RAND

Re-Estimation of LMS Time-of-Day Module Project

Estimation Results

Gerard de Jong, Carine Vellay, Marits Pieters, Andrew Daly

RAND Europe

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Preface

This is the report on model estimation results in a project that RAND Europe (before 2001 Hague Consulting Group) has carried out together with Bureau Veldkamp and Mark Bradley Research and Consulting (MBRC) for the Transport Research Centre (AVV) of the Dutch Ministry of Transport, Public Works and Water Management. The objective of the project is to estimate a new time of day model that will replace the present time of day component in the Dutch National Model System (LMS), which predicts car drivers' responses to changing travel times (e.g. from congestion) or to the imposition of time-dependent road user charging.

This report contains estimation results both for a detailed 'optimal' model, which is not restricted by the requirement of practical use as module of the LMS, and a simplified model that can be integrated into the LMS. Not only the final 'best' models are presented, but also models which have been tried, but were rejected in favour of others.

Summary

This study has estimated two sets of models of the choice of time of travel, based exclusively on stated preference (SP) data:

- a detailed model, which represents the choices made by respondents among the varying alternatives presented in the SP exercises, using an error components logit (mixed logit) formulation;
- a 'simplified' model, which represents choices made by the SP respondents among 11 fixed alternatives defined over a 24-hour day, using models from the GEV family.

The objective of estimating these two sets of models was to obtain the maximum understanding of the circumstances influencing the choice of time-of-day of travel through the detailed models, then to obtain as the simplified models formulae which were more closely suited to implementation in the national model system for transport and traffic, LMS. The simplified models exploit the coefficients estimated in the detailed models, but apply an overall scale factor, add alternative-specific constants for the choice of each period on the outbound leg and for the change-mode alternative.

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1 Introduction

This is the report on model estimation results in a project that RAND Europe (before 2001 Hague Consulting Group) has carried out together with Bureau Veldkamp and Mark Bradley Research and Consulting (MBRC) for the Transport Research Centre (AVV) of the Dutch Ministry of Transport and Public Works. The objective of the project is to estimate a new time of day model that will replace the present time of day component in the Dutch National Model System (LMS), which predicts car drivers' responses to changing travel times (e.g. from congestion) or to the imposition of time-dependent road user charging. The new time-of-day model has to meet a number of requirements:

1. Within the module there will be a distinction by travel purpose, mode and time period (0600-0700, 0700-0800, 0800-0900, 0900-1000, 1000-1500, 1500-1600, 1600-1700, 1700-1800, 1800-1900, 1900-2400 and 2400-0600 hours).

2. It can be integrated in the Dutch National Model System (LMS).

3. Compensation given by employers for the cost of possible pricing measures such as road pricing will be modelled explicitly.

4. The model will take account of the degree of (in)flexibility of starting and departure times and the possible link between a change in time-of-day of the outward and inward leg of the same tour.

5. The model will deal with both car and train travellers.

6. The model will be sensitive to changes in travel time and cost (for train also frequency and if possible seat availability).

This report contains estimation results both for a detailed 'optimal' model, which is not restricted by the requirement of practical use as module of the LMS, and a simplified model that can be integrated into the LMS. Not only the final 'best' models are presented, but also models which have been tried, but were rejected in favour of others. Background information on the model structures used can be found in the technical memorandum 'Re-estimation of the LMS time-of-day module: model structure and data' of May 2000 by Hague Consulting Group. The models have been estimated on a stated preference dataset, gathered as part of this project. The questionnaire and fieldwork procedures are described in a technical memorandum by Hague Consulting Group of October 2000. The technical memorandum of July 2001 by RAND Europe contains the description of the database used for estimating the models.

In this report, the estimation results for the detailed models are presented first (chapter 2), followed by the outcomes for the simplified models (chapter 4). In chapter 3 are simulation results using the detailed models. Chapter 5 focusses on the implementation of the time-of-day model.

2 Detailed models

Rand Europe received the complete SP dataset from Veldkamp on the 16th of March 2001. However, in February we already had about 90 % of the data and started analysing the data and estimating the models.

In this report we shall present the tests we have made and the models we have estimated using the SP data of February. We shall not make an exhaustive presentation of all the models that have been tested but only the ones that were relevant for the analysis.

The number of observations used in the models presented may vary for the reason explained above, i.e. we started the analysis before we had received all the data. As 90% or more of the data were used, the conclusions should be correct on this part of the data.

Criteria used for comparing different model specification

In this report we shall be comparing many different model specifications. These specifications have been judged on the basis of the following criteria:

- A measure of the overall 'fit' of the model. All models have been estimated using the maximum likelihood (ML) method. In ML estimation there is no measure like R^2 in least squares regression which gives the proportion of variation in the dependent variable explained by the regressor variables (and even for least squares there is an ongoing debate whether this is a good measure). In ML estimation the value of the log likelihood function is maximised. The resulting loglikelihood (LL) value (the maximum value obtained) can be used for statistical tests. Because of the logarithmic transformation of the choice probabilities, this value will be negative. The closer to zero the LL value gets, the better the model fits the data. Adding coefficients will always increase the LL value, but the increase may not be significant. The LL value that was obtained, LL(final) can be compared to the LL of a model with all coefficients restricted to zero, LL(0): $Rho^2(0)$.

  $Rho^2(0)$: 1 – LL(final)/LL(0)

  A higher value indicates a better fitting model. If we compare the LL value obtained with the LL of a model with only constants (LL(c), one less than the number of alternatives), we get:

  $Rho^2(c)$: 1 – LL(final)/LL(c)

  This statistic is not really useful in this report, because in the models we estimated we do not have a full set of constants (because constants do have an interpretation for mode choice, but not for TOD choice). The most important use of the LL value is to compare different model specifications. This can only be done in a formal statistical test if two model specifications have been estimated on the same data and one specification is nested in the other (by restricting coefficients one specification can be derived from the other). This is the likelihood ratio test, in which minus twice the difference of the LL values is compared to a Chi^2 value from published statistical tables. The value in the table depends on the confidence interval chosen (usually 95%) and the number of restrictions needed to go from one model to the other. For example with the 95% confidence interval and one restriction the critical value in the Chi^2 table is 3.84. If the difference in LL values between a model A and a model B with one extra coefficient exceeds 1.92, the specification of model B gives a significant improvement.

- The t-value of the coefficient: a coefficient should have a t-value greater than 1.96 to be significantly different from zero (at 95% confidence). For evaluation we shall use the 95% confidence interval throughout this report. The t-values reported in most of the tables in the report are biassed upwards, because they do not take account of the fact that the data contain repeated measurements (choices for the same individuals). Proper t-values can be obtained by applying jackknife estimation. This estimation, which requires drawing many subsamples, takes a long runtime, which increases with the number of subsamples specified. Therefore in this report, we have estimated many specifications without jackknife to find out the best model for each travel purpose and have only performed the jackknife on these best models to obtain the proper t-ratios. In judging the estimation results before doing the jackknife we therefore have to keep in mind that a t-value just above 1.96 will probably not be enough for significance. The t-test can also be used to compare model specifications with each other, but this gives the same results as the likelihood ratio test described above.

- Sign and size of the estimated coefficients (e.g. negative coefficients for cost, travel time and scheduling penalties are required for consistency with random utility maximisation).

- Values of time and other ratios between estimated coefficients (also see the utility functions in the next section). We would like to point out however that this study is not a value of time study and that the trade-offs presented to respondents focus on trading between scheduling on the one hand and travel time and/or cost on the other hand. So we regard a value of time which comes close to reported value of time studies as a desirable property in judging the various mode specifications, but not as a conditio sine qua non.

Utility functions; definitions of trade-off ratios

These models directly use the four alternatives that were presented to a respondent on each screen as four different utility functions:

- U_0 : observed mode and observed or close to observed time-of-day;
- U_1 : observed mode, outward leg departure considerably earlier;
- U_2 : observed mode, outward leg departure considerably later;
- U_3 : different mode, and observed or close to observed time-of-day.

Although there were not alternatives on a screen that were originally designed and labelled in terms of departure time for the return leg, there is considerable variation among the alternatives presented in terms of departure time for the return leg. For instance for alternatives that depart considerably earlier for the outward leg, there are observations with a longer duration of stay (possibly with the original return leg departure time) and observations with an earlier departure time for the return leg as well. The models estimated in this report are for the decision-making on both legs of the tour (with the exception of the models for the travel purpose non-home – based business trips).

The utility functions for these base models are based on the Vickrey-Small utility functions, with scheduling penalty terms measured in minutes (also see the report on the model structure of May 2000).

For a person observed making a car tour for some travel purpose, the **utility functions** are as follows (the subscripts refer to the four alternatives presented on a screen):

$U_0 = \alpha\ CARTIME_0 + \beta^0\ EARLY_0 + \gamma^0\ LATE_0 + \beta^r\ REARLY_0 + \gamma^r\ RLATE_0 + \delta\ CARCOST_0 + \ldots$
$U_1 = \alpha\ CARTIME_1 + \beta^0\ EARLY_1 + \beta^r\ REARLY_1 + \delta\ CARCOST_1 + \ldots$
$U_2 = \alpha\ CARTIME_2 + \gamma^0\ LATE_2 + \gamma^r\ RLATE_2 + \delta\ CARCOST_2 + \ldots$
$U_3 = \alpha\ PTTIME_3 + \beta^0\ EARLY_3 + \gamma^0\ LATE_3 + \beta^r\ REARLY_3 + \gamma^r\ RLATE_3 + \delta\ PTCOST_3 + \ldots$

In which:
α, β, γ, δ: coefficients to be estimated (these can also be alternative-specific); the suprscripts o and r denote the outward and the return leg
CARTIME: travel time by car for both tour legs (minutes)
CARCOST: travel cost by car for both tour legs (guilders)
PTTIME: travel time by public transport for both tour legs (minutes)
PTCOST: travel cost by public transport for both tour legs (guilders)
EARLY: early schedule penalty for the outward leg: the difference in minutes between the preferred departure time and the presented departure time, if presented departure time is before the preferred departure time; otherwise zero.
LATE: late schedule penalty for the outward leg: the difference in minutes between the presented departure time and the preferred departure time, if presented departure time is after the preferred departure time; otherwise zero.
REARLY: early schedule penalty for the return leg: the difference in minutes between the preferred departure time and the presented departure time, if presented departure time is before the preferred departure time; otherwise zero.
RLATE: late schedule penalty for the return leg: the difference in minutes between the presented departure time and the preferred departure time, if presented departure time is after the preferred departure time; otherwise zero.

The value of the scheduling penalty variables will usually be smaller for the first and fourth alternative than for the second and third.

For a person observed making a tour by train the utility functions are:

$U_4 = \alpha\ PTTIME_4 + \beta^0\ EARLY_4 + \gamma^0\ LATE_4 + \beta^r\ REARLY_4 + \gamma^r\ RLATE_4 + \delta\ PTCOST_4 + \ldots$
$U_5 = \alpha\ PTTIME_5 + \beta^0\ EARLY_5 + \beta^r\ REARLY_5 + \delta\ PTCOST_5 + \ldots$
$U_6 = \alpha\ PTTIME_6 + \gamma^0\ LATE_6 + \gamma^r\ RLATE_6 + \delta\ PTCOST_6 + \ldots$
$U_7 = \alpha\ CARTIME_7 + \beta^0\ EARLY_7 + \gamma^0\ LATE_7 + \beta^r\ REARLY_7 + \gamma^r\ RLATE_7 + \delta\ CARCOST_7 + \ldots$:

Finally for a person observed making a car trip, the utility functions are:

$U_8 = \alpha\ CARTIME_8 + \beta^0\ EARLY_8 + \gamma^0\ LATE_8 + \delta\ CARCOST_8 + \ldots$
$U_9 = \alpha\ CARTIME_9 + \beta^0\ EARLY_9 + \delta\ CARCOST_9 + \ldots$
$U_{10} = \alpha\ CARTIME_{10} + \gamma^0\ LATE_{10} + \delta\ CARCOST_{10} + \ldots$
$U_{11} = \alpha\ PTTIME_{11} + \beta^0\ EARLY_{11} + \gamma^0\ LATE_{11} + \delta\ PTCOST_0 + \ldots$:

Here, CARTIME, CARCOST, PTTIME and PTCOST refer to a trip, not a tour.

Some respondents have a choice between three alternatives, because the alternative mode was not available (e.g. if no public transport available, or for train users: no driving licence). Because we condition on car availability, we did not include a car to licences ratio in the utility functions.

The **value of time** (VOT) is defined as: α/δ. This gives the VOT in guilders/minute. After multiplying by 60 we obtain the VOT in guilders/hour.

Furthermore we shall calculate **trade-off ratios** for the scheduling penalties versus the travel time coefficients:

- Being early on outward leg: β^o/α
- Being early on return leg: β^r/α
- Being late on outward leg: γ^o/α
- Being late on return leg: γ^r/α

These ratios give the importance of being one minute early or late in terms of a minute travel time. If these ratios are between zero and one, a minute scheduling delay is not as bad as a minute travel time.

Order of model specification tests carried out for the detailed models

We start by estimating models with a limited number of variables:

- Alternative-specific constants
- Travel time and travel cost
- Scheduling penalties (on time of day choice or activity participation time).

This is the minimum amount of variables to be used. First, we try to get a good specification for these key variables. Later on, the error components will be added to the best models with the above ingredients (basically because estimating an error components model takes rather long, because of the simulations that need to be performed). After this, other variables presented on the screen will be added as well.

Finally, models with the best specifications and relevant socio-economic variables and error components will be estimated resulting in the best detailed models. These models will be estimated with jackknife methods to obtain proper t-ratios.

2.1 Base multinomial models

The base multinomial logit that we will use as reference for different tests is presented below. From the beginning we worked with specific models for each purpose as we assumed that travellers have specific preferences and different constraints according to the purpose of their tour or trip. The first model presented is only for **commuting**, the second one for **business**, the third one contains only information from tours for **education** and the last one is concerned with **'other'** purposes. We shall keep this order throughout the report. Please note that in the models presented the t-ratios are overestimated due to the repeated measurement problems in the SP data. This can be corrected using jackknife estimation, however jackknife runs are slow depending on the nnumber of specified subsamples. Therefore we shall apply it on the best estimated models in section 2.21. An overview of all the estimated models is given in the Appendix.

In the business model there are both non-home based business trips and home-based business tours. In the cost for the education purpose we presented cost based on an annual pass also for students with an OVS-card (entitlement to free public transport either during the week or during the weekend). The cost for the specific tour for holders of annual passes were calculated by dividing the annual cost of the pass by the relevant number of tours the respondent made in a year. Almost 80% of the persons travelling for education has an annual ticket (for the other purposes this is between 18 and 65%).

In this base model, we start with scheduling penalty coefficients which are not alternative-specific (e.g. the same for car and public transport). This assumption will be relaxed later.

Estimated coefficients for base multinomial logit models for commuting, business, education and other purposes respectively (t-ratios between brackets)

File	todmod9c.f12		Todmod10b.L12		Todmod9e.f12		Todmod9f.f12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True	
Observations	4979		2871		1073		3280	
Final log (L)	-4286.0		-2583.6		-708.6		-3180.2	
D.O.F.	14		17		14		14	
Rho^2 (0)	0.318		0.291		0.435		0.233	
Rho^2 (c)	0.072		0.083		0.136		0.080	
Prepared	26 Feb 01		28 Feb 01		26 Feb 01		26 Feb 01	
Estimated	26 Feb 01		28 Feb 01		26 Feb 01		26 Feb 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
cearl_c	-1.20	(-22.9)	-1.02	(-9.5)	-1.38	(-2.8)	-1.03	(-15.0)
clate_c	-1.41	(-24.2)	-1.12	(-11.4)	-1.68	(-3.4)	-1.11	(-19.7)
train_c	-1.69	(-12.8)	-1.39	(-7.0)	0.754	(1.8)	-2.19	(-13.6)
Tearly_c	-2.08	(-20.2)	-1.62	(-17.2)	-2.04	(-16.1)	-0.862	(-7.9)
Tlate_c	-2.14	(-19.0)	-1.65	(-17.6)	-1.67	(-13.3)	-0.544	(-6.3)
T_caralt_c	-1.65	(-9.5)	-1.77	(-8.0)	-3.72	(-7.5)	-1.03	(-4.7)
NH_early_c	0	(*)	-0.574	(-4.0)	0	(*)	0	(*)
NH_late_c	0	(*)	-1.22	(-9.3)	0	(*)	0	(*)
NH_PTalt_c	0	(*)	-2.71	(-7.7)	0	(*)	0	(*)
DepEarly	-0.0095	(-8.6)	-0.0132	(-9.8)	-0.0133	(-4.5)	-0.0072	(-9.5)
RDepEarly	-0.0028	(-1.9)	-0.0063	(-2.8)	-0.0113	(-2.3)	-8.5e-5	(-0.1)
DepLate	-0.0080	(-9.3)	-0.0074	(-7.0)	-0.0060	(-3.5)	-0.0057	(-4.4)
RDepLate	-0.0037	(-3.2)	-0.0035	(-2.1)	-0.0100	(-2.6)	1.3e-4	(0.1)
Ccost_Com	-0.0147	(-8.0)						
Tcost_Com	-0.0142	(-5.8)						
ctime_com	-0.0120	(-11.9)						
ttime_com	-0.0140	(-12.0)						
Ccost_Bus			-0.0074	(-4.8)				
Tcost_Bus			-0.0157	(-5.8)				
ctime_bus			-0.0116	(-8.5)				
ttime_bus			-0.0115	(-9.4)				
Ccost_Edu					-0.0800	(-4.8)		
Tcost_Edu					-7.1e-4	(-0.1)		
ctime_edu					-0.0095	(-2.0)		
ttime_edu					-0.0388	(-9.1)		
Ccost_Oth							-0.0060	(-2.7)
Tcost_Oth							-0.0128	(-4.6)
ctime_Oth							-0.0158	(-12.4)
ttime_oth							-0.0143	(-11.6)

In the table below we describe the variables used in these base models. Each time that we include a new variable in the model, we shall explain it in the appropriate paragraph. In annex A, all variables used in the tables in this report are listed.

Description of variables used

Variable	Description
Cearl_c	Constant – Car earlier alternative
Clate_c	Constant – Car later alternative
Train_c	Constant – Car 'switch mode' alternative
Tearly_c	Constant – Train earlier alternative
Tlate_c	Constant – Train later alternative
T_caralt_c	Constant – Train 'switch mode' alternative
NH_early_c	Constant – Car non-home based trips earlier alternative
NH_late_c	Constant – Car non-home based trips later alternative
NH_PTalt_c	Constant – Car non-home based trips 'switch mode' alternative
DepEarly	Early schedule penalty – outward leg
DepLate	Late schedule penalty – outward leg
RdepEearly	Early schedule penalty – return leg
RdepLate	Late schedule penalty – return leg
Ccost_com	Car cost – Commuting
Tcost_com	Train cost– Commuting
Ccost_bus	Car cost – Business
Tcost_bus	Train cost– Business
Ccost_edu	Car cost – Education
Tcost_edu	Train cost– Education
Ccost_oth	Car cost – 'Other' purposes
Tcost_oth	Train cost– 'Other' purposes
Ctime_com	Car time – Commuting
Ttime_com	Train time – Commuting
Ctime_bus	Car time – Business
Ttime_bus	Train time – Business
Ctime_edu	Car time – Education
Ttime_edu	Train time – Education
Ctime_oth	Car time – 'Other' purposes
Ttime_oth	Train time – 'Other' purposes
*	Not relevant

The early schedule penalty is the difference between the preferred or reported departure time on the one hand and the time that was presented on the screen on the other hand, provided that this difference is positive. The late schedule penalty is the difference between the departure time that was presented on the screen and the respondent's preferred or reported departure time, provided that this difference is positive. The preferred departure or arrival times for many respondents were equal to the observed times. We only asked about the preferred times if the respondents said that they didn't depart/arrive at their preferred departure/arrival time. Therefore, for the preferred departure time we use the reported departure time, unless a different preferred departure time was given. In the Appendix a detailed list of all the variables used in the models is given.

