	9.5	12.1	8.7	10.7	yes

In most instances the 4-step model trips are shorter that the 3-step model trips because of the inclusion of walking and cycling trips. There are, however examples of trip lengths slightly greater in the 4 step model, particularly in the inter peak period.

For Home to Business and Home to Shopping purposes approximately 80% of all trips are vehicle driver trips and there is very little difference between the 3-step and 4-step averages. For Home to Other trips in the inter peak period there are only a small number of vehicle driver trips sampled in the HIS, and in all cases the standard deviation of all trip lengths are very large.