The values of time (guilders/hour) and scheduling trade-off ratios from these models are presented in the tables below. The definition of the value of time and the other trade-off ratios can be found in the above presentation of the utility functions. For the scheduling trade-offs we used the train time coefficient in the denominator. In these tables we only use coefficients which are significant

(but please note that after jackknifing some coefficients which are significant can become insignificant afterwards).

Values of time (guilders/hour)

	Commuting	Business	Education	Other
Car	49	94	7	158
Train	59	44	/	67

Scheduling trade-off ratios (using train travel time)

Variable	Schedule penalty coefficient divided by travel time coefficient			
	Commuting	Business	Education	Other
Early schedule penalty – Outward leg	0.68	1.15	0.34	0.50
Late schedule penalty – Outward leg	0.57	0.64	0.15	0.40
Early schedule penalty – Return leg	0.20	0.55	0.29	/
Late schedule penalty – Return leg	0.26	0.30	0.26	/

Discussion of outcomes

Only three variables are not significant and/or don't have the right sign: the train cost coefficient in the education model and the early and late schedule penalties for the return leg in the 'other' purposes model. All the values of time are quite high compared to the values AVV recommends for evaluation purposes, except for education, car users. These models show that we were able to run a correct model with the data we received, however some tests need to be done in order to improve them.

2.2 Test 1 : Exclude the respondents who didn't change their behaviour from the dataset.

We excluded respondents who never changed their behaviour throughout the experiments and who always made the same choice. One might assume that these respondents didn't participate correctly in the game, making always the same choices in order to answer quickly, without taking time to look at all the alternatives.

Estimated coefficients for multinomial logit models excluding persons who never changed their choice for commuting, business, education and other purposes respectively (t-ratios between brackets)

File	TODMOD12C.L12		Todmod12b.L12		Todmod12e.L12		Todmod12f.L12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True	
Observations	4419		2535		785		2976	
Final log (L)	-4087.6		-2424.3		-623.0		-2995.1	
D.O.F.	14		17		14		14	
$Rho^2(0)$	0.270		0.246		0.335		0.204	
$Rho^2(c)$	0.071		0.087		0.155		0.085	
Prepared	1 Mar 01		1 Mar 01		1 Mar 01		1 Mar 01	
Estimated	1 Mar 01		1 Mar 01		1 Mar 01		1 Mar 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
cearl_c	-1.05	(-19.7)	-0.772	(-6.9)	-1.43	(-2.9)	-0.819	(-11.6)
clate_c	-1.27	(-21.4)	-0.882	(-8.7)	-1.71	(-3.4)	-0.928	(-16.0)
train_c	-1.52	(-11.5)	-0.957	(-4.7)	0.812	(1.9)	-2.03	(-12.5)
Tearly_c	-1.74	(-16.6)	-1.39	(-14.5)	-1.50	(-11.3)	-0.664	(-6.0)
Tlate_c	-1.82	(-15.9)	-1.50	(-15.7)	-1.22	(-9.3)	-0.398	(-4.5)
T_caralt_c	-1.49	(-8.5)	-1.71	(-7.4)	-3.91	(-7.4)	-0.777	(-3.5)
NH_early_c	0	(*)	-0.367	(-2.5)	0	(*)	0	(*)
NH_late_c	0	(*)	-1.10	(-8.2)	0	(*)	0	(*)
NH_PTalt_c	0	(*)	-2.51	(-7.1)	0	(*)	0	(*)
DepEarly	-0.0096	(-8.8)	-0.0134	(-9.9)	-0.0122	(-4.5)	-0.0073	(-9.6)
RDepEarly	-0.0027	(-1.8)	-0.0064	(-2.8)	-0.0100	(-2.2)	-2.2e-5	(-0.0)
DepLate	-0.0080	(-9.2)	-0.0071	(-6.6)	-0.0053	(-2.7)	-0.0051	(-3.7)
RDepLate	-0.0038	(-3.3)	-0.0035	(-2.1)	-0.0112	(-2.7)	-5.9e-4	(-0.3)
Ccost_Com	-0.0139	(-7.6)						
Tcost_Com	-0.0134	(-5.4)						
ctime_com	-0.0112	(-11.2)						
ttime_com	-0.0135	(-11.6)						
Ccost_Bus			-0.0061	(-4.0)				
Tcost_Bus			-0.0176	(-6.3)				
ctime_bus			-0.0120	(-8.6)				
ttime_bus			-0.0112	(-8.9)				
Ccost_Edu					-0.0874	(-5.0)		
Tcost_Edu					-5.4e-4	(-0.1)		
ctime_edu					-0.0108	(-2.2)		
ttime_edu					-0.0428	(-9.1)		
Ccost_Oth							-0.0052	(-2.3)
Tcost_Oth							-0.0126	(-4.4)
ctime_Oth							-0.0160	(-12.3)
ttime_oth							-0.0140	(-11.3)

The values of time for each purpose are presented in the table below.

Values of time (guilders/hour)

	Commuting	Business	Education	Other
Car	48	118	7	184
Train	60	38	/	66

In the table below, we present the ratios of schedule penalty coefficient to train travel time coefficient only, later on we shall calculate different ratios based on car travel time coefficients for car users and on train travel time coefficients for train users.

Scheduling trade-off ratios (using train travel time)

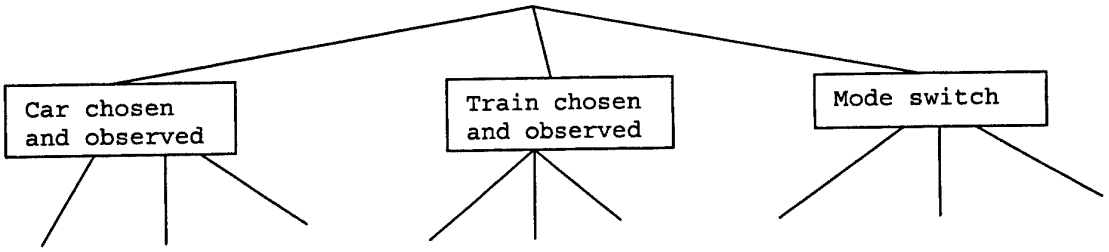
Variable	Schedule penalty coefficient divided by travel time coefficient			
	Commuting	Business	Education	Other
Early schedule penalty – Outward leg	0.71	1.19	0.285	0.136
Late schedule penalty – Outward leg	0.59	0.63	0.123	0.36
Early schedule penalty – Return leg	0.2	0.57	0.233	/
Late schedule penalty – Return leg	0.28	0.31	0.261	/

Discussion of outcomes

The models obtained are not very different from the base models. Generally, the rho-squared and t-ratios are lower than in the base model (the loglikelihood values cannot be compared due to the different number of observations). The values of time are also quite similar, except for business – car users. There is then no reason to exclude respondents who did not change their behaviour from the models. We return to the base specification including the non-changers.

2.3 Test 2: Nested logit model.

We estimated a nested logit model. The structure of this model is presented below. The utility functions, using the numbering in the introduction, are indicated in the bottom row. The utility functions are the same as before, except for the introduction of an extra tree coefficient or nest coefficient (1 - nest coefficient is a measure of the correlation between alternatives). The model is not conditional on observed mode choice; the train utility function for persons observed as car drivers and the train utility functions for train travellers are basically the same.



The results of this model are presented below. The variable 'Nestcoef' in this table is the extra coefficient for the nest, with the same value for all three nests.

Estimated coefficients for nested logit models for commuting, business, education and other purposes respectively (t-ratios between brackets)

File	TODMOD10C.F12		Todmod10b.F12		Todmod10e.F12		Todmod10f.F12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True	
Observations	4979		2871		1073		3280	
Final log (L)	-4273.5		-2582.1		-697.8		-3179.0	
D.O.F.	15		18		15		15	
$Rho^2(0)$	0.320		0.291		0.443		0.234	
$Rho^2(c)$	0.075		0.084		0.150		0.081	
Prepared	28 Feb 01		28 Feb 01		28 Feb 01		28 Feb 01	
Estimated	28 Feb 01		28 Feb 01		28 Feb 01		28 Feb 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
cearl_c	-1.33	(-22.5)	-1.08	(-9.4)	-1.55	(-3.2)	-1.00	(-14.4)
clate_c	-1.54	(-23.6)	-1.17	(-11.2)	-1.62	(-3.3)	-1.08	(-18.6)
train_c	-4.11	(-5.8)	-2.08	(-4.0)	0.511	(2.7)	-1.61	(-4.5)
Tearly_c	-2.12	(-20.3)	-1.62	(-17.1)	-2.01	(-16.0)	-0.856	(-7.9)
Tlate_c	-2.26	(-18.0)	-1.68	(-17.2)	-1.63	(-14.0)	-0.547	(-6.4)
T_caralt_c	-3.33	(-6.3)	-2.40	(-4.9)	-1.63	(-3.3)	-0.781	(-3.3)
NH_early_c	0	(*)	-0.598	(-4.1)	0	(*)	0	(*)
NH_late_c	0	(*)	-1.23	(-9.3)	0	(*)	0	(*)
NH_PTalt_c	0	(*)	-3.85	(-4.3)	0	(*)	0	(*)
DepEarly	-0.0102	(-8.8)	-0.0134	(-9.7)	-0.0114	(-4.2)	-0.0071	(-9.4)
RDepEarly	-0.0029	(-1.8)	-0.0067	(-2.8)	-0.0084	(-2.0)	-1.2e-4	(-0.1)
DepLate	-0.0086	(-9.4)	-0.0079	(-7.1)	-0.0060	(-3.7)	-0.0054	(-4.2)
RDepLate	-0.0032	(-2.7)	-0.0033	(-1.9)	-0.0053	(-2.1)	-6.7e-5	(-0.0)
Ccost_Com	-0.0311	(-5.6)						
Tcost_Com	-0.0206	(-5.3)						
ctime_com	-0.0198	(-10.4)						
ttime_com	-0.0255	(-8.0)						
nestcoef	0.470	(7.0)	0.735	(5.8)	3.00	(3.7)	1.28	(6.3)
Ccost_Bus			-0.0097	(-3.8)				
Tcost_Bus			-0.0177	(-5.3)				
ctime_bus			-0.0148	(-6.0)				
ttime_bus			-0.0152	(-5.6)				
Ccost_Edu					-0.0429	(-3.5)		
Tcost_Edu					-2.3e-4	(-0.1)		
ctime_edu					-0.0046	(-1.8)		
ttime_edu					-0.0199	(-4.0)		
Ccost_Oth							-0.0045	(-2.3)
Tcost_Oth							-0.0125	(-4.9)
ctime_Oth							-0.0135	(-7.2)
ttime_oth							-0.0118	(-6.5)

The values of time from the nested logit models are presented below.

Value of time (guilders/hour)

	Commuting	Business	Education	Other
Car	38	92	/	180
Train	74	52	/	56

In the table below, we present the ratios of schedule penalty coefficient to train travel time coefficient.

Scheduling trade-off ratios (using train travel time)

Variable	Schedule penalty coefficient divided by travel time coefficient			
	Commuting	Business	Education	Other
Early schedule penalty – Outward leg	0.4	0.88	0.57	0.60
Late schedule penalty – Outward leg	0.33	0.52	0.30	0.45
Early schedule penalty – Return leg	0.11	0.44	0.42	/
Late schedule penalty – Return leg	0.12	0.21	0.26	/

Discussion of outcomes

The estimation results can be compared to the base model in section 2.1. The new structure significantly improves the likelihood of the model for commuting. For business the increase in the loglikelihood value (1.5 points) is not a significant improvement over the base model (critical chi^2 value at 95% is 1.92). For both commuting and business the nest coefficient (nestcoef) is significantly smaller than 1, as required for random utility maximisation. The nest coefficient (nestcoef) is higher than one for education and 'other' purpose. This is not consistent with random utility theory. It means that this nested structure is not appropriate for these purposes.

2.4 Test 3: Change in the number of alternative-specific constants

We present below models similar to our base nested models in 2.3 but with fewer constants. These have only three constants (instead of nine before):

- Train_c: constant for car observed and train chosen in SP;
- T_caralt_c: constant for train observed and car chosen in SP;
- TrTswi_C: constant for train earlier or later alternatives chosen in SP.

Estimated coefficients for nested logit models with 3 constants instead of 9 for commuting, business, education and other purposes respectively (t-ratios between brackets)

File	TODMOD17C.F12		Todmod17b.F12		Todmod17e.F12		Todmod17f.F12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True	
Observations	4979		2871		1073		3280	
Final log (L)	-4782.3		-2728.1		-711.3		-3433.1	
D.O.F.	12		12		12		12	
$Rho^2(0)$	0.239		0.251		0.433		0.172	
$Rho^2(c)$	-0.036		0.032		0.133		0.007	
Prepared	5 Mar 01		5 Mar 01		5 Mar 01		5 Mar 01	
Estimated	5 Mar 01		5 Mar 01		5 Mar 01		5 Mar 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
train_c	-1.15	(-3.9)	-1.30	(-3.8)	1.21	(6.2)	-0.478	(-2.7)
T_caralt_c	-1.76	(-5.7)	-1.65	(-4.8)	-1.91	(-4.2)	-0.284	(-1.9)
TrTswi_C	-1.97	(-24.8)	-1.54	(-22.2)	-1.82	(-20.8)	-0.566	(-7.7)
DepEarly	-0.0175	(-15.6)	-0.0153	(-13.5)	-0.0135	(-4.9)	-0.0093	(-12.5)
RDepEarly	-0.0060	(-3.8)	-0.0090	(-3.8)	-0.0102	(-2.3)	-0.0011	(-1.2)
DepLate	-0.0153	(-16.3)	-0.0130	(-11.9)	-0.0054	(-3.4)	-0.0091	(-7.4)
RDepLate	-0.0064	(-5.4)	-0.0047	(-2.8)	-0.0057	(-2.1)	-0.0038	(-2.4)
Ccost_Com	-0.0187	(-5.7)						
Tcost_Com	-0.0099	(-3.7)						
ctime_com	-0.0036	(-3.5)						
ttime_com	-0.0108	(-7.5)						
nestcoef	0.924	(7.3)	0.983	(6.9)	2.51	(4.5)	1.84	(8.3)
Ccost_Bus			-0.0099	(-4.6)				
Tcost_Bus			-0.0140	(-5.1)				
ctime_bus			-0.0067	(-5.2)				
ttime_bus			-0.0088	(-5.6)				
Ccost_Edu					-0.0492	(-4.1)		
Tcost_Edu					-0.0020	(-0.6)		
ctime_edu					-0.0054	(-1.9)		
ttime_edu					-0.0225	(-5.0)		
Ccost_Oth							-0.0045	(-3.2)
Tcost_Oth							-0.0090	(-4.6)
ctime_Oth							-0.0070	(-7.7)
ttime_oth							-0.0068	(-7.7)

The values of time (guilders/ hour) derived from this model are presented in the table below.

Values of time (guilders/hour)

	Commuting	Business	Education	Other
Car	12	41	/	93
Train	65	38	/	45

In the table below we present the ratios of scheduling delay to train travel time coefficients.

Scheduling trade-off ratios (using train travel time)

Variable	Schedule penalty coefficient divided by travel time coefficient			
	Commuting	Business	Education	Other
Early schedule penalty – Outward leg	1.62	1.73	0.6	1.36
Late schedule penalty – Outward leg	1.41	1.47	0.24	1.33
Early schedule penalty – Return leg	0.55	1.02	0.45	/
Late schedule penalty – Return leg	0.59	0.53	0.25	0.55

Discussion

The loglikelihood of the models with nine constants (of section 2.3) is significantly higher than in the models with only three constants presented here. Nevertheless there is no behavioural

interpretation for constants referring to TOD alternatives. The rho² with respect to 'only constants' does not do justice to the model with three constants, since 'only constants' here means 11 constants. The values of time calculated from the models with three constants are lower and more plausible than the ones we obtained from the previous models. Only the value of time for education remains low and cannot be calculated. It is also worth noting that the train cost coefficient for education tours is still not significant. All other tests will be based on models using these three constants. The nest coefficients in the models for commuting and business are close to one: the models are not significantly different from multinomial logit models. For education and 'other', the nesting structure tested remains inappropriate.

2.5 Test 4: Separation between train and car users.

From now on we are using the complete database. Until now we have presented mainly nested logit models. As explained above these didn't give satisfactory results, therefore the following tests are based on a multinomial logit model. Later on, we shall try again to estimate a nested logit model.

The train costs variables used in the models presented in this section are :

- Tkaart: train cost coefficient for 'vastrecht', 'vastrecht' are train users having a NS seasonal ticket, either a 'NS jaarkaart', an 'OV jaarkaart' or a 'jaartrajectkaart';
- Tother: train cost coefficient for other train users;

2.5.1 Commuting

The first model presented includes all commuters, the second one includes only car users and the third one only train users. Model todcom1b has only one cost coefficient for train users.

Estimated coefficients for multinomial logit models with three constants for commuting (t-ratios between brackets): all commuters, car users, train users all commuters respectively

File	Todcom01.f12		Todcomc1.f12		Todcomt1.f12		todcom1b.f12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True	
Observations	6212		4648		1564		6212	
Final log (L)	-6066.0		-4844.4		-1153.2		-6067.9	
D.O.F.	12		9		11		11	
Rho²(0)	0.232		0.185		0.410		0.232	
Rho²(c)	-0.038		-0.052		0.069		-0.038	
Prepared	18 Apr 01		12 Apr 01		12 Apr 01		24 Apr 01	
Estimated	18 Apr 01		12 Apr 01		12 Apr 01		24 Apr 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
train_c	-1.13	(-10.0)	-1.27	(-9.1)	0	(*)	-1.12	(-10.0)
T_caralt_c	-1.78	(-10.1)	0	(*)	-1.72	(-8.0)	-1.63	(-10.5)
TrTswi_C	-1.98	(-26.7)	0	(*)	-2.14	(-27.0)	-1.97	(-26.6)
DepEarly	-0.0165	(-18.2)	-0.0176	(-17.5)	-0.0157	(-5.8)	-0.0165	(-18.2)
RDepEarly	-0.0051	(-4.0)	-0.0046	(-3.2)	-0.0069	(-2.1)	-0.0052	(-4.0)
DepLate	-0.0155	(-20.4)	-0.0200	(-20.2)	-0.0042	(-3.6)	-0.0155	(-20.4)
RDepLate	-0.0053	(-5.4)	-0.0041	(-3.6)	-8.3e-4	(-0.4)	-0.0053	(-5.4)
Ccost_Com	-0.0145	(-9.9)	-0.0127	(-6.6)	-0.0164	(-6.6)	-0.0153	(-10.6)
ctime_com	-3.6e-4	(-2.8)	-4.5e-4	(-0.4)	-3.1e-4	(-2.4)	-3.6e-4	(-2.8)
ttime_com	-0.0082	(-8.8)	-0.0069	(-4.7)	-0.0080	(-6.9)	-0.0076	(-8.8)
Tkaartc	-0.0096	(-3.8)	0	(*)	-0.0089	(-3.5)		
Totherc	-0.0026	(-0.8)	-0.0018	(-0.4)	-0.0043	(-1.0)		
Tcost_Com							-0.0073	(-3.2)

We present below values of time and ratios of schedule penalty to train time coefficient from models todcom01, todcomc1 and todcomt1.

Values of time (guilders/hour)

	All commuters	Only car users	Only train users
Car	1	2	1
Train – Vastrecht	51	/	54
Train – normal ticket	/	/	/

Scheduling trade-off ratios

Variable	Schedule penalty coefficient divided by travel time coefficient		
	All commuters	Only car users	Only train users
Early schedule penalty – Outward leg	2.01	2.55	1.96
Late schedule penalty – Outward leg	1.89	2.89	0.52
Early schedule penalty – Return leg	0.62	0.66	0.86
Late schedule penalty – Return leg	0.64	0.59	0.10

Discussion

The loglikelihoods of the models for car users and train users can be added and compared to the model in the first column. The critical Chi^2 value for eight coefficients restricted to be the same is 15.5. The total likelihood is significantly improved by the split between car users and train users, but the car time coefficient is not significant in model todcomc1. The split on the cost coefficient for train does not improve the model significantly, and will not be chosen. For these reasons we prefer model todcom01, even though the car VOT is quite low. This is not caused by the fact that all variation in car time should come from comparing modes; car time also varies between TOD alternatives within the car mode.

2.5.2 Business

The first model presented includes all respondents travelling for 'business' purpose (including non-home-based trips), the second one includes only car users and the third one only train users. Both travellers making a home-based-tour and travellers making a non-home-based trip are included in these models. Model 1 has only one cost coefficient for train users.

Estimated coefficients for multinomial logit models with three constants for business (t-ratios between brackets): all business, car users, train users, all business respectively

File	todbus02.f12		bus02car.f12		bus02tra.f12		todbus01.f12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True	
Observations	3812		2204		1608		3812	
Final log (L)	-3626.6		-2116.8		-1428.1		-3626.7	
D.O.F.	12		9		11		11	
Rho²(0)	0.250		0.239		0.305		0.250	
Rho²(c)	0.035		0.058		0.055		0.035	
Prepared	12 Apr 01		12 Apr 01		12 Apr 01		12 Apr 01	
Estimated	12 Apr 01		12 Apr 01		12 Apr 01		12 Apr 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
train_c	-1.25	(-8.3)	-1.20	(-5.4)	0	(*)	-1.25	(-8.4)
T_caralt_c	-1.93	(-9.4)	0	(*)	-1.91	(-8.1)	-1.94	(-9.9)
TrTswi_C	-1.53	(-22.6)	0	(*)	-1.69	(-23.8)	-1.53	(-22.9)
DepEarly	-0.0169	(-17.5)	-0.0208	(-17.4)	-0.0092	(-4.4)	-0.0169	(-17.5)
RDepEarly	-0.0082	(-4.2)	-0.0056	(-2.3)	-0.0109	(-3.1)	-0.0082	(-4.1)
DepLate	-0.0156	(-17.1)	-0.0220	(-17.3)	-0.0054	(-4.4)	-0.0156	(-17.1)
RDepLate	-0.0043	(-2.9)	-0.0068	(-3.1)	0.0011	(0.6)	-0.0043	(-2.9)
Ccost_Bus	-0.0034	(-3.2)	-0.0197	(-7.1)	-8.2e-4	(-0.8)	-0.0034	(-3.2)
ctime_bus	-0.0072	(-6.9)	-0.0064	(-4.0)	-0.0076	(-5.5)	-0.0072	(-6.9)
ttime_bus	-0.0092	(-8.7)	-0.0184	(-7.0)	-0.0080	(-6.5)	-0.0093	(-8.8)
Tkaartb	-0.0086	(-1.5)			-0.0051	(-0.9)		
Totherb	-0.0101	(-4.2)			-0.0108	(-4.2)		
Tcost_Bus			-0.0134	(-1.8)	0	(*)	-0.0100	(-4.2)

We present below values of time and ratios of schedule penalty to train time coefficient from models 2, 2car and 2tra.

Value of time (guilders/hour)

	All business	Only car users	Only train users
Car	127	19	/
Train – Vastrecht	64	/	/
Train – normal ticket	54	/	81

Scheduling trade-off ratios

Variable	Schedule penalty coefficient divided by travel time coefficient		
	All business	Only car users	Only train users
Early schedule penalty – Outward leg	1.83	1.13	1.15
Late schedule penalty – Outward leg	0.89	0.304	1.36
Early schedule penalty – Return leg	1.69	1.19	0.675
Late schedule penalty – Return leg	0.46	0.37	/

Discussion of outcomes

The split between car users and train users for business travel improves the total likelihood significantly. However, several cost variables of the separated models are not significant. The split in the cost coefficient for train users does not improve the model significantly, and willnot be chosen. We prefer model todbus02.

2.5.3 Education

The first model presented includes all respondents travelling for education purpose, the second one includes only car users and the third one only train users. Model todedu1b has only one cost coefficient for train.

Estimated coefficients for multinomial logit models with three constants for education (t-ratios between brackets): all education, car users, train users, all education respectively

File	todedu01.f12		todedu1c.f12		todedu1t.f12		Todedu1b.F12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True	
Observations	1250		57		1193		1250	
Final log (L)	-861.1		-51.5		-788.1		-900.9	
D.O.F.	12		9		11		11	
Rho²(0)	0.414		0.336		0.434		0.387	
Rho²(c)	0.125		0.191		0.144		0.085	
Prepared	12 Apr 01		12 Apr 01		12 Apr 01		24 Apr 01	
Estimated	12 Apr 01		12 Apr 01		12 Apr 01		24 Apr 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
train_c	1.56	(3.9)	0.0100	(0.0)	0	(*)	1.57	(4.1)
T_caralt_c	-2.89	(-6.2)	0	(*)	-3.53	(-6.3)	-3.48	(-8.2)
TrTswi_C	-1.72	(-21.3)	0	(*)	-1.76	(-21.4)	-1.77	(-22.1)
DepEarly	-0.0137	(-5.6)	-0.0258	(-1.6)	-0.0126	(-5.1)	-0.0128	(-5.2)
RDepEarly	-0.0149	(-3.1)	-0.0247	(-0.7)	-0.0145	(-2.9)	-0.0169	(-3.3)
DepLate	-0.0063	(-4.0)	-0.0413	(-1.3)	-0.0055	(-3.5)	-0.0077	(-4.9)
RDepLate	-0.0101	(-3.0)	-0.169	(-2.2)	-0.0076	(-2.4)	-0.0088	(-2.8)
Ccost_Edu	-0.0794	(-5.9)	0.0814	(1.1)	-0.107	(-6.1)	-0.0272	(-4.2)
ctime_edu	-0.0148	(-3.9)	-0.0140	(-0.9)	-0.0056	(-1.2)	-0.0110	(-3.9)
ttime_edu	-0.0348	(-9.7)	-0.0045	(-0.2)	-0.0368	(-9.5)	-0.0233	(-8.2)
Tkaarte	0.0036	(0.8)			0.0016	(0.4)		
Tothere	-0.0467	(-7.9)			-0.0571	(-7.8)		
Tcost_Edu			0.0632	(1.1)			-0.0168	(-6.5)

We present below the values of time and ratios of schedule penalty to train time coefficient from models 1, 1c and 1t.

Value of time (guilders/hour)

	All education	Only car users	Only train users
Car	11	/	3.1
Train – Vastrecht	/	/	/
Train – normal ticket	45	/	38.6

Scheduling trade-off ratios

Variable	Schedule penalty coefficient divided by travel time coefficient		
	All education	Only car users	Only train users
Early schedule penalty – Outward leg	0.39	/	0.34
Late schedule penalty – Outward leg	0.18	/	0.15
Early schedule penalty – Return leg	0.43	/	0.39
Late schedule penalty – Return leg	0.29	/	0.21

Discussion of outcomes

The split between car and train users improves the total likelihood significantly, but the time and cost coefficients in the 'car users only' model are not significant anymore, and the cost coefficient becomes positive. The split of the train cost coefficient between 'vastrecht' and other train users does improve the model but the coefficient of 'Tkaarte' is not significant (maybe because the cost calculated per tour are rather low). The preferred model is the one without splitting between car and train users and without splitting the train cost.

2.5.4 *'Other' purposes*

The first model presented includes all respondents travelling for 'other' purposes, the second one includes only car users and the third one only train users. Model todoth1b has only one cost coefficient for train users.

Estimated coefficients for multinomial logit models with three constants for 'other' purposes (t-ratios between brackets): all 'other', car users, train users, all 'other' respectively

File	Todoth01.f12		Todoth1c.f12		Todoth1t.f12		todoth1b.f12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True	
Observations	3224		2274		950		3224	
Final log (L)	-3350.9		-2333.8		-944.9		-3351.5	
D.O.F.	12		9		11		11	
Rho²(0)	0.177		0.197		0.189		0.177	
Rho²(c)	0.007		-0.003		0.098		0.007	
Prepared	12 Apr 01		12 Apr 01		12 Apr 01		24 Apr 01	
Estimated	12 Apr 01		12 Apr 01		12 Apr 01		24 Apr 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
train_c	-1.58	(-10.3)	-2.04	(-9.6)	0	(*)	-1.55	(-10.2)
T_caralt_c	-0.824	(-3.7)	0	(*)	-1.45	(-5.0)	-0.919	(-4.5)
TrTswi_C	-0.700	(-9.2)	0	(*)	-0.914	(-11.3)	-0.696	(-9.2)
DepEarly	-0.0097	(-12.4)	-0.0128	(-10.9)	-0.0037	(-3.6)	-0.0097	(-12.4)
RDepEarly	-0.0014	(-1.4)	-7.7e-5	(-0.1)	-0.0017	(-1.0)	-0.0014	(-1.4)
DepLate	-0.0105	(-8.0)	-0.0148	(-7.4)	-0.0053	(-3.2)	-0.0103	(-7.9)
RDepLate	-0.0051	(-2.7)	-0.0107	(-3.7)	0.0031	(1.2)	-0.0051	(-2.7)
Ccost_Oth	-0.0106	(-5.0)	-0.0018	(-0.6)	-0.0242	(-5.0)	-0.0105	(-5.0)
ctime_Oth	-0.0092	(-7.4)	-0.0077	(-5.7)	-0.0080	(-2.9)	-0.0089	(-7.3)
ttime_oth	-0.0089	(-7.4)	-0.0084	(-4.0)	-0.0120	(-6.6)	-0.0093	(-8.3)
Tkaarto	-0.0156	(-4.5)			-0.0211	(-5.6)		
Tothero	-0.0214	(-5.5)	0.0136	(2.1)	-0.0361	(-7.6)		
Tcost_Oth							-0.0181	(-6.6)

We present below VoTs and ratios of schedule penalty to train time coefficient from models 1, 1c and 1t.

Value of time (guilders/hour)

	All other	Only car users	Only train users
Car	52	256	20
Train – Vastrecht	34		34
Train – normal ticket	24	37	20

Scheduling trade-off ratios

Variable	Schedule penalty coefficient divided by travel time coefficient		
	All other	Only car users	Only train users
Early schedule penalty – Outward leg	1.09	1.52	0.308
Late schedule penalty – Outward leg	0.157	1.76	0.44
Early schedule penalty – Return leg	1.17	/	/
Late schedule penalty – Return leg	0.57	1.27	/

Discussion of outcomes

The split between car and train users significantly improves the total likelihood. However, splitting the models between car and train users is not a good alternative: several cost and time coefficients become insignificant in the separate models. The split in train cost coefficient for train users does not improve the model, and will not be chosen. Model todoth01 is the preferred model.

2.6 *Test 5: split of home-based and non home-based business.*

In section 2.5.2 we tested splitting business travellers into car and train users. Here we test splitting between home-based tours (with car and train as observed modes) and non-home-based business trips (only with car as observed mode). Model 1h contains both car and train users who made a home-based tour for business purpose. Model 1n contains only car users who made a non-home-based trip for business purpose. Model 1hcar contains only car users who made a home-based tour and 1htra only train users who made a home-based tour.

Estimated coefficients for multinomial logit models with three constants for business (t-ratios between brackets): home-based tours, non-home-based trips, home-based car tours and home-based train tours respectively

File	todbus1h.f12		todbus1n.f12		bus1hcar.f12		bus1htra.f12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True	
Observations	2976		836		1368		1608	
Final log (L)	-2840.2		-741.0		-1344.5		-1428.1	
D.O.F.	12		7		9		11	
Rho² (0)	0.250		0.294		0.224		0.305	
Rho² (c)	0.031		0.106		0.053		0.055	
Prepared	19 Apr 01		12 Apr 01		12 Apr 01		19 Apr 01	
Estimated	19 Apr 01		12 Apr 01		12 Apr 01		19 Apr 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
train_c	-0.623	(-3.6)	-3.15	(-4.9)	-0.118	(-0.4)	0	(*)
T_caralt_c	-2.17	(-10.3)	0	(*)	0	(*)	-1.91	(-8.1)
TrTswi_C	-1.55	(-23.0)	0	(*)	0	(*)	-1.69	(-23.8)
DepEarly	-0.0149	(-11.4)	-0.0219	(-13.8)	-0.0206	(-10.5)	-0.0092	(-4.4)
RDepEarly	-0.0085	(-4.2)	0	(*)	-0.0050	(-1.8)	-0.0109	(-3.1)
DepLate	-0.0118	(-11.0)	-0.0236	(-13.8)	-0.0210	(-10.4)	-0.0054	(-4.4)
RDepLate	-0.0060	(-3.9)	0	(*)	-0.0071	(-2.9)	0.0011	(0.6)
Ccost_Bus	-0.0032	(-3.1)	0.0088	(0.5)	-0.0187	(-6.5)	-8.2e-4	(-0.8)
ctime_bus	-0.0057	(-5.4)	-0.0235	(-5.6)	-0.0025	(-1.4)	-0.0076	(-5.5)
ttime_bus	-0.0091	(-8.6)	-0.0308	(-3.0)	-0.0198	(-7.2)	-0.0080	(-6.5)
Tkaartb	-0.0082	(-1.5)					-0.0051	(-0.9)
Totherb	-0.0094	(-3.9)	0.0434	(1.9)	-0.0094	(-1.0)	-0.0108	(-4.2)

We present below the values of time and ratios of schedule penalty to train time coefficient from these models.

Value of time (guilders/hour)

	All business home-based	All business non home-based	Business home based – Only car users	Business home based – Only train users
Car	106	/	8	/
Train – Vastrecht	66	/	/	94
Train – normal ticket	58	/	126	44

Scheduling trade-off ratios (using train time in the denominator)

Variable and Mode	Schedule penalty coefficient divided by travel time coefficient			
	All business home-based	All business non home-based	Business home based – Only car users	Business home based – Only train users
Early schedule penalty – Outward leg	1.63	0.71	1.04	1.15
Late schedule penalty – Outward leg	1.29	0.76	1.06	0.87
Early schedule penalty – Return leg	0.93	/	/	1.36
Late schedule penalty – Return leg	0.66	/	0.55	/

Discussion of outcomes

The split between home-based and non-home-based business models (1h and 1n) significantly improves the likelihood, compared to model todbus02 in section 2.5.2. No value of time could be calculated from model todbus1n (non-home based trips only), due to the non-significant cost coefficients. Therefore we prefer to merge the business trips with the business tours, as in model todbus02.

2.7 Test 6: Split of flexible and non-flexible working hours for commuters.

In the model todcom04, we included two dummies in the retimed alternative utility functions (earlier and later: U_1, U_2, U_5,U_6, U_9 and U_{10} in the notation of section 2.1), ccarflex for car users and ttraflex for train users. These dummies are equal to one if the respondent has flexible working hours and 0 otherwise. In model todcom05, we included only commuters with flexible working hours and in todcom06 only commuters with non-flexible working hours.

We also present model todcom01, the base model and model todcom04 to see the benefit of the new dummies.

Estimated coefficients for multinomial logit models with three constants for commuting (t-ratios between brackets): all commuters, all commuters including coefficients for flexible and non-flexible work hours, commuters with flexible work hours and commuters with non-flexible work hours respectively

File	todcom01.f12	todcom04.f12	todcom05.f12	todcom06.f12
Title	TOD MODEL	TOD MODEL	TOD MODEL	TOD MODEL
Converged	True	True	True	True
Observations	6212	6212	3106	3106
Final log (L)	-6066.0	-5918.5	-2953.4	-3007.5
D.O.F.	12	14	12	12
Rho²(0)	0.232	0.251	0.250	0.240
Rho²(c)	-0.038	-0.013	0.024	-0.087
Prepared	18 April 01	18 Apr 01	18 Apr 01	18 Apr 01
Estimated	18 April 01	18 Apr 01	18 Apr 01	18 Apr 01
Scaling	1.0000	1.0000	1.0000	1.0000
train_c	-1.13 (-10.0)	-1.08 (-8.9)	-0.946 (-4.7)	-1.41 (-9.1)
T_caralt_c	-1.78 (-10.1)	-1.39 (-7.9)	-4.59 (-11.9)	-0.367 (-1.8)
TrTswi_C	-1.98 (-26.7)	-1.83 (-21.2)	-1.85 (-17.8)	-2.16 (-19.5)
DepEarly	-0.0165 (-18.2)	-0.0139 (-15.2)	-0.0175 (-13.7)	-0.0156 (-11.7)
RDepEarly	-0.0051 (-4.0)	-0.0038 (-3.0)	-0.0043 (-2.3)	-0.0066 (-3.4)
DepLate	-0.0155 (-20.4)	-0.0128 (-17.3)	-0.0151 (-15.5)	-0.0180 (-14.1)
RDepLate	-0.0053 (-5.4)	-0.0048 (-5.0)	-0.0033 (-2.8)	-0.0083 (-4.6)
Ccost_Com	-0.0145 (-9.9)	-0.0165 (-11.3)	-0.0145 (-6.3)	-0.0112 (-4.9)
ctime_com	-3.6e04 (-2.8)	-3.4e-4 (-2.2)	-1.5e-4 (-1.2)	-0.0020 (-1.7)
ttime_com	-0.0082 (-8.8)	-0.0087 (-9.4)	-0.0211 (-12.5)	-6.3e-4 (-0.4)
Tkaartc	-0.0096 (-3.8)	-0.0086 (-3.4)	-0.0173 (-3.2)	-0.0074 (-2.5)
Totherc	-0.0026 (-0.8)	-0.0040 (-1.2)	0.0319 (5.4)	-0.0228 (-5.2)
CCarFlex		-0.776 (-17.0)		
TTraFlex		-0.359 (-3.5)		

We present below values of time and ratios of schedule penalty to train time coefficient from models 4, 5 and 6.

Value of time (guilders/hour)

	All commuters	All commuters with flexible working hours	All commuters with non flexible working hours
Car	1	1	11
Train – Vastrecht	61	73	/
Train – normal ticket	/	/	/

Scheduling trade-off ratios

Variable	Schedule penalty coefficient divided by travel time coefficient		
	All commuters	All commuters with flexible working hours	All commuters with non flexible working hours
Early schedule penalty – Outward leg	1.59	0.83	/
Late schedule penalty – Outward leg	1.47	0.71	/
Early schedule penalty – Return leg	0.53	0.20	/
Late schedule penalty – Return leg	0.55	0.15	/

Discussion of outcomes

Just as when we separated car and train users, some time and cost coefficients in the new models 5 and 6 are not significant. When we include specific dummies for flexible working hours, these are significant but don't have the right sign. They should be positive: respondents with flexible

working hours should have less problems to adapt their departure time. Model 1 still is the preferred model.

2.8 Test 7: Split of compensated and non-compensated travellers for commuters.

Some travellers receive from their employer a compensation for the travel cost of their commuting trips. In the three models presented below, there are specific time and cost coefficient for compensated and non-compensated commuters. These new coefficients are:

- CcarNoComp: car cost coefficient for non-compensated travellers;
- CcarComp: car cost coefficient for compensated travellers;
- CtraNoComp: train cost coefficient for non-compensated travellers;
- CTraComp: train cost coefficient for compensated travellers.

Model todcom01 is the base model with different train cost coefficients, model todcom1b has one train cost coefficient only and comcomp1 has specific cost coefficients for travellers with travel cost compensated by their employers and travellers who are not compensated.

Estimated coefficients for multinomial logit models with three constants for commuting (t-ratios between brackets): all commuters

File	todcom01.f12	todcom1b.f12	comcomp1.F12
Title	TOD MODEL	TOD MODEL	TOD MODEL
Converged	True	True	True
Observations	6212	6212	6212
Final log (L)	-6066.0	-6067.9	-6062.7
D.O.F.	12	11	13
Rho²(0)	0.232	0.232	0.232
Rho²(c)	-0.038	-0.038	-0.037
Prepared	18 Apr 01	24 Apr 01	18 Apr 01
Estimated	18 Apr 01	24 Apr 01	18 Apr 01
Scaling	1.0000	1.0000	1.0000
train_c	-1.13 (-10.0)	-1.12 (-10.0)	-1.12 (-9.9)
T_caralt_c	-1.78 (-10.1)	-1.63 (-10.5)	-1.65 (-10.6)
TrTswi_C	-1.98 (-26.7)	-1.97 (-26.6)	-1.99 (-26.6)
DepEarly	-0.0165 (-18.2)	-0.0165 (-18.2)	-0.0165 (-18.2)
RDepEarly	-0.0051 (-4.0)	-0.0052 (-4.0)	-0.0052 (-4.0)
DepLate	-0.0155 (-20.4)	-0.0155 (-20.4)	-0.0155 (-20.4)
RDepLate	-0.0053 (-5.4)	-0.0053 (-5.4)	-0.0053 (-5.4)
Ccost_Com	-0.0145 (-9.9)	-0.0153 (-10.6)	0 (*)
ctime_com	-3.6e-4 (-2.8)	-3.6e-4 (-2.8)	-3.9e-4 (-2.9)
ttime_com	-0.0082 (-8.8)	-0.0076 (-8.8)	-0.0073 (-8.4)
Tkaartc	-0.0096 (-3.8)		
Totherc	-0.0026 (-0.8)		0 (*)
Tcost_Com		-0.0073 (-3.2)	
CcarNocomp			-0.0192 (-3.0)
Ccarcomp			-0.0144 (-9.8)
CTraNocomp			-0.0280 (-3.6)
CTracomp			-0.0063 (-2.8)

We present below values of time and ratios of schedule penalty to train time coefficient from the model in the last column.

Value of time (guilders/hour)

	All commuters
Car – compensated	2
Car – not compensated	1
Train – compensated	70
Train – not compensated	16

Scheduling trade-off ratios

Variable and Mode	Schedule penalty coefficient divided by travel time coefficient
	All commuters
Early schedule penalty – Outward leg	2.26
Late schedule penalty – Outward leg	2.12
Early schedule penalty – Return leg	0.71
Late schedule penalty – Return leg	0.72

Discussion of outcomes

The loglikelihood value is improved significantly by the split on the cost coefficient between compensated and non-compensated travellers but not by the separation between 'vastrecht' and other train users. All four new coefficients we added to the model are significant. As expected, compensated travellers have higher values of time than non-compensated travellers. Model comcomp1 is preferred.

A further test concerns having not only separate cost coefficients for compensated and non-compensated travellers, but fully separate models (all coefficients different) for both.

In model todcom02 presented below, only respondents who would receive a compensation from their employers are included. In model todcom03, only commuters who don't receive a compensation from their employers are included.

Estimated coefficients for multinomial logit models with three constants for commuting (t-ratios between brackets): compensated and non-compensated commuters respectively

File	todcom02.f12		todcom03.f12	
Title	TOD MODEL		TOD MODEL	
Converged	True		True	
Observations	5075		1137	
Final log (L)	-4893.2		-1142.2	
D.O.F.	11		11	
$Rho^2(0)$	0.243		0.203	
$Rho^2(c)$	-0.027		-0.076	
Prepared	18 Apr 01		18 Apr 01	
Estimated	18 Apr 01		18 Apr 01	
Scaling	1.0000		1.0000	
train_c	-1.38	(-10.3)	-0.297	(-1.3)
T_caralt_c	-1.44	(-8.8)	-2.44	(-4.2)
TrTswi_C	-2.08	(-25.5)	-1.44	(-7.5)
DepEarly	-0.0176	(-17.4)	-0.0106	(-5.3)
RDepEarly	-0.0043	(-3.0)	-0.0093	(-3.1)
DepLate	-0.0153	(-18.6)	-0.0177	(-7.9)
RDepLate	-0.0051	(-5.0)	-0.0076	(-2.2)
Ccost_Com	0	(*)	0	(*)
CcarNocomp	0	(*)	0.0025	(0.2)
Ccarcomp	-0.0149	(-9.9)	0	(*)
CTraNocomp	0	(*)	-0.0262	(-2.9)
CTracomp	-0.0061	(-2.7)	0	(*)
ctime_com	-3.0e-4	(-2.2)	-0.0063	(-2.9)
ttime_com	-0.0062	(-6.8)	-0.0139	(-4.6)
Totherc	0	(*)	0	(*)

We present below values of time and ratios of schedule penalty to train time coefficient from these models.

Value of time (guilders/hour)

	All commuters – Compensated	All commuters – non compensated
Car – compensated	1	/
Train – compensated	61	32

Scheduling trade-off ratios

Variable and Mode	Schedule penalty coefficient divided by travel time coefficient	
	All commuters – Compensated	All commuters – non compensated
Early schedule penalty – Outward leg	2.83	0.76
Late schedule penalty – Outward leg	2.46	1.27
Early schedule penalty – Return leg	0.69	0.67
Late schedule penalty – Return leg	0.82	0.54

Discussion of outcomes

When we compare the sum of the loglikelihoods of the models 2 and 3 with model comcomp1, the split models have a significantly higher loglikelihood. However, one of the car cost coefficients is clearly insignificant in model 3. We prefer model comcomp1.

2.9 Test 8: Estimate APRIL type models.

Until now we have been presenting models with scheduling penalties for both tour legs. An alternative formulation would be to have departure time choice penalties only for the outward leg

(and the trip for the non-home-based travel) and participation time choice penalties, as in the APRIL model, originally developed by Polak and Jones (also see the model structure report in this project of May 2000). For each purpose we present below a base model with coefficients for early/late schedule penalty for both legs and a model with coefficients for early/late schedule penalty for the outward leg only and participation time penalties. The models we present are multinomial logit whereas the APRIL model is a nested logit. The new variables included in these models are:

- StLonger: duration of stay presented on the screen - reported duration of stay (only if this difference is positive);
- StShorter: reported duration of stay - duration of stay presented on the screen (only if this difference is positive).

2.9.1 Commuters

Estimated coefficients for multinomial logit models with three constants for commuting (t-ratios between brackets): scheduling penalties on both legs versus APRIL-type model

File	todcom01.f12	todcom07.f12
Title	TOD MODEL	TOD MODEL
Converged	True	True
Observations	6212	6212
Final log (L)	-6066.0	-5962.6
D.O.F.	12	12
Rho²(0)	0.232	0.245
Rho²(c)	-0.038	-0.020
Prepared	18 Apr 01	19 Apr 01
Estimated	18 Apr 01	19 Apr 01
Scaling	1.0000	1.0000
train_c	-1.13 (-10.0)	-1.12 (-10.0)
T_caralt_c	-1.78 (-10.1)	-1.70 (-9.6)
TrTswi_C	-1.98 (-26.7)	-1.53 (-19.6)
DepEarly	-0.0165 (-18.2)	-0.0156 (-18.5)
RDepEarly	-0.0051 (-4.0)	
DepLate	-0.0155 (-20.4)	-0.0155 (-21.9)
RDepLate	-0.0053 (-5.4)	
Ccost_Com	-0.0145 (-9.9)	-0.0151 (-10.2)
ctime_com	-3.6e-4 (-2.8)	-3.9e-4 (-2.9)
ttime_com	-0.0082 (-8.8)	-0.0084 (-8.8)
Tkaartc	-0.0096 (-3.8)	-0.0101 (-4.0)
Totherc	-0.0026 (-0.8)	-0.0026 (-0.8)
StLonger		-0.0109 (-12.1)
StShorter		-0.0065 (-10.1)

We present below values of time and ratios of schedule penalty to train time coefficient from these models.

Value of time (guilders/hour)

	All commuters Model 1	All commuters Model 7
Car	1	2
Train – Vastrecht	51	50
Train – normal ticket	/	/

Scheduling trade-off ratios

Variable and Mode	Schedule penalty coefficient divided by travel time coefficient	
	All commuters Model 1	All commuters Model 7
Early schedule penalty – Outward leg	2.01	2.55
Late schedule penalty – Outward leg	1.89	2.89
Early schedule penalty – Return leg	0.62	
Late schedule penalty – Return leg	0.64	
Increased participation time penalty		1.29
Decreased participation time penalty		0.77

2.9.2 Business.

Models 2 and 7 include all business travellers.

Estimated coefficients for multinomial logit models with three constants for business (t-ratios between brackets): scheduling penalties on both legs versus APRIL-type model

File	todbus02.f12	todbus07.f12
Title	TOD MODEL	TOD MODEL
Converged	True	True
Observations	3812	3812
Final log (L)	-3626.6	-3579.2
D.O.F.	12	12
Rho²(0)	0.250	0.260
Rho²(c)	0.035	0.048
Prepared	12 Apr 01	19 Apr 01
Estimated	12 Apr 01	19 Apr 01
Scaling	1.0000	1.0000
train_c	-1.25 (-8.3)	-1.23 (-8.2)
T_caralt_c	-1.93 (-9.4)	-1.88 (-9.1)
TrTswi_C	-1.53 (-22.6)	-1.19 (-16.2)
DepEarly	-0.0169 (-17.5)	-0.0170 (-17.9)
RDepEarly	-0.0082 (-4.2)	
DepLate	-0.0156 (-17.1)	-0.0160 (-17.9)
RDepLate	-0.0043 (-2.9)	
Ccost_Bus	-0.0034 (-3.2)	-0.0035 (-3.3)
ctime_bus	-0.0072 (-6.9)	-0.0084 (-7.7)
ttime_bus	-0.0092 (-8.7)	-0.0101 (-9.1)
Tkaartb	-0.0086 (-1.5)	-0.0129 (-2.2)
Totherb	-0.0101 (-4.2)	-0.0110 (-4.4)
StLonger		-0.0083 (-8.1)
StShorter		-0.0072 (-7.7)

We present below VOT's and ratios of schedule penalty to train time coefficient from these models.

Value of time (guilders/hour)

	All business Model 2	All business Model 7
Car	127	144
Train – Vastrecht	/	47
Train – normal ticket	54	55

Scheduling trade-off ratios

Variable	Schedule penalty coefficient divided by travel time coefficient	
	All business Model 2	All business Model 7
Early schedule penalty – Outward leg	1.83	1.68
Late schedule penalty – Outward leg	0.89	1.58
Early schedule penalty – Return leg	1.69	
Late schedule penalty – Return leg	0.46	
Increased participation time penalty		0.82
Decreased participation time penalty		0.71

2.9.3 Education

Estimated coefficients for multinomial logit models with three constants for education (t-ratios between brackets): scheduling penalties on both legs versus APRIL-type model

File	todedu01.f12		todedu07.f12	
Title	TOD MODEL		TOD MODEL	
Converged	True		True	
Observations	1250		1250	
Final log (L)	-861.1		-862.9	
D.O.F.	12		12	
Rho²(0)	0.414		0.413	
Rho²(c)	0.125		0.123	
Prepared	12 Apr 01		19 Apr 01	
Estimated	12 Apr 01		19 Apr 01	
Scaling	1.0000		1.0000	
train_c	1.56	(3.9)	1.72	(4.3)
T_caralt_c	-2.89	(-6.2)	-2.96	(-6.4)
TrTswi_C	-1.72	(-21.3)	-1.52	(-16.2)
DepEarly	-0.0137	(-5.6)	-0.0114	(-4.5)
RDepEarly	-0.0149	(-3.1)		
DepLate	-0.0063	(-4.0)	-0.0065	(-4.0)
RDepLate	-0.0101	(-3.0)		
Ccost_Edu	-0.0794	(-5.9)	-0.0791	(-6.0)
ctime_edu	-0.0148	(-3.9)	-0.0161	(-4.3)
ttime_edu	-0.0348	(-9.7)	-0.0362	(-10.1)
Tkaarte	0.0036	(0.8)	0.0021	(0.5)
Tothere	-0.0467	(-7.9)	-0.0471	(-7.9)
StLonger			-0.0063	(-3.8)
StShorter			-0.0035	(-3.0)

We present below values of time and ratios of schedule penalty to train time coefficient from these models.

Value of time (guilders/hour)

	All education Model 1	All education Model 7
Car	11.2	12.2
Train – Vastrecht	/	/
Train – normal ticket	44.7	46.1

Scheduling trade-off ratios

Variable and Mode	Schedule penalty coefficient divided by travel time coefficient	
	All education Model 1	All education Model 7
Early schedule penalty – Outward leg	0.39	0.31
Late schedule penalty – Outward leg	0.18	0.17
Early schedule penalty – Return leg	0.43	
Late schedule penalty – Return leg	0.29	
Increased participation time penalty		0.17
Decreased participation time penalty		0.13

2.9.4 Other purposes.

Estimated coefficients for multinomial logit models with three constants for 'other' purposes (t-ratios between brackets): scheduling penalties on both legs versus APRIL-type model

File	todoth01.f12	todoth07.f12
Title	TOD MODEL	TOD MODEL
Converged	True	True
Observations	3224	3224
Final log (L)	-3350.9	-3304.4
D.O.F.	12	12
$Rho^2(0)$	0.177	0.188
$Rho^2(c)$	0.007	0.021
Prepared	12 Apr 01	19 Apr 01
Estimated	12 Apr 01	19 Apr 01
Scaling	1.0000	1.0000
train_c	-1.58 (-10.3)	-1.62 (-10.4)
T_caralt_c	-0.824 (-3.7)	-0.657 (-2.9)
TrTswi_C	-0.700 (-9.2)	-0.449 (-5.6)
DepEarly	-0.0097 (-12.4)	-0.0084 (-12.4)
RDepEarly	-0.0014 (-1.4)	
DepLate	-0.0105 (-8.0)	-0.0111 (-8.9)
RDepLate	-0.0051 (-2.7)	
Ccost_Oth	-0.0106 (-5.0)	-0.0103 (-4.8)
ctime_Oth	-0.0092 (-7.4)	-0.0100 (-7.9)
ttime_oth	-0.0089 (-7.4)	-0.0087 (-6.9)
Tkaarto	-0.0156 (-4.5)	-0.0148 (-4.3)
Tothero	-0.0214 (-5.5)	-0.0238 (-5.8)
StLonger		-0.0059 (-7.0)
StShorter		-0.0077 (-7.1)

We present below values of time and ratios of schedule penalty to train time coefficient from these models.

Value of time (guilders/hour)

	All other Model 1	All other Model 7
Car	52	58
Train – Vastrecht	34	35.
Train – normal ticket	24	22

Scheduling trade-off ratios

Variable	Schedule penalty coefficient divided by travel time coefficient	
	All other Model 1	All other Model 7
Early schedule penalty – Outward leg	1.09	0.96
Late schedule penalty – Outward leg	1.17	1.27
Early schedule penalty – Return leg	0.16	
Late schedule penalty – Return leg	0.57	
Increased participation time penalty		0.68
Decreased participation time penalty		0.88

Discussion of outcomes (all four purposes)

For all purposes but 'education', the use of participation time penalty coefficients instead of departure time scheduling penalties improves the overall fit of the models, but the values of time remain high. Generally speaking, the APRIL-type models also yield that later departure (and arrival) is worse than early departure and working longer is valued to be worse than working shorter, which appears plausible. We prefer the APRIL-type specification to the earlier specification.

2.10 Test 9: Replace the preferred departure time in the calculation of the schedule time penalty variables by the reported departure time.

In the models presented so far, we used preferred departure time (when different from the reported time) to calculate the scheduling penalties. In test 9 we try out what will happen if we use reported departure time for all individuals to calculate the penalties. We do this test for the models with departure time scheduling terms for both legs and APRIL-type models.

Models 1 and 7 were already presented in the previous section. Models 7b and 7c are similar to 1 and 7 but the schedule penalty variables are the differences between the actual departure time and the reported one only, not the preferred one.

Estimated coefficients for multinomial logit models with three constants for commuting (t-ratios between brackets): models with scheduling penalties on both legs versus APRIL-type model, and models with preferred departure time versus reported departure time

File	todcom01.f12	todcom07.f12	todcom07b.f12	todcom7c.F12
Title	TOD MODEL	TOD MODEL	TOD MODEL	TOD MODEL
Converged	True	True	True	True
Observations	6212	6212	6212	6212
Final log (L)	-6066.0	-5962.6	-6062.0	-5973.5
D.O.F.	12	12	12	12
Rho² (0)	0.232	0.245	0.233	0.244
Rho² (c)	-0.038	-0.020	-0.037	-0.022
Prepared	18 Apr 01	19 Apr 01	2 May 01	2 May 01
Estimated	18 Apr 01	19 Apr 01	2 May 01	2 May 01
Scaling	1.0000	1.0000	1.0000	1.0000
train_c	-1.13 (-10.0)	-1.12 (-10.0)	-1.14 (-10.1)	-1.13 (-10.1)
T_caralt_c	-1.78 (-10.1)	-1.70 (-9.6)	-1.78 (-10.1)	-1.69 (-9.6)
TrTswi_C	-1.98 (-26.7)	-1.53 (-19.6)	-1.94 (-26.2)	-1.52 (-19.4)
DepEarly	-0.0165 (-18.2)	-0.0156 (-18.5)	-0.0191 (-17.0)	-0.0169 (-17.2)
RDepEarly	-0.0051 (-4.0)		-0.0027 (-1.9)	
DepLate	-0.0155 (-20.4)	-0.0155 (-21.9)	-0.0123 (-18.4)	-0.0126 (-20.7)
RDepLate	-0.0053 (-5.4)		-0.0055 (-5.0)	
Ccost_Com	-0.0145 (-9.9)	-0.0151 (-10.2)	-0.0146 (-10.0)	-0.0151 (-10.3)
ctime_com	-3.6e-4 (-2.8)	-3.9e-4 (-2.9)	-2.5e-4 (-1.9)	-2.8e-4 (-2.1)
ttime_com	-0.0082 (-8.8)	-0.0084 (-8.8)	-0.0081 (-8.8)	-0.0084 (-8.9)
Tkaartc	-0.0096 (-3.8)	-0.0101 (-4.0)	-0.0095 (-3.8)	-0.0098 (-3.9)
Totherc	-0.0026 (-0.8)	-0.0026 (-0.8)	-0.0027 (-0.8)	-0.0025 (-0.8)
StLonger		-0.0109 (-12.1)		-0.0102 (-11.1)
StShorter		-0.0065 (-10.1)		-0.0062 (-9.4)

We present below values of time and ratios of schedule penalty to train time coefficient from these models.

Value of time (guilders/hour)

	Model 1	Model 7	Model 7b	Model 7c
Car	1	2	1	1
Train – Vastrecht	51	50	48	51
Train – normal ticket	/	/	/	/

Scheduling trade-off ratios

Variable	Schedule penalty coefficient divided by travel time coefficient			
	Model 1	Model 7	Model 7b	Model 7c
Early schedule penalty – Outward leg	2.01	1.85	2.35	2.01
Late schedule penalty – Outward leg	1.89	1.84	1.51	1.5
Early schedule penalty – Return leg	0.62		0.33	
Late schedule penalty – Return leg	0.64		0.67	
Increased participation time penalty		1.29		1.21
Decreased participation time penalty		0.77		0.73

Discussion of outcomes

We made this test only for commuters. It seems better to keep the preferred departure time in the calculations, when available, as the t-ratios of the delay variables decrease when we take into account only the reported departure times. It is also worth noting that the likelihood is best for the model with participation time variables and preferred departure time (model 7). This is the preferred model.

2.11 Test 10: include an 'arrival time at work' penalty variable and a 'departure time from work' penalty variable.

We also did another test –still on the model with time of travel choice scheduling penalties both ways. Models 1 and 7b are the same as the ones presented in the previous section. In model 8 and 8b we added two new variables:

- In model 8:
  - Arrearly: preferred or reported arrival time – presented arrival time (outward leg); provided this difference is positive; otherwise zero;
  - Arrlate: presented arrival time - preferred or reported arrival time (outward leg); provided this difference is positive; otherwise zero.

- In model 8b:
  - Arrearly: reported arrival time - presented arrival time (outward leg); provided this difference is positive; otherwise zero;
  - Arrlate: presented arrival time - reported arrival time (outward leg); provided this difference is positive; otherwise zero;.

Estimated coefficients for multinomial logit models with three constants for commuting (t-ratios between brackets): models with departure versus arrival time scheduling penalties on both legs, models with preferred departure time versus reported departure time

File	todcom01.f12	todcom07b.f12	todcom08.F12	todcom8b.F12
Title	TOD MODEL	TOD MODEL	TOD MODEL	TOD MODEL
Converged	True	True	True	True
Observations	6212	6212	6212	6212
Final log (L)	-6066.0	-6062.0	-6026.2	-6419.9
D.O.F.	12	12	12	12
$Rho^2(0)$	0.232	0.233	0.237	0.187
$Rho^2(c)$	-0.038	-0.037	-0.031	-0.098
Prepared	18 Apr 01	2 May 01	2 May 01	2 May 01
Estimated	18 Apr 01	2 May 01	2 May 01	2 May 01
Scaling	1.0000	1.0000	1.0000	1.0000
train_c	-1.13 (-10.0)	-1.14 (-10.1)	-1.18 (-10.5)	-1.00 (-9.0)
T_caralt_c	-1.78 (-10.1)	-1.78 (-10.1)	-1.63 (-9.5)	-1.63 (-9.6)
TrTswi_C	-1.98 (-26.7)	-1.94 (-26.2)	-1.67 (-21.7)	-1.91 (-25.2)
DepEarly	-0.0165 (-18.2)	-0.0191 (-17.0)		
RDepEarly	-0.0051 (-4.0)	-0.0027 (-1.9)	-0.0052 (-3.5)	-0.0146 (-12.4)
DepLate	-0.0155 (-20.4)	-0.0123 (-18.4)		
RDepLate	-0.0053 (-5.4)	-0.0055 (-5.0)	-0.0026 (-2.5)	-0.0113 (-13.0)
Ccost_Com	-0.0145 (-9.9)	-0.0146 (-10.0)	-0.0140 (-9.6)	-0.0109 (-7.8)
ctime_com	-3.6e-4 (-2.8)	-2.5e-4 (-1.9)	-1.7e-4 (-1.4)	-1.6e-4 (-1.4)
ttime_com	-0.0082 (-8.8)	-0.0081 (-8.8)	-0.0073 (-8.2)	-0.0068 (-7.9)
Tkaartc	-0.0096 (-3.8)	-0.0095 (-3.8)	-0.0081 (-3.2)	-0.0065 (-2.6)
Totherc	-0.0026 (-0.8)	-0.0027 (-0.8)	-0.0030 (-0.9)	4.1e-4 (0.1)
Arrearly			-0.0188 (-17.6)	-0.0096 (-9.2)
Arrlate			-0.0135 (-18.6)	-0.0023 (-7.7)

We present below values of time and ratios of schedule penalty to train time coefficient from these models.

Value of time (guilders/hour)

	Model 1	Model 7b	Model 8	Model 8b
Car	1	1	1	1
Train – Vastrecht	51	48	54	63
Train – normal ticket	/	/	/	/

Scheduling trade-off ratios

Variable	Schedule penalty coefficient divided by travel time coefficient			
	Model 1	Model 7b	Model 8	Model 8b
Early schedule penalty – Outward leg –Departure time	2.01	2.35		
Late schedule penalty – Outward leg –Departure time	1.89	1.51		
Early schedule penalty – Return leg – Departure time	0.62	0.33	0.71	2.14
Late schedule penalty – Return leg – Departure time	0.64	0.67	0.35	1.91
Early schedule penalty – Outward leg –Arrival time			2.57	1.41
Late schedule penalty – Outward leg – Arrival time			1.84	0.33

Discussion of outcomes

Within the models using preferred times (1 and 8), the model on arrival time choice (8) has a somewhat better likelihood. For the models with only reported times the model on arrival time choice (8b) is considerably worse. Model 1 is the one we prefer (within the class not including the APRIL-type models; these we prefer over 1): in model 7b and 8, the delay variables for the return leg have rather low t-ratios and ctime is not significant (unlike in mdoel 1). No value of time for train users without a seasonal ticket can be calculated.

2.12 Test 11: specific schedule and delay penalty variables per mode.

As pointed in the previous paragraphs it seems better to use APRIL-like models as such a structure improves the overall fit of the model. The base model for this test is an APRIL-like model with a schedule penalty variable for the outward leg of the tour, based on the departure time, and a participation time penalty. The new variables that we shall test in this series are:

- DepEarlyC: Preferred or reported departure time – presented departure time, car users only (if preferred> than presented);otherwise zero;
- DepEarlyT: Preferred or reported departure time – presented departure time, train users only; otherwise zero;
- DepLateC: Presented departure time - preferred or reported departure time, car users only (if presented > than preferred); otherwise zero;
- DepLateT: Presented departure time - preferred or reported departure time, train users only (if positive); otherwise zero;
- StLongerC: Presented duration of stay time - Reported duration of stay time, car users only (if positive); otherwise zero;
- StLongerT: Presented duration of stay time - Reported duration of stay time, train users only (if positive); otherwise zero;
- StShorterC: Reported duration of stay time - presented duration of stay time, car users only (if positive); otherwise zero;

- StShorterT: Reported duration of stay time - presented duration of stay time, train users only (if positive); otherwise zero;.

2.12.1 Commute

Model 7 is the base model. Model 9 has specific schedule penalty and participation penalty variables for each mode (explained above).
Model 9b has specific schedule penalty and participation penalty variables for respondents with flexible (DepEarlyF, DepLateF, StlongerF, StShorterF) and non-flexible working hours (DepEarlyNF, DepLateNF, StlongerNF, StShorterNF).
Model 9c has specific schedule penalty and participation penalty variables for respondents with flexible and non-flexible working hours and it has also specific car and train coefficients for compensated and non-compensated travellers.

Estimated coefficients for multinomial logit models with three constants for commuting (t-ratios between brackets): APRIL-type models with mode-specific departure time scheduling penalties and participation time penalties

File	todcom07.f12	todcom09.f12	todcom9b.f12	todcom9c.f12	todcom9d.f12
Title	TOD MODEL	TOD MODEL	TOD MODEL	TOD MODEL	TOD MODEL
Converged	True	True	True	True	True
Observations	6180	6180	6180	6180	6180
Final log (L)	-5912.0	-5892.1	-5892.7	-5888.5	-5959.2
D.O.F.	12	16	16	17	17
Rho²(0)	0.247	0.250	0.250	0.250	0.241
Rho²(c)	-0.018	-0.014	-0.014	-0.014	-0.026
Prepared	2 May 01	3 May 01	3 May 01	3 May 01	3 May 01
Estimated	2 May 01	3 May 01	3 May 01	3 May 01	3 May 01
Scaling	1.0000	1.0000	1.0000	1.0000	1.0000
train_c	-1.18 (-10.4)	-1.19 (-10.3)	-1.19 (-10.5)	-1.17 (-10.3)	-1.14 (-10.0)
T_caralt_c	-1.61 (-9.2)	-1.60 (-9.2)	-1.61 (-9.2)	-1.54 (-9.8)	-1.88 (-11.4)
TrTswi_C	-1.53 (-19.3)	-1.67 (-17.9)	-1.52 (-19.1)	-1.53 (-19.2)	-1.66 (-17.9)
DepEarly	-0.0158 (-18.6)				
DepLate	-0.0160 (-22.3)				
StLonger	-0.0117 (-12.9)				
StShorter	-0.0066 (-10.1)				
Ccost_Com	-0.0134 (-8.9)	-0.0144 (-9.5)	-0.0133 (-8.8)		
ctime_com	-0.0057 (-6.3)	-0.0065 (-7.2)	-0.0056 (-6.1)	-0.0058 (-6.6)	-0.0088 (-9.8)
ttime_com	-0.0112 (-10.3)	-0.0130 (-12.2)	-0.0110 (-10.3)	-0.0104 (-9.9)	-0.0162 (-14.9)
Tkaartc	-0.0103 (-4.0)	-0.0093 (-3.7)	-0.0105 (-4.1)		
Totherc	-0.0060 (-1.8)	-0.0053 (-1.6)	-0.0060 (-1.8)	0 (*)	0 (*)
DepEarlyC		-0.0162 (-18.5)	0 (*)	0 (*)	-0.0115 (-16.1)
DepEarlyT		-0.0152 (-7.5)	0 (*)	0 (*)	-0.0124 (-5.1)
DepLateC		-0.0172 (-22.2)	0 (*)	0 (*)	-0.0153 (-21.0)
DepLateT		-0.0080 (-6.3)	0 (*)	0 (*)	-0.0098 (-6.8)
StLongerC		-0.0122 (-11.9)			-0.0142 (-14.1)
StLongerT		-0.0095 (-5.1)			-0.0101 (-5.4)
StShorterC		-0.0069 (-8.3)			-0.0068 (-8.2)
StShorterT		-0.0059 (-5.4)			-0.0052 (-4.9)
DepEarlyF			-0.0163 (-14.1)	-0.0163 (-14.1)	
DepEarlyNF			-0.0152 (-12.2)	-0.0152 (-12.2)	
DepLateF			-0.0143 (-16.2)	-0.0142 (-16.1)	
DepLateNF			-0.0188 (-15.3)	-0.0189 (-15.3)	
StLongerF			-0.0111 (-9.2)	-0.0111 (-9.1)	
SLongerNF			-0.0127 (-9.7)	-0.0127 (-9.7)	
StShorterF			-0.0048 (-6.0)	-0.0049 (-6.1)	
SShorterNF			-0.0100 (-8.8)	-0.0100 (-8.8)	
CcarNocomp				-0.0125 (-1.5)	-0.0105 (-1.2)
Ccarcomp				-0.0128 (-8.5)	-0.0137 (-9.0)
CTraNocomp				-0.0277 (-3.2)	-0.0215 (-2.5)
CTracomp				-0.0086 (-3.7)	-0.0056 (-2.4)

Value of time (guilders/hour)

	Model 7	Model 9	Model 9b	Model 9c	Model 9d
Car	26	27	25		
Train – Vastrecht	65	84	62		
Train – normal ticket	/	/	/		
Car – Compensation				27	39
Car –No compensation				/	/
Train - Compensation				73	173
Train –No compensation				23	45

In the table below are the ratios of schedule penalty (or participation penalty) to the train time coefficient when there are common schedule/participation penalty coefficients or train specific coefficients. We use the ratio of car schedule penalty to car time for models with car specific schedule or participation coefficients:

Scheduling trade-off ratios

Variable and Mode	Schedule penalty coefficient divided by travel time coefficient				
	Model 7	Model 9	Model 9b	Model 9c	Model 9d
Early schedule penalty – Outward leg – All modes	1.41				
Early schedule penalty – Outward leg - Car		2.49			1.30
Early schedule penalty – Outward leg - Train		1.16			0.76
Late schedule penalty – Outward leg– All modes	1.42				
Late schedule penalty – Outward leg- Car		2.64			1.73
Late schedule penalty – Outward leg- Train		0.61			0.60
Increased participation time penalty– All modes	1.04				
Increased participation time penalty- Car		1.87			1.61
Increased participation time penalty- Train		0.73			0.62
Decreased participation time penalty– All modes	0.58				
Decreased participation time penalty- Car		1.06			0.77
Decreased participation time penalty- Train		0.45			0.32
Early schedule penalty – Outward leg – Non- flexible WH			1.38	1.46	
Late schedule penalty – Outward leg– Non- flexible WH			1.71	1.81	
Early schedule penalty – Outward leg – Flexible WH			1.47	1.56	
Late schedule penalty – Outward leg– Flexible WH			1.30	1.36	
Increased participation time penalty- Non- flexible WH			1.15	1.22	
Decreased participation time penalty– Non- flexible WH			0.90	0.96	
Increased participation time penalty- Flexible WH			1	1.06	
Decreased participation time penalty– Flexible WH			0.43	0.47	

Discussion of outcomes

For this purpose, the model (in terms of loglikelihood) is improved by including mode-specific scheduling coefficients. Adding specific cost coefficients for compensated and non-compensated travellers also improves the results significantly. Model 9c gives the best results in terms of

likelihood and of values of time. However, it does not seem necessary to have two different cost coefficients for compensated and non-compensated car users as these two coefficients are practically the same (and one is not significant). This is tested below.

In model 9e, there is only one cost coefficient for car users that are compensated and non-compensated.

File	todcom9c.f12		todcom9e.f12	
Title	TOD MODEL		TOD MODEL	
Converged	True		True	
Observations	6180		6180	
Final log (L)	-5888.5		-5888.5	
D.O.F.	17		16	
$Rho^2(0)$	0.250		0.250	
$Rho^2(c)$	-0.014		-0.014	
Prepared	3 May 01		4 May 01	
Estimated	3 May 01		4 May 01	
Scaling	1.0000		1.0000	
train_c	-1.17	(-10.3)	-1.17	(-10.3)
T_caralt_c	-1.54	(-9.8)	-1.54	(-9.8)
TrTswi_C	-1.53	(-19.2)	-1.53	(-19.2)
Ccost_Com	0	(*)	-0.0128	(-8.5)
CcarNocomp	-0.0125	(-1.5)		
Ccarcomp	-0.0128	(-8.5)		
CTraNocomp	-0.0277	(-3.2)	-0.0279	(-4.3)
CTracomp	-0.0086	(-3.7)	-0.0085	(-3.7)
ctime_com	-0.0058	(-6.6)	-0.0058	(-6.6)
ttime_com	-0.0104	(-9.9)	-0.0104	(-10.0)
DepEarlyF	-0.0163	(-14.1)	-0.0163	(-14.1)
DepEarlyNF	-0.0152	(-12.2)	-0.0152	(-12.2)
DepLateF	-0.0142	(-16.1)	-0.0143	(-16.1)
DepLateNF	-0.0189	(-15.3)	-0.0189	(-15.4)
StLongerF	-0.0111	(-9.1)	-0.0111	(-9.1)
SLongerNF	-0.0127	(-9.7)	-0.0127	(-9.7)
StShorterF	-0.0049	(-6.1)	-0.0049	(-6.1)
SShorterNF	-0.0100	(-8.8)	-0.0100	(-8.8)

Value of time

	Model 9c	Model 9e
Car		27
Car – Compensation	/	
Car –No compensation	28	
Train - Compensation	73	73
Train –No compensation	23	22

Scheduling trade-off ratios (using train travel time in the denominator)

Variable and Mode	Schedule penalty coefficient divided by travel time coefficient	
	Model 9c	Model 9e
Early schedule penalty – Outward leg – Non- flexible WH	1.46	1.46
Late schedule penalty – Outward leg– Non- flexible WH	1.81	1.81
Early schedule penalty – Outward leg – Flexible WH	1.56	1.56
Late schedule penalty – Outward leg– Flexible WH	1.36	1.37
Increased participation time penalty- Non- flexible WH	1.22	1.22
Decreased participation time penalty– Non- flexible WH	0.96	0.96
Increased participation time penalty- Flexible WH	1.06	1.06
Decreased participation time penalty– Flexible WH	0.47	0.47

Discussion of outcomes

As expected, having the same coefficient for car cost did not reduce the loglikelihood significantly and it gives a significant car cost coefficient. Model 9e is the preferred model.

2.12.2 Business.

Model 7 is the base model.
Model 7b has specific schedule penalty and participation penalty variables for each mode (explained above).
Model 7e is similar to Model 7b but has only one train cost coefficient.
Model 7c has specific schedule penalty coefficients for non-home-based trips (DepEarlyN and DepLateN).
Model 7d has specific schedule penalty coefficients for non-home-based trips (DepEarlyN and DepLateN) and specific cost and time coefficients for non-home-based trips.

Estimated coefficients for multinomial logit models with three constants for business (t-ratios between brackets): APRIL-type models with mode-specific and non-home-based-specific departure time scheduling penalties and participation time penalties

File	todbus07.f12	todbus7b.f12	todbus7c.f12	todbus7d.f12	todbus7e.f12
Title	TOD MODEL	TOD MODEL	TOD MODEL	TOD MODEL	TOD
MODEL					
Converged	True	True	True	True	True
Observations	3812	3812	3812	3812	3812
Final log (L)	-3579.2	-3502.6	-3502.5	-3487.4	-3502.6
D.O.F.	12	16	18	22	15
Rho²(0)	0.260	0.276	0.276	0.279	0.276
Rho²(c)	0.048	0.068	0.068	0.072	0.068
Prepared	19 Apr 01	3 May 01	3 May 01	3 May 01	3 May 01
Estimated	19 Apr 01	3 May 01	3 May 01	3 May 01	3 May 01
Scaling	1.0000	1.0000	1.0000	1.0000	1.0000
train_c	-1.23 (-8.2)	-1.51 (-9.6)	-1.51 (-9.6)	-1.20 (-6.7)	-1.51 (-9.6)
T_caralt_c	-1.88 (-9.1)	-1.63 (-7.8)	-1.62 (-7.8)	-1.71 (-8.2)	-1.64 (-8.3)
TrTswi_C	-1.19 (-16.2)	-1.40 (-17.5)	-1.40 (-17.5)	-1.39 (-17.3)	-1.41 (-17.5)
DepEarly	-0.0170 (-17.9)				
DepLate	-0.0160 (-17.9)				
StLonger	-0.0083 (-8.1)				
StShorter	-0.0072 (-7.7)				
Ccost_Bus	-0.0035 (-3.3)	-0.0035 (-3.3)	-0.0035 (-3.3)	-0.0035 (-3.3)	-0.0035 (-3.3)
ctime_bus	-0.0084 (-7.7)	-0.0100 (-8.8)	-0.0100 (-8.8)	-0.0087 (-7.5)	-0.0100 (-8.8)
ttime_bus	-0.0101 (-9.1)	-0.0120 (-10.3)	-0.0120 (-10.2)	-0.0113 (-9.5)	-0.0120 (-10.4)
Tkaartb	-0.0129 (-2.2)	-0.0088 (-1.5)	-0.0088 (-1.5)	-0.0092 (-1.6)	
Totherb	-0.0110 (-4.4)	-0.0102 (-4.1)	-0.0102 (-4.1)	-0.0101 (-4.0)	
DepEarlyC		-0.0204 (-18.7)	-0.0200 (-12.7)	-0.0193 (-12.4)	-0.0204 (-18.7)
DepEarlyT		-0.0083 (-4.2)	-0.0082 (-4.1)	-0.0089 (-4.4)	-0.0083 (-4.2)
DepLateC		-0.0222 (-19.4)	-0.0225 (-14.0)	-0.0216 (-13.6)	-0.0223 (-19.4)
DepLateT		-0.0024 (-1.9)	-0.0024 (-1.9)	-0.0025 (-2.0)	-0.0024 (-2.0)
StLongerC		-0.0099 (-6.6)	-0.0100 (-6.6)	-0.0094 (-6.2)	-0.0099 (-6.6)
StLongerT		-0.0062 (-4.5)	-0.0063 (-4.5)	-0.0062 (-4.5)	-0.0062 (-4.5)
StShorterC		-0.0078 (-4.7)	-0.0077 (-4.5)	-0.0076 (-4.5)	-0.0078 (-4.7)
StShorterT		-0.0078 (-6.6)	-0.0078 (-6.6)	-0.0080 (-6.7)	-0.0078 (-6.7)
DepEarlyN			-0.0206 (-13.7)	-0.0216 (-13.7)	
DepLateN			-0.0221 (-13.5)	-0.0233 (-13.7)	
Ccost_NHB				7.8e-4 (0.0)	
Tcost_NHB				0.0324 (1.5)	
ctime_NHB				-0.0205 (-5.0)	
ttime_NHB				-0.0492 (-4.6)	
Tcost_Bus					-0.0102 (-4.1)

We don't present values of time and ratios of schedule coefficients/ train time from model 7d, as this model has insignificant cost coefficients for non-home-based trips, all the other coefficients being not very different from those in model 7c.

Values of time (guilders/hour)

	Model 7	Model 7b	Model 7c	Model 7e
Car	144	171	171	171
Train – Vastrecht	46.9	/	/	
Train – normal ticket	55.1	71	71	71

Scheduling trade-off ratios

Variable and Mode	Schedule penalty coefficient divided by travel time coefficient			
	Model 7	Model 7b	Model 7c	Model 7e
Early schedule penalty – Outward leg – All modes	1.68			
Early schedule penalty – Outward leg – Car		2.04	2	2.04
Early schedule penalty – Outward leg – Train		0.69	0.68	0.69
Late schedule penalty – Outward leg– All modes	1.58			
Late schedule penalty – Outward leg- Car		2.22	2.4	2.23
Late schedule penalty – Outward leg- Train		0.20	0.2	0.20
Increased participation time penalty– All modes	0.82			
Increased participation time penalty- Car		0.99	1	0.99
Increased participation time penalty- Train		0.51	0.52	0.51
Decreased participation time penalty– All modes	0.71			
Decreased participation time penalty- Car		0.78	0.77	0.78
Decreased participation time penalty- Train		0.65	0.65	0.65
Early schedule penalty – NHB trip		2.03	1.05	
Late schedule penalty – NHB trip		2.21	1.13	

Discussion of outcomes

Model 7d is the model with the best likelihood, but has insignificant cost coefficients for non-home-based trips, and therefore has not been chosen. Model 7c also gives satisfactory results, but it does not seem necessary to have non-home-based specific delay variables as these are similar to the car tour specific delay variables. Model 7e gives satisfactory results as well. Before we make a choice here, we report some further tests for business.

In the table below, model 7i is similar to model 7e but it has specific time coefficients for non-home-based trips. Model 7j has specific time coefficients and schedule penalty coefficients for non- home-based trips. Model 7h is similar to model 7j and has specific cost coefficients for non-home- based trips.

Estimated coefficients for multinomial logit models with three constants for business (t-ratios between brackets): APRIL-type models with mode-specific and non-home-based-specific departure time scheduling penalties and participation time penalties

File	todbus7e.f12	todbus7h.f12	todbus7j.f12	todbus7i.f12
Title	TOD MODEL	TOD MODEL	TOD MODEL	TOD MODEL
Converged	True	True	True	True
Observations	3812	3812	3812	3812
Final log (L)	-3502.6	-3487.4	-3489.8	-3496.6
D.O.F.	15	21	19	17
Rho²(0)	0.276	0.279	0.278	0.277
Rho²(c)	0.068	0.072	0.072	0.070
Prepared	3 May 01	3 May 01	4 May 01	4 May 01
Estimated	3 May 01	3 May 01	4 May 01	4 May 01
Scaling	1.0000	1.0000	1.0000	1.0000
train_c	-1.51 (-9.6)	-1.20 (-6.7)	-1.19 (-6.7)	-1.27 (-7.0)
T_caralt_c	-1.64 (-8.3)	-1.72 (-8.6)	-1.72 (-8.6)	-1.69 (-8.4)
TrTswi_C	-1.41 (-17.5)	-1.39 (-17.4)	-1.39 (-17.3)	-1.37 (-17.2)
Ccost_Bus	-0.0035 (-3.3)	-0.0035 (-3.3)	-0.0035 (-3.4)	-0.0036 (-3.4)
Tcost_Bus	-0.0102 (-4.1)	-0.0101 (-4.0)	-0.0094 (-3.8)	-0.0095 (-3.8)
ctime_bus	-0.0100 (-8.8)	-0.0087 (-7.5)	-0.0086 (-7.4)	-0.0087 (-7.5)
ttime_bus	-0.0120 (-10.4)	-0.0113 (-9.6)	-0.0114 (-9.7)	-0.0113 (-9.7)
DepEarlyC	-0.0204 (-18.7)	-0.0193 (-12.4)	-0.0193 (-12.4)	-0.0203 (-18.6)
DepEarlyT	-0.0083 (-4.2)	-0.0089 (-4.4)	-0.0090 (-4.4)	-0.0087 (-4.6)
DepLateC	-0.0223 (-19.4)	-0.0216 (-13.6)	-0.0216 (-13.6)	-0.0217 (-19.3)
DepLateT	-0.0024 (-2.0)	-0.0025 (-2.1)	-0.0025 (-2.0)	-0.0037 (-3.0)
StLongerC	-0.0099 (-6.6)	-0.0094 (-6.2)	-0.0094 (-6.2)	-0.0092 (-6.2)
StLongerT	-0.0062 (-4.5)	-0.0062 (-4.5)	-0.0063 (-4.5)	-0.0065 (-4.7)
StShorterC	-0.0078 (-4.7)	-0.0076 (-4.5)	-0.0076 (-4.5)	-0.0077 (-4.7)
StShorterT	-0.0078 (-6.7)	-0.0080 (-6.8)	-0.0079 (-6.7)	-0.0076 (-6.5)
Ccost_NHB		7.6e-4 (0.0)		
Tcost_NHB		0.0324 (1.5)		
ctime_NHB		-0.0205 (-5.0)	-0.0224 (-5.6)	-0.0176 (-4.5)
ttime_NHB		-0.0493 (-4.6)	-0.0375 (-6.2)	-0.0426 (-6.6)
DepEarlyN		-0.0216 (-13.7)	-0.0218 (-13.8)	
DepLateN		-0.0233 (-13.7)	-0.0236 (-13.8)	

Values of time (guilders/hour)

	Model 7e	Model 7i	Model 7j
Car	171	147	145
Car NHB only		384	293
Train	70	73	78
Train NHB only		239	226

Scheduling trade-off ratios

Variable and Mode	Schedule penalty coefficient divided by travel time coefficient		
	Model 7e	Model 7i	Model 7j
Early schedule penalty – Outward leg - Car	2.04	2.24	2.33
Early schedule penalty – Outward leg - Train	0.69	0.79	0.77
Late schedule penalty – Outward leg- Car	2.23	2.51	2.49
Late schedule penalty – Outward leg- Train	0.2	0.22	0.32
Increased participation time penalty- Car	0.99	1.09	1.05
Increased participation time penalty- Train	0.51	0.55	0.57
Decreased participation time penalty- Car	0.78	0.88	0.87
Decreased participation time penalty- Train	0.65	0.69	0.67
Early schedule penalty – NHB trip		2.53	
Late schedule penalty – NHB trip		2.74	

Discussion of outcomes

Model 7j has a significantly better likelihood than model 7i, which in turn is significantly better than model 7e. Model 7h has some insignificant cost parameters. Having specific time coefficients for non-home-based trips as in 7j and 7i results in high values of time for these trips, but for tours they are lower than in model 7e. For the moment we prefer model 7j for business travel.

2.12.3 Education

Model 7 is the base model. Model 2 has specific schedule penalty and participation penalty variables for each mode (explained below). Model 2b excludes car users whose purpose is education. In model2b we can still estimate car-specific variables because a shift to the car alternative was offered in the SP to the train users.

Estimated coefficients for multinomial logit models with three constants for education (t-ratios between brackets): APRIL-type models with mode-specific departure time scheduling penalties and participation time penalties; all education (2x) and train users respectively

File	Todedu07.F12		Todedu02.F12		Todedu2b.F12	
Title	TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True	
Observations	1250		1250		1193	
Final log (L)	-862.9		-856.7		-780.5	
D.O.F.	12		16		15	
Rho²(0)	0.413		0.417		0.439	
Rho²(c)	0.123		0.130		0.152	
Prepared	19 Apr 01		3 May 01		3 May 01	
Estimated	19 Apr 01		3 May 01		3 May 01	
Scaling	1.0000		1.0000		1.0000	
train_c	1.72	(4.3)	1.35	(3.2)	0	(*)
T_caralt_c	-2.96	(-6.4)	-2.77	(-5.8)	-4.21	(-6.0)
TrTswi_C	-1.52	(-16.2)	-1.48	(-15.4)	-1.51	(-15.6)
DepEarly	-0.0114	(-4.5)				
DepLate	-0.0065	(-4.0)				
StLonger	-0.0063	(-3.8)				
StShorter	-0.0035	(-3.0)				
Ccost_Edu	-0.0791	(-6.0)	-0.0807	(-5.9)	-0.109	(-6.3)
ctime_edu	-0.0161	(-4.3)	-0.0143	(-3.7)	-9.1e-4	(-0.2)
ttime_edu	-0.0362	(-10.1)	-0.0343	(-8.9)	-0.0334	(-8.3)
Tkaarte	0.0021	(0.5)	0.0041	(0.9)	-5.8e-4	(-0.1)
Tothere	-0.0471	(-7.9)	-0.0477	(-7.8)	-0.0597	(-8.0)
DepEarlyC			-0.0191	(-2.7)	-0.0176	(-0.9)
DepEarlyT			-0.0103	(-3.9)	-0.0092	(-3.5)
DepLateC			-0.0193	(-2.5)	0.0183	(1.5)
DepLateT			-0.0058	(-3.6)	-0.0057	(-3.6)
StLongerC			0.0026	(0.6)	0.0147	(2.0)
StLongerT			-0.0081	(-4.3)	-0.0080	(-4.2)
StShorterC			-0.0140	(-1.1)	-0.0251	(-0.4)
StShorterT			-0.0037	(-3.1)	-0.0039	(-3.3)

Values of time (guilders/hour)

	Model 7	Model 2	Model 2b
Car	12	11	/
Train – Vastrecht	/	/	/
Train – normal ticket	46	43	34

Scheduling trade-off ratios

Variable and Mode	Schedule penalty coefficient divided by travel time coefficient		
	Model 7	Model 2	Model 2b
Early schedule penalty – Outward leg – All modes	0.31		
Early schedule penalty – Outward leg - Car		0.33	/
Early schedule penalty – Outward leg - Train		0.30	0.27
Late schedule penalty – Outward leg– All modes	0.18		
Late schedule penalty – Outward leg- Car		1.34	/
Late schedule penalty – Outward leg- Train		0.17	0.17
Increased participation time penalty– All modes	0.17		
Increased participation time penalty- Car		/	/
Increased participation time penalty- Train		0.23	0.23
Decreased participation time penalty– All modes	0.09		
Decreased participation time penalty- Car		0.97	/
Decreased participation time penalty- Train		0.10	0.11

Discussion of outcomes

In models 2 and 2b StLongerC is not significant or has a wrong sign. Tkaarte is not significant either in all three models. If we exclude the car users, as in model 2b, the car cost coefficient changes a lot and car time becomes insignificant. Before we draw conclusions for education, we first present some other specifications.

Model 2d is similar to model 2, but has only one train cost coefficient. Model 2f has a common increased participation penalty coefficient for car and train (StLonger), to remedy the findings on StlongerC in 2 and 2b. Also, in both models 2d and 2f, we only have one train cost coefficient, as the split for this in the above models did not produce satisfactory results

Estimated coefficients for multinomial logit models with three constants for education (t-ratios between brackets): APRIL-type models with mode-specific departure time scheduling penalties and participation time penalties

File	todedu2d.f12		todedu2f.f12	
Title	TOD MODEL		TOD MODEL	
Converged	True		True	
Observations	1250		1250	
Final log (L)	-896.1		-897.8	
D.O.F.	15		14	
Rho²(0)	0.390		0.389	
Rho²(c)	0.090		0.088	
Prepared	3 May 01		4 May 01	
Estimated	3 May 01		4 May 01	
Scaling	1.0000		1.0000	
train_c	1.46	(3.6)	1.49	(3.7)
T_caralt_c	-3.52	(-8.0)	-3.51	(-8.0)
TrTswi_C	-1.53	(-16.2)	-1.57	(-16.9)
Ccost_Edu	-0.0284	(-4.3)	-0.0296	(-4.5)
Tcost_Edu	-0.0182	(-6.6)	-0.0184	(-6.7)
ctime_edu	-0.0109	(-3.6)	-0.0125	(-4.3)
ttime_edu	-0.0235	(-7.4)	-0.0257	(-8.6)
DepEarlyC	-0.0193	(-2.5)	-0.0176	(-2.4)
DepEarlyT	-0.0104	(-3.8)	-0.0111	(-4.1)
DepLateC	-0.0147	(-2.0)	-0.0165	(-2.3)
DepLateT	-0.0068	(-4.3)	-0.0067	(-4.2)
StLongerC	8.8e-4	(0.2)		
StLongerT	-0.0069	(-3.7)		
StShorterC	-0.0157	(-1.2)	-0.0163	(-1.3)
StShorterT	-0.0049	(-4.2)	-0.0047	(-4.1)
StLonger			-0.0055	(-3.4)

Value of time (guilders/hour)

	Model 2d	Model 2f
Car	23	25
Train	77	83

Scheduling trade-off ratios

Variable and Mode	Schedule penalty coefficient divided by travel time coefficient	
	Model 2d	Model 2f
Early schedule penalty – Outward leg - Car	1.77	1.41
Early schedule penalty – Outward leg - Train	0.30	0.43
Late schedule penalty – Outward leg- Car	1.34	1.32
Late schedule penalty – Outward leg- Train	0.17	0.26
Increased participation time penalty- Car	/	0.44
Increased participation time penalty- Train	0.23	0.63
Decreased participation time penalty- Car	1.44	1.30
Decreased participation time penalty- Train	0.10	0.18

Discussion of outcomes

Although model 2f is not significantly better (in terms of likelihood) than model 2d, it does have a correct outcome for Stlonger. In model 2f StShorterC is not significant. Both models have a likelihood value that is significantly worse than models 7, 2 and 2b (but 2b has less observations). Given the insignificant coefficients in these three models, we nevertheless prefer model 2.

2.12.4 'Other' purposes.

Model 7 is the base model. Model 2 has specific schedule penalty and participation penalty variables for each mode (explained above). Model 2d is similar to Model 2 but has only one train cost coefficient. Model 2b includes car users whose purpose is education. We made this test because we noticed that car users travelling for education purpose are different from train users travelling for the same purpose. Often, train users are younger than car users and they are going to a school or a university whereas car users are often above 25 and are following a course for their work. A model for education with only car users gives bad results as it has only 57 observations, therefore we tested including car users in the 'other' purposes models.

Estimated coefficients for multinomial logit models with three constants for 'other' purposes (t-ratios between brackets): APRIL-type models with mode-specific departure time scheduling penalties and participation time penalties; other (2x), other plus car users for education, other respectively

File	todoth07.f12		todoth02.f12		todoth2b.f12		todoth2d.f12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True	
Observations	3224		3224		3281		3224	
Final log (L)	-3304.4		-3265.7		-3351.4		-3267.1	
D.O.F.	12		16		16		15	
$Rho^2(0)$	0.188		0.198		0.192		0.198	
$Rho^2(c)$	0.021		0.032		0.032		0.032	
Prepared	19 Apr 01		3 May 01		3 May 01		16 May 01	
Estimated	19 Apr 01		3 May 01		3 May 01		16 May 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
train_c	-1.62	(-10.4)	-1.71	(-10.9)	-1.52	(-10.5)	-1.67	(-10.8)
T_caralt_c	-0.657	(-2.9)	-0.695	(-3.1)	-0.682	(-3.1)	-0.839	(-4.0)
TrTswi_C	-0.449	(-5.6)	-0.654	(-7.7)	-0.635	(-7.5)	-0.652	(-7.7)
DepEarly	-0.0084	(-12.4)						
DepLate	-0.0111	(-8.9)						
StLonger	-0.0059	(-7.0)						
StShorter	-0.0077	(-7.1)						
Ccost_Oth	-0.0103	(-4.8)	-0.0117	(-5.5)	-0.0109	(-5.1)	-0.0116	(-5.4)
ctime_Oth	-0.0100	(-7.9)	-0.0108	(-8.4)	-0.0114	(-9.2)	-0.0105	(-8.3)
ttime_oth	-0.0087	(-6.9)	-0.0112	(-8.6)	-0.0118	(-9.2)	-0.0120	(-9.8)
Tkaarto	-0.0148	(-4.3)	-0.0163	(-4.7)	-0.0158	(-4.6)		
Tothero	-0.0238	(-5.8)	-0.0249	(-6.0)	-0.0217	(-5.4)		
DepEarlyC			-0.0112	(-12.3)	-0.0112	(-12.5)	-0.0112	(-12.3)
DepEarlyT			-0.0011	(-1.2)	-0.0015	(-1.5)	-0.0012	(-1.3)
DepLateC			-0.0155	(-9.9)	-0.0161	(-10.4)	-0.0154	(-9.8)
DepLateT			-0.0046	(-2.8)	-0.0049	(-3.0)	-0.0045	(-2.8)
StLongerC			-0.0076	(-6.1)	-0.0077	(-6.2)	-0.0075	(-6.1)
StLongerT			-0.0055	(-5.3)	-0.0055	(-5.2)	-0.0055	(-5.3)
StShorterC			-0.0104	(-6.5)	-0.0102	(-6.5)	-0.0104	(-6.6)
StShorterT			-0.0052	(-3.8)	-0.0052	(-3.8)	-0.0049	(-3.6)
Tcost_Oth							-0.0199	(-7.0)

Values of time (guilders/hour)

	Model 7	Model 2	Model 2b	Model 2d
Car	58	55	63	54
Train –all				36
Train – Vastrecht	35	41	45	
Train – normal ticket	22	27	33	

Scheduling trade-off ratios

Variable and Mode	Schedule penalty coefficient divided by travel time coefficient			
	Model 7	Model 2	Model 2b	Model 2d
Early schedule penalty – Outward leg – All modes	0.96			
Early schedule penalty – Outward leg – Car		1.03	0.98	1.06
Early schedule penalty – Outward leg – Train		0.09	0.12	0.10
Late schedule penalty – Outward leg– All modes	1.2			
Late schedule penalty – Outward leg- Car		1.43	1.41	1.46
Late schedule penalty – Outward leg- Train		0.41	0.41	0.37
Increased participation time penalty– All modes	0.67			
Increased participation time penalty- Car		0.70	0.67	0.70
Increased participation time penalty- Train		0.48	0.46	0.45
Decreased participation time penalty– All modes	0.88			
Decreased participation time penalty- Car		0.96	0.89	0.99
Decreased participation time penalty- Train		0.46	0.44	0.41

Discussion of outcomes

Adding mode specific schedule delay variables improves the overall fit of the model. The derived ratios (schedule delay)/(time) are different for car and train users, they are lower for train users which shows that one minute schedule delay for a train user is less bad in terms of travel time than one minute schedule delay for a car user. Model 2d is not significantly worse than 2, and is the preferred model. Adding the car users for education to 'other' is a feasible solution, which needs to be compared with adding car users for education to train users for education (as in all models in 2.1.3 except Todedu2b). Given the insignificant outcomes of Todedu2b for car time and some scheduling variables, we prefer to use model 2 for education and model 2d for other.

2.13 Test 12: log of cost

In this test we shall work on the cost coefficient trying to improve the values of time which are still rather high compared to other studies.

In all models 12 the cost variables are incorporated in logarithms. We present two purposes at the same time.

2.13.1 Commuters and business

Estimated coefficients for multinomial logit models with three constants (t-ratios between brackets): APRIL-type models with mode-specific departure time scheduling penalties and participation time penalties: commuting with linear cost, commuting with log cost, business with linear cost and business with log cost respectively

File	todcom9e.f12		todcom12.f12		todbus7j.f12		todbus12.f12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True	
Observations	6180		6180		3812		3812	
Final log (L)	-5888.5		-5935.4		-3489.8		-3473.4	
D.O.F.	16		16		19		19	
Rho²(0)	0.250		0.244		0.278		0.282	
Rho²(c)	-0.014		-0.022		0.072		0.076	
Prepared	4 May 01		16 May 01		4 May 01		18 May 01	
Estimated	4 May 01		16 May 01		4 May 01		18 May 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
train_c	-1.17	(-10.3)	-1.53	(-5.1)	-1.19	(-6.7)	-2.87	(-5.3)
T_caralt_c	-1.54	(-9.8)	-1.16	(-3.5)	-1.72	(-8.6)	-0.0676	(-0.1)
TrTswi_C	-1.53	(-19.2)	-1.49	(-18.9)	-1.39	(-17.3)	-1.41	(-17.5)
Ccost_Com	**-0.0128**	**(-8.5)**	**-0.223**	**(-3.2)**				
CTraNocomp	**-0.0279**	**(-4.3)**	**-0.205**	**(-2.3)**				
CTracomp	**-0.0085**	**(-3.7)**	**-0.140**	**(-1.9)**				
ctime_com	-0.0058	(-6.6)	-0.0069	(-7.9)				
ttime_com	-0.0104	(-10.0)	-0.0090	(-8.6)				
DepEarlyC	0	(*)	0	(*)	-0.0193	(-12.4)	-0.0195	(-12.5)
DepEarlyT	0	(*)	0	(*)	-0.0090	(-4.4)	-0.0091	(-4.4)
DepEarlyF	-0.0163	(-14.1)	-0.0163	(-14.0)				
DepEarlyNF	-0.0152	(-12.2)	-0.0152	(-12.1)				
DepLateC	0	(*)	0	(*)	-0.0216	(-13.6)	-0.0220	(-13.7)
DepLateT	0	(*)	0	(*)	-0.0025	(-2.0)	-0.0025	(-2.0)
DepLateF	-0.0143	(-16.1)	-0.0142	(-15.8)				
DepLateNF	-0.0189	(-15.4)	-0.0189	(-15.2)				
StLongerF	-0.0111	(-9.1)	-0.0110	(-9.0)				
SLongerNF	-0.0127	(-9.7)	-0.0128	(-9.8)				
StShorterF	-0.0049	(-6.1)	-0.0047	(-5.9)				
SShorterNF	-0.0100	(-8.8)	-0.0098	(-8.6)				
Ccost_Bus					**-0.0035**	**(-3.4)**	**-0.751**	**(-6.7)**
Tcost_Bus					**-0.0094**	**(-3.8)**	**-0.449**	**(-5.0)**
ctime_bus					-0.0086	(-7.4)	-0.0077	(-6.8)
ctime_NHB					-0.0224	(-5.6)	-0.0226	(-5.6)
ttime_bus					-0.0114	(-9.7)	-0.0125	(-10.5)
ttime_NHB					-0.0375	(-6.2)	-0.0374	(-6.3)
DepEarlyN					-0.0218	(-13.8)	-0.0218	(-13.8)
DepLateN					-0.0236	(-13.8)	-0.0235	(-13.8)
StLongerC					-0.0094	(-6.2)	-0.0095	(-6.2)
StLongerT					-0.0063	(-4.5)	-0.0060	(-4.3)
StShorterC					-0.0076	(-4.5)	-0.0076	(-4.5)
StShorterT					-0.0079	(-6.7)	-0.0081	(-6.9)

In calculating the 'value of time' in cost terms for a model with a log cost formulation, account must be taken of the non-linearity of the cost variable. The approach we have taken in the present study is to use the slope of the log function at the average cost value. For most travellers this is an approximation, an overstatement of the VOT for short-distance travellers and an understatement for long-distance travellers, but it is the most representative measure that is known to give an overall assessment of VOT. The VOT values must therefore be treated with a certain amount of caution for this reason alone. The value of time calculated from a model with a log cost formulation is then:
(Time coefficient / cost coefficient) * average cost value

We present below only the value of time for commuters.

Value of time for commuting (guilders/hour)

	Model 9e	Model 12
Car	27	68
Train – Compensation	73	189
Train –No compensation	22	129

We present below only the value of time for business.

Value of time for business (guilders/hour)

	Model 7j	Model 12
Car	145	61
Car NHB	293	122
Train	80	71
Train NHB	226	129

2.13.2 Education and other

Estimated coefficients for multinomial logit models with three constants (t-ratios between brackets): APRIL-type models with mode-specific departure time scheduling penalties and participation time penalties: education with linear cost, education with log cost, 'other' with linear cost and 'other' with log cost respectively

File	todedu2f.f12		todedu12.f12		todoth2d.f12		todoth12.f12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True	
Observations	1250		1250		3224		3224	
Final log (L)	-897.8		-901.4		-3267.1		-3271.9	
D.O.F.	14		14		15		15	
Rho²(0)	0.389		0.386		0.198		0.196	
Rho²(c)	0.088		0.084		0.032		0.030	
Prepared	4 May 01		16 May 01		16 May 01		16 May 01	
Estimated	4 May 01		16 May 01		16 May 01		16 May 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
train_c	1.49	(3.7)	-1.72	(-1.5)	-1.67	(-10.8)	-2.11	(-4.8)
T_caralt_c	-3.51	(-8.0)	-0.105	(-0.1)	-0.839	(-4.0)	-0.162	(-0.3)
TrTswi_C	-1.57	(-16.9)	-1.62	(-16.6)	-0.652	(-7.7)	-0.619	(-7.3)
DepEarlyC	-0.0176	(-2.4)	-0.0212	(-2.7)	-0.0112	(-12.3)	-0.0114	(-12.4)
DepEarlyT	-0.0111	(-4.1)	-0.0102	(-3.7)	-0.0012	(-1.3)	-0.0010	(-1.1)
DepLateC	-0.0165	(-2.3)	-0.0173	(-2.4)	-0.0154	(-9.8)	-0.0159	(-10.3)
DepLateT	-0.0067	(-4.2)	-0.0062	(-4.0)	-0.0045	(-2.8)	-0.0044	(-2.7)
StLongerC					-0.0075	(-6.1)	-0.0077	(-6.2)
StLongerT					-0.0055	(-5.3)	-0.0054	(-5.2)
StShorterC	-0.0163	(-1.3)	-0.0160	(-1.2)	-0.0104	(-6.6)	-0.0106	(-6.7)
StShorterT	-0.0047	(-4.1)	-0.0049	(-4.2)	-0.0049	(-3.6)	-0.0045	(-3.3)
StLonger	-0.0055	(-3.4)	-0.0050	(-3.1)				
Ccost_Edu	**-0.0296**	**(-4.5)**	**-1.51**	**(-4.8)**				
Tcost_Edu	**-0.0184**	**(-6.7)**	**-0.743**	**(-5.2)**				
ctime_edu	-0.0125	(-4.3)	-0.0106	(-3.8)				
ttime_edu	-0.0257	(-8.6)	-0.0235	(-8.2)				
Ccost_Oth					**-0.0116**	**(-5.4)**	**-0.676**	**(-6.0)**
Tcost_Oth					**-0.0199**	**(-7.0)**	**-0.628**	**(-7.0)**
ctime_Oth					-0.0105	(-8.3)	-0.0103	(-8.2)
ttime_oth					-0.0120	(-9.8)	-0.0119	(-9.9)

Values of time for education (guilders/hour)

	Model 2f	Model 12
Car	23	33
Train	77	60

Values of time for 'other' (guilders/hour)

	Model 2d	Model 12
Car	54	36
Train	36	42

Discussion of outcomes (all four purposes)

The models for commuting, education and 'other' are not improved (likelihood, value of time) by the introduction of the log of the cost in the utility functions. Only the model and value of time for business are improved by this change. For business the log of the cost is maintained.

2.14 Test 13: specific tests per purpose

2.14.1 Business

The value of time for non-home based trips is rather high and it seems preferable to have only one time coefficient and then only one common value of time for non-home-based trips and home-based tours. This test has been made in Model 7l.

In model 7m, the cost of the train tour for 'vastrecht' is zero: one might assume that these travellers purchased their jaarkaart for a specific journey they make everyday (most of the time for commuting), and all other journeys they would make by train are free to them. In the data used in estimation, 29% of the business travellers using train owns a jaarkaart or trajectkaart, versus 49% for all travellers. This makes it unlikely that model 7m will bring about an improvement.

Estimated coefficients for multinomial logit models with three constants for business (t-ratios between brackets): APRIL-type models with mode-specific departure time scheduling penalties and participation time penalties

File	todbus7j.f12		todbus7l.f12		todbus7m.f12	
Title	TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True	
Observations	3812		3812		3812	
Final log (L)	-3489.8		-3502.5		-3503.6	
D.O.F.	19		17		17	
$Rho^2(0)$	0.278		0.276		0.275	
$Rho^2(c)$	0.072		0.068		0.068	
Prepared	4 May 01		18 May 01		18 May 01	
Estimated	4 May 01		18 May 01		18 May 01	
Scaling	1.0000		1.0000		1.0000	
train_c	-1.19	(-6.7)	-1.51	(-9.6)	-1.54	(-9.8)
T_caralt_c	-1.72	(-8.6)	-1.64	(-8.2)	-1.54	(-7.7)
TrTswi_C	-1.39	(-17.3)	-1.41	(-17.5)	-1.39	(-17.4)
Ccost_Bus	-0.0035	(-3.4)	-0.0035	(-3.3)	-0.0035	(-3.3)
Tcost_Bus	-0.0094	(-3.8)	-0.0102	(-4.1)		
ctime_bus	-0.0086	(-7.4)	-0.0100	(-8.8)	-0.0099	(-8.7)
ctime_NHB	-0.0224	(-5.6)				
ttime_bus	-0.0114	(-9.7)	-0.0121	(-10.3)	-0.0120	(-10.2)
ttime_NHB	-0.0375	(-6.2)				
DepEarlyC	-0.0193	(-12.4)	-0.0200	(-12.7)	-0.0199	(-12.7)
DepEarlyT	-0.0090	(-4.4)	-0.0082	(-4.1)	-0.0082	(-4.2)
DepEarlyN	-0.0218	(-13.8)	-0.0206	(-13.7)	-0.0206	(-13.7)
DepLateC	-0.0216	(-13.6)	-0.0225	(-14.0)	-0.0224	(-14.0)
DepLateT	-0.0025	(-2.0)	-0.0024	(-2.0)	-0.0022	(-1.8)
DepLateN	-0.0236	(-13.8)	-0.0221	(-13.5)	-0.0221	(-13.5)
StLongerC	-0.0094	(-6.2)	-0.0100	(-6.6)	-0.0100	(-6.6)
StLongerT	-0.0063	(-4.5)	-0.0062	(-4.5)	-0.0064	(-4.6)
StShorterC	-0.0076	(-4.5)	-0.0077	(-4.5)	-0.0077	(-4.5)
StShorterT	-0.0079	(-6.7)	-0.0078	(-6.6)	-0.0075	(-6.4)
Totherb					-0.0089	(-3.8)

Value of times (guilders/hour)

	Model 7j	Model 7l	Model 7m
Car	147	171	169
Car NHB only	384		
Train	73	72	81
Train NHB only	239		

Scheduling trade-off ratios

Variable and Mode	Schedule penalty coefficient divided by travel time coefficient		
	Model 7j	Model 7m	Model 7l
Early schedule penalty – Outward leg - Car	2.24	2	2
Early schedule penalty – Outward leg - Train	0.79	0.67	0.92
Late schedule penalty – Outward leg- Car	2.51	2.25	2.26
Late schedule penalty – Outward leg- Train	0.22	0.20	0.247
Increased participation time penalty- Car	1.09	1	1
Increased participation time penalty- Train	0.55	0.51	0.72
Decreased participation time penalty- Car	0.88	0.77	0.77
Decreased participation time penalty- Train	0.69	0.64	0.84
Early schedule penalty – NHB trip	2.53	2.06	2.06
Late schedule penalty – NHB trip	2.74	2.21	2.21

Discussion of outcomes

Model 7j performs significantly better than the other two in terms of likelihood value. Furthermore, the values of time are not improved by the changes made in the models 7l and 7m, they remain quite high.

2.14.2 Education and other

In model 2j for education and 2h for 'other purposes' we fixed the train cost for 'vastrecht' to 0, for the reason we explained above: one might assume that these travellers purchased their jaarkaart for a specific journey they make everyday (most of the time for commuting), and all other journeys they would make by train are free to them. 79% of the train users in the estimation data owns a jaarkaart or jaartrajectkaart, for travellers for 'other' purposes this is only 19% (49% for all purposes).

Estimated coefficients for multinomial logit models with three constants (t-ratios between brackets): APRIL-type models with mode-specific departure time scheduling penalties and participation time penalties: education (2x) and 'other' (2x) respectively

File	todedu2f.f12		todedu2j.f12		todoth2d.f12		todoth2h.f12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True	
Observations	1250		1250		3224		3224	
Final log (L)	-897.8		-859.5		-3267.1		-3278.9	
D.O.F.	14		14		15		15	
Rho²(0)	0.389		0.415		0.198		0.195	
Rho²(c)	0.088		0.127		0.032		0.028	
Prepared	4 May 01		22 May 01		16 May 01		22 May 01	
Estimated	4 May 01		22 May 01		16 May 01		22 May 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
train_c	1.49	(3.7)	1.42	(3.4)	-1.67	(-10.8)	-1.83	(-11.6)
T_caralt_c	-3.51	(-8.0)	-2.85	(-6.2)	-0.839	(-4.0)	-0.298	(-1.4)
TrTswi_C	-1.57	(-16.9)	-1.54	(-16.6)	-0.652	(-7.7)	-0.617	(-7.3)
StLonger	-0.0055	(-3.4)	-0.0064	(-3.8)				
Ccost_Edu	-0.0296	(-4.5)	-0.0830	(-6.1)				
Tcost_Edu	-0.0184	(-6.7)	0	(*)				
ctime_edu	-0.0125	(-4.3)	-0.0159	(-4.2)				
ttime_edu	-0.0257	(-8.6)	-0.0371	(-10.1)				
DepEarlyC	-0.0176	(-2.4)	-0.0168	(-2.4)	-0.0112	(-12.3)	-0.0111	(-12.3)
DepEarlyT	-0.0111	(-4.1)	-0.0110	(-4.1)	-0.0012	(-1.3)	-0.0016	(-1.6)
DepLateC	-0.0165	(-2.3)	-0.0214	(-2.7)	-0.0154	(-9.8)	-0.0155	(-9.9)
DepLateT	-0.0067	(-4.2)	-0.0058	(-3.7)	-0.0045	(-2.8)	-0.0047	(-2.9)
StShorterC	-0.0163	(-1.3)	-0.0150	(-1.1)	-0.0104	(-6.6)	-0.0103	(-6.5)
StShorterT	-0.0047	(-4.1)	-0.0036	(-3.2)	-0.0049	(-3.6)	-0.0051	(-3.7)
Tothere			-0.0486	(-8.0)				
Ccost_Oth					-0.0116	(-5.4)	-0.0118	(-5.6)
Tcost_Oth					-0.0199	(-7.0)		
ctime_Oth					-0.0105	(-8.3)	-0.0105	(-8.3)
ttime_oth					-0.0120	(-9.8)	-0.0105	(-8.1)
StLongerC					-0.0075	(-6.1)	-0.0075	(-6.1)
StLongerT					-0.0055	(-5.3)	-0.0059	(-5.5)
Tothero							-0.0225	(-5.5)

Values of time for education (guilders/hour)

	Model edu2f	Model edu2j
Car	25	11
Train	83	45

Values of time for 'other' purposes (guilders/hour)

	Model oth2d	Model oth2h
Car	54	53
Train	36	28

Discussion of outcomes

For education model 2j has clearly a higher likelihood and both the train and car users' value of time decrease relative to model 2f. The train cost AND car cost coefficients in both models are quite different, probably because of correlation between the cost for both modes. Model 2j is preferred, but further testing will be done in section 2.14.3.

For other purposes, fixing the 'vastrecht' at 0 gives a lower likelihood, whereas the train value of time decreases only slightly and the car users VoT is not affected by the change. Model 2d is preferred.

2.14.3 Education: only one schedule coefficient for shorter participation

As the shorter participation penalty coefficient is not significant for car users in model 2f, we included only one shorter participation penalty both for car and train in model 2i.

Estimated coefficients for multinomial logit models with three constants for education (t-ratios between brackets): APRIL-type models with mode-specific departure time scheduling penalties and participation time penalties

File	todedu2f.f12		todedu2i.f12	
Title	TOD MODEL		TOD MODEL	
Converged	True		True	
Observations	1250		1250	
Final log (L)	-897.8		-898.3	
D.O.F.	14		13	
$Rho^2(0)$	0.389		0.388	
$Rho^2(c)$	0.088		0.087	
Prepared	4 May 01		18 May 01	
Estimated	4 May 01		18 May 01	
Scaling	1.0000		1.0000	
train_c	1.49	(3.7)	1.51	(3.7)
T_caralt_c	-3.51	(-8.0)	-3.49	(-8.0)
TrTswi_C	-1.57	(-16.9)	-1.57	(-16.9)
StLonger	-0.0055	(-3.4)	-0.0056	(-3.4)
Ccost_Edu	-0.0296	(-4.5)	-0.0296	(-4.5)
Tcost_Edu	-0.0184	(-6.7)	-0.0184	(-6.7)
ctime_edu	-0.0125	(-4.3)	-0.0128	(-4.4)
ttime_edu	-0.0257	(-8.6)	-0.0258	(-8.6)
DepEarlyC	-0.0176	(-2.4)	-0.0175	(-2.4)
DepEarlyT	-0.0111	(-4.1)	-0.0111	(-4.1)
DepLateC	-0.0165	(-2.3)	-0.0180	(-2.6)
DepLateT	-0.0067	(-4.2)	-0.0067	(-4.2)
StShorterC	-0.0163	(-1.3)		
StShorterT	-0.0047	(-4.1)		
StShorter			-0.0048	(-4.1)

Values of time for education (guilders/hour)

	Model 2f	Model 2i
Car	25.3	25.3
Train	83	83

Scheduling trade-off ratios

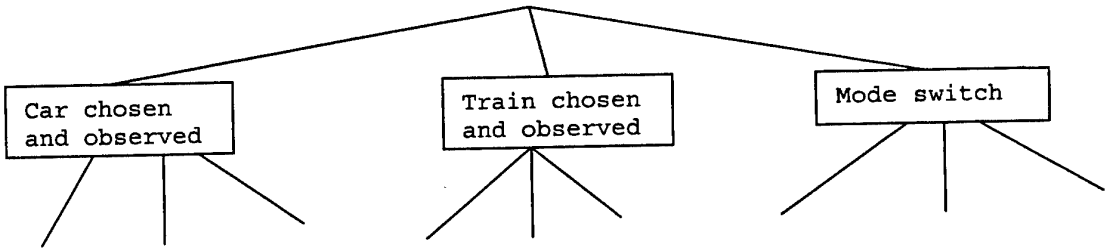
Variable and Mode	Schedule penalty coefficient divided by travel time coefficient	
	Model 2f	Model 2i
Early schedule penalty – Outward leg - Car	1.41	1.40
Early schedule penalty – Outward leg - Train	0.43	0.43
Late schedule penalty – Outward leg- Car	1.32	1.36
Late schedule penalty – Outward leg- Train	0.26	0.26
Increased participation time penalty- Car	0.44	0.44
Increased participation time penalty- Train	0.21	0.21
Decreased participation time penalty- Car	1.30	0.37
Decreased participation time penalty- Train	0.18	0.18

Discussion of outcomes

The decrease in likehood from model 2f to model 2i is not significant. StShorter is significant in model 2i. For education, model 2i is preferred to model 2f, but model 2j is even better (see section 2.14.2)

2.15 Test 14: nested logit models

The nest structure we test is the following:



The utility functions ($U_1 - U_{11}$) are explained in section 2.1. In the nested models these functions remain the same, only nest coefficients (1 – nest coefficient gives the amount of correlation between alternatives) have been added. It is not the case in these nested models that there are new utility functions for the three nests with only nest-specific constants as alternatives: the composite utility of a nest is a function of the utilities that belong to the nest.

For each respondent, only one of the 'car chosen' or 'train chosen' alternatives are available and possibly also one alternative mode .The difference with section 2.3 is that we now use all the data, not 90% of the data.

'Nestcoef' is the nest coefficient common to the three nest included in the following models. 'Nestcoef1', 'nestcoef2', 'nestcoef3' are the three different nest coefficient used respectively for the 'car chosen nest', for the 'train chosen' nest and for the 'mode switch' nest.

2.15.1 Commute

Model 10 has only three constants as in the multinomial base model (a train-time switch constant and two mode switch constant) whereas model 10b has four constants: the same as in model 10 and a car time-switch constant (CaTswi_c), for the considerably earlier and later alternatives. Model 10g is the same as model 10, but is has three nest coefficients instead of a single coefficent for all three nests.

Estimated coefficients for nested logit models for commuting (t-ratios between brackets): APRIL-type models with mode-specific departure time scheduling penalties and participation time penalties: three constants and one nest coefficient, four constants and one nest coefficient and three constants and three nest coefficients respectively

File	todcom10.f12		todcom10b.f12		todcom10g.f12	
Title	TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True	
Observations	6180		6180		6180	
Final log (L)	-5888.5		-5342.9		-5886.5	
D.O.F.	17		18		19	
Rho²(0)	0.250		0.320		0.251	
Rho²(c)	-0.014		0.080		-0.013	
Prepared	9 May 01		9 May 01		14 May 01	
Estimated	9 May 01		9 May 01		14 May 01	
Scaling	1.0000		1.0000		1.0000	
train_c	-1.17	(-5.0)	-4.13	(-6.5)	-1.35	(-4.8)
T_caralt_c	-1.54	(-6.5)	-3.18	(-6.7)	-1.89	(-5.6)
TrTswi_C	-1.53	(-19.2)	-1.93	(-22.2)	-1.52	(-18.9)
Ccost_Com	-0.0128	(-6.2)	-0.0238	(-5.5)	-0.0122	(-6.2)
CTraNocomp	-0.0278	(-4.1)	-0.0418	(-5.1)	-0.0262	(-3.6)
CTracomp	-0.0085	(-3.6)	-0.0180	(-5.1)	-0.0084	(-3.4)
ctime_com	-0.0058	(-6.6)	-0.0218	(-12.3)	-0.0056	(-6.3)
ttime_com	-0.0104	(-8.7)	-0.0250	(-8.8)	-0.0099	(-6.2)
DepEarlyC	0	(*)	0	(*)	0	(*)
DepEarlyT	0	(*)	0	(*)	0	(*)
DepEarlyF	-0.0163	(-13.7)	-0.0098	(-8.1)	-0.0162	(-13.7)
DepEarlyNF	-0.0152	(-12.1)	-0.0065	(-5.4)	-0.0153	(-12.1)
DepLateC	0	(*)	0	(*)	0	(*)
DepLateT	0	(*)	0	(*)	0	(*)
DepLateF	-0.0142	(-15.1)	-0.0088	(-9.4)	-0.0142	(-15.2)
DepLateNF	-0.0189	(-15.3)	-0.0112	(-9.7)	-0.0189	(-15.3)
StLongerF	-0.0111	(-9.0)	-0.0055	(-4.3)	-0.0111	(-9.0)
SLongerNF	-0.0127	(-9.7)	-0.0065	(-5.1)	-0.0127	(-9.7)
StShorterF	-0.0049	(-6.1)	-0.0018	(-2.3)	-0.0048	(-6.1)
SShorterNF	-0.0100	(-8.8)	-0.0071	(-6.1)	-0.0100	(-8.8)
Totherc	0	(*)	0	(*)	0	(*)
nestcoef	1.00	(9.4)	0.495	(7.8)		
CaTswi_C			-1.35	(-28.9)		
Nestcoef1					1.05	(8.5)
nestcoef3					0.966	(8.1)
nestcoef2					1.10	(5.1)

Values of time (guilders/hour)

	Model 10	Model10b
Car	27	55
Train – Compensation	73	83
Train –No compensation	22	36

Scheduling trade-off ratios

Variable	Schedule penalty coefficient divided by travel time coefficient	
	Model 10	Model 10b
Early schedule penalty – Outward leg – Non- flexible WH	1.46	0.26
Late schedule penalty – Outward leg– Non- flexible WH	1.81	0.45
Early schedule penalty – Outward leg – Flexible WH	1.56	0.39
Late schedule penalty – Outward leg– Flexible WH	1.37	0.35
Increased participation time penalty- Non- flexible WH	1.22	0.26
Decreased participation time penalty– Non- flexible WH	0.96	0.28
Increased participation time penalty- Flexible WH	1.06	0.22
Decreased participation time penalty– Flexible WH	0.47	0.07

Discussion of outcomes

Model 10b appears quite better in terms of likelihood than model 10 and the nest coefficient has a consistent value. The time coefficients and the cost coefficients increased a lot (the time coefficient increased most). This results in values of time higher than in model 10. Even though model 10b has a good fit, we do not prefer it, because the car time-switch constant takes away too much of the explanatory power from coefficients that should explain the time of day behaviour such as scheduling penalties, travel time and cost. We want behavioural variables to explain TOD choice, not constants without a behavioural explanation. Moreover, in the model that needs to be implemented in the LMS, a constant for time switching would be highly undesirable, since it is unclear what should be used for this variable when predicting for future years. We didn't calculate values of time from model 10g, as all nest coefficients are close to or higher than one which means that this nested structure is not suitable for this dataset.

2.15.2 Business.

Model 8 has only three constants as in the multinomial base model (a train time-switch constant and two mode-switch constants) whereas model 8d has four constants: the same as in model 8 and a car time-switch constant. (CaTswi_c). Both models have only one nest coefficient. Model 8f has three nest coefficients (nest coef, nestcoe2 and nestcoe3).

Estimated coefficients for nested logit models for business (t-ratios between brackets): APRIL-type models with mode-specific departure time scheduling penalties and participation time penalties: three constants and one nest coefficient, four constants and one nest coefficient and three constants and three nest coefficients respectively

File	todbus08.f12		todbus8d.f12		todbus8f.f12	
Title	TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True	
Observations	3812		3812		3812	
Final log (L)	-3489.8		-3343.3		-3486.6	
D.O.F.	20		21		22	
Rho²(0)	0.278		0.309		0.279	
Rho²(c)	0.072		0.111		0.073	
Prepared	7 May 01		14 May 01		14 May 01	
Estimated	7 May 01		14 May 01		14 May 01	
Scaling	1.0000		1.0000		1.0000	
train_c	-1.17	(-4.6)	-1.94	(-5.6)	-1.39	(-3.5)
T_caralt_c	-1.69	(-5.6)	-2.13	(-5.5)	-1.99	(-4.9)
TrTswi_C	-1.39	(-17.3)	-1.42	(-17.6)	-1.40	(-17.2)
Ccost_Bus	-0.0035	(-3.1)	-0.0028	(-2.1)	-0.0044	(-3.4)
Tcost_Bus	-0.0093	(-3.7)	-0.0135	(-4.7)	-0.0119	(-3.7)
ctime_bus	-0.0086	(-7.1)	-0.0144	(-8.3)	-0.0082	(-6.8)
ctime_NHB	-0.0223	(-5.5)	-0.0438	(-9.0)	-0.0191	(-4.7)
ttime_bus	-0.0113	(-7.9)	-0.0145	(-7.6)	-0.0153	(-5.9)
ttime_NHB	-0.0373	(-5.8)	-0.0627	(-7.1)	-0.0472	(-4.9)
DepEarlyC	-0.0193	(-12.0)	-0.0142	(-8.7)	-0.0186	(-11.8)
DepEarlyT	-0.0090	(-4.5)	-0.0076	(-3.7)	-0.0096	(-4.3)
DepEarlyN	-0.0218	(-13.7)	-0.0163	(-10.1)	-0.0214	(-13.6)
DepLateC	-0.0215	(-12.7)	-0.0155	(-9.1)	-0.0219	(-12.8)
DepLateT	-0.0025	(-2.0)	-0.0022	(-1.8)	-0.0029	(-2.3)
DepLateN	-0.0236	(-13.7)	-0.0179	(-10.3)	-0.0231	(-13.5)
StLongerC	-0.0094	(-6.1)	-0.0062	(-3.8)	-0.0096	(-6.1)
StLongerT	-0.0063	(-4.5)	-0.0064	(-4.6)	-0.0063	(-4.5)
StShorterC	-0.0076	(-4.5)	-0.0045	(-2.6)	-0.0074	(-4.4)
StShorterT	-0.0079	(-6.7)	-0.0083	(-7.0)	-0.0080	(-6.7)
nestcoef	1.01	(8.9)	0.833	(7.9)	1.23	(8.1)
CaTswi_C			-0.970	(-16.1)		
nestcoe2					0.686	(4.9)
nestcoe3					0.885	(7.8)

Values of time (guilders/hour)

	Model 8	Model 8d	Model 8f
Car	145	308	112
Car NHB only	382	938	260
Train	73	64	77
Train NHB only	241	278	238

Scheduling trade-off ratios

Variable and Mode	Schedule penalty coefficient divided by travel time coefficient		
	Model 8	Model 8d	Model 8f
Early schedule penalty – Outward leg - Car	2.24	0.98	2.27
Early schedule penalty – Outward leg - Train	0.79	0.52	0.63
Late schedule penalty – Outward leg- Car	2.48	1.07	2.67
Late schedule penalty – Outward leg- Train	0.22	0.15	0.19
Increased participation time penalty- Car	1.09	0.43	1.17
Increased participation time penalty- Train	0.55	0.44	0.41
Decreased participation time penalty- Car	0.88	0.31	0.90
Decreased participation time penalty- Train	0.69	0.57	0.52
Early schedule penalty – NHB trip	0.98	0.37	1.12
Late schedule penalty – NHB trip	1.06	0.41	1.21

Discussion of outcomes

The nested coefficient in model 8d and two out of three nest coefficients in model 8f have a value consistent with random utility theory. In model 8 , the nest coefficient is not significantly different from one, which is the value at which the nested model reduces to a multinomial model. In model 8b, the extra time-switch constant takes away too much explanation from behavioural variables, as happened in section 2.15.1. For all these models the values of time are increasing a lot compared with previous models. We do not prefer these nested models for business to the earlier multinomial logit models.

2.15.3 Education

Both model 8 and 8b have one nest coefficient. Model 8 has only three constants as in the multinomial base model (a train-time switch constant and two mode switch constant) whereas models 8e has and additional car-time switch constant. (CaTswi_c). For this purpose we also tried to run models with several nest coefficient, but the dataset was not large enough to support these specifications.

Estimated coefficients for nested logit models for education (t-ratios between brackets): APRIL-type models with mode-specific departure time scheduling penalties and participation time penalties: three constants and one nest coefficient, four constants and one nest coefficient respectively

File	todedu08.f12	todedu8e.f12
Title	TOD MODEL	TOD MODEL
Converged	True	True
Observations	1250	1250
Final log (L)	-891.8	-883.0
D.O.F.	15	16
$Rho^2(0)$	0.393	0.399
$Rho^2(c)$	0.094	0.103
Prepared	7 May 01	14 May 01
Estimated	7 May 01	14 May 01
Scaling	1.0000	1.0000
train_c	1.39 (7.2)	0.774 (3.6)
T_caralt_c	-1.76 (-3.7)	-1.71 (-3.4)
TrTswi_C	-1.57 (-17.8)	-1.58 (-17.8)
StLonger	-0.0035 (-2.3)	-0.0033 (-2.1)
Ccost_Edu	-0.0198 (-3.9)	-0.0197 (-3.7)
Tcost_Edu	-0.0125 (-4.4)	-0.0125 (-4.1)
ctime_edu	-0.0067 (-2.9)	-0.0067 (-2.8)
ttime_edu	-0.0142 (-3.8)	-0.0138 (-3.6)
DepEarlyC	-0.0099 (-2.0)	-0.0083 (-1.6)
DepEarlyT	-0.0116 (-4.6)	-0.0115 (-4.6)
DepLateC	-0.0024 (-0.6)	-0.0010 (-0.3)
DepLateT	-0.0060 (-3.9)	-0.0059 (-3.8)
StShorterC	-0.0191 (-1.7)	-0.0100 (-0.9)
StShorterT	-0.0040 (-3.5)	-0.0039 (-3.4)
nestcoef	2.52 (3.6)	2.59 (3.5)
CaTswi_C		-1.47 (-3.8)

Values of time (guilders/hour)

	Model 8	Model 8e
Car	20.3	20.4
Train	68.1	66.2

Scheduling trade-off ratios

Variable and Mode	Schedule penalty coefficient divided by travel time coefficient		
	Model 8	Model 8[e]	Model 8c
Early schedule penalty – Outward leg - Car	1.47	1.23	0.81
Early schedule penalty – Outward leg - Train	1.12	0.83	0.42
Late schedule penalty – Outward leg- Car	0.35	0.45	0.68
Late schedule penalty – Outward leg- Train	0.42	0.42	0.25
Increased participation time penalty- Car	0.52	0.52	0.41
Increased participation time penalty- Train	0.24	0.24	0.21
Decreased participation time penalty- Car	2.89	1.49	0.78
Decreased participation time penalty- Train	0.28	0.28	0.18

Discussion of outcomes

The nest coefficient are clearly higher than one in both models, which is unacceptable. This shows again that for this purpose the nested structure is not suitable.

2.15.4 'Other' purposes.

Models 8 has only three constants as in the multinomial base model (a train-time switch constant and two mode switch constant) whereas models 8e has four constants: the same as in model 8 and a car-time switch constant. (CaTswi_c). Both models have one nest coefficient. Model 8g is the same as model 8 but has three nest coefficients.

Estimated coefficients for nested logit models for 'other' (t-ratios between brackets): APRIL-type models with mode-specific departure time scheduling penalties and participation time penalties: three constants and one nest coefficient, four constants and one nest coefficient and three constants and three nest coefficients respectively

File	todoth08.f12		todoth8e.f12		todoth8g.f12	
Title	TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True	
Observations	3224		3224		3224	
Final log (L)	-3261.6		-3053.8		-3249.7	
D.O.F.	16		17		18	
Rho²(0)	0.199		0.250		0.202	
Rho²(c)	0.033		0.095		0.037	
Prepared	7 May 01		14 May 01		14 May 01	
Estimated	7 May 01		14 May 01		14 May 01	
Scaling	1.0000		1.0000		1.0000	
train_c	-0.839	(-3.9)	-1.80	(-5.4)	-1.52	(-4.1)
T_caralt_c	-0.460	(-2.6)	-0.998	(-4.0)	-1.11	(-3.2)
TrTswi_C	-0.638	(-7.7)	-0.687	(-8.1)	-0.641	(-7.7)
Ccost_Oth	-0.0072	(-4.2)	-0.0066	(-3.1)	-0.0069	(-3.8)
Tcost_Oth	-0.0153	(-5.9)	-0.0224	(-6.8)	-0.0184	(-4.8)
ctime_Oth	-0.0094	(-8.7)	-0.0156	(-8.6)	-0.0092	(-8.3)
ttime_oth	-0.0100	(-9.0)	-0.0134	(-8.0)	-0.0090	(-6.2)
DepEarlyC	-0.0107	(-12.5)	-0.0077	(-9.1)	-0.0106	(-12.2)
DepEarlyT	-0.0016	(-1.7)	-9.7e-4	(-1.0)	-0.0014	(-1.5)
DepLateC	-0.0134	(-8.8)	-0.0059	(-3.8)	-0.0137	(-8.8)
DepLateT	-0.0050	(-3.3)	-0.0030	(-1.9)	-0.0051	(-3.3)
StLongerC	-0.0068	(-6.1)	-0.0032	(-2.8)	-0.0073	(-6.1)
StLongerT	-0.0054	(-5.3)	-0.0055	(-5.3)	-0.0055	(-5.3)
StShorterC	-0.0102	(-6.7)	-0.0059	(-3.6)	-0.0099	(-6.4)
StShorterT	-0.0041	(-3.2)	-0.0050	(-3.7)	-0.0044	(-3.2)
nestcoef	1.54	(8.3)	1.17	(7.3)	1.56	(7.4)
CaTswi_C			-1.02	(-19.1)		
nestcoe2					1.53	(4.2)
nestcoe3					1.24	(6.4)

Values of time (guilders/hour)

	Model 8	Model 8e
Car	78	141
Train	39	36

Schedule trade-off ratios

Variable and Mode	Schedule penalty coefficient divided by travel time coefficient	
	Model 8	Model 8[e]
Early schedule penalty – Outward leg - Car	1.13	0.49
Early schedule penalty – Outward leg - Train	0.16	/
Late schedule penalty – Outward leg- Car	1.42	0.37
Late schedule penalty – Outward leg- Train	0.5	0.22
Increased participation time penalty- Car	0.72	0.20
Increased participation time penalty- Train	0.54	0.41
Decreased participation time penalty- Car	1.08	0.37
Decreased participation time penalty- Train	0.41	0.37

Discussion of outcomes

All nest coefficiencts in the above table for 'other' purposes are higher than one and these models are therefore not acceptable.

To conclude this paragraph, we can point out that using the nested structures tested to estimate the TOD model does not seem to be appropriate, except maybe for commuting and business (in combination with an additional constant). However, we prefer the models without this additional constant for time of day switching, because this variable does not have a behavioural interpretation and takes away explanatory power from variables that have.

2.16 Test 15: include income categories specific cost coefficients.

We tested different cost categories and we present only the best results obtained. The models presented below have two or three income category cost coefficients. Income here is net annual household income.

If there are two income categories, these are:

- Category 1: from 0 to 60 000 guilders a year;
- Category 2: above 60 000 guilders a year.

If there are three income categories, these are:

- Category 1: from 0 to 60 000 guilders a year;
- Category 2: from 60000 to 85 000 guilders a year;
- Category 3: above 85 000 guilders a year.

We included income categories for car users (costincx) and income categories for train users (tcostincx). We present the estimation results for all four purposes and then draw conclusions.

2.16.1 Commuters

Model 13c has two income categories specific cost coefficients and model 13d has 3.

Estimated coefficients for nested logit models for commuting with three constants (t-ratios between brackets): APRIL-type models with specific departure time scheduling penalties and participation time penalties: income categories

File	Todcom13c.F12	Todcom13d.F12
Title	TOD MODEL	TOD MODEL
Converged	True	True
Observations	6180	6180
Final log (L)	-5894.1	-5894.1
D.O.F.	17	19
$Rho^2(0)$	0.250	0.250
$Rho^2(c)$	-0.015	-0.015
Prepared	20 Jun 01	20 Jun 01
Estimated	20 Jun 01	20 Jun 01
Scaling	1.0000	1.0000
train_c	-1.17 (-10.4)	-1.18 (-10.2)
T_caralt_c	-1.56 (-9.9)	-1.55 (-9.6)
TrTswi_C	-1.53 (-19.2)	-1.53 (-19.2)
costinc1	-0.0157 (-7.2)	-0.0157 (-7.2)
costinc2	-0.0115 (-6.6)	-0.0124 (-3.5)
ctime_com	-0.0060 (-6.6)	-0.0060 (-6.6)
ttime_com	-0.0104 (-9.8)	-0.0104 (-9.7)
DepEarlyF	-0.0164 (-14.1)	-0.0164 (-14.1)
DepEarlyNF	-0.0152 (-12.2)	-0.0152 (-12.2)
DepLateF	-0.0143 (-16.2)	-0.0143 (-16.2)
DepLateNF	-0.0188 (-15.3)	-0.0188 (-15.3)
StLongerF	-0.0111 (-9.1)	-0.0111 (-9.2)
SLongerNF	-0.0127 (-9.7)	-0.0127 (-9.7)
StShorterF	-0.0048 (-6.0)	-0.0048 (-6.0)
SShorterNF	-0.0100 (-8.8)	-0.0100 (-8.8)
tcostinc1	-0.0111 (-4.0)	-0.0111 (-4.0)
tcostinc2	-0.0106 (-3.0)	-0.0111 (-2.2)
costinc3		-0.0114 (-5.7)
tcostinc3		-0.0103 (-2.3)

Values of time (guilders/hour)

	Model 13c	Model 13d
Car – income category 1	23	23
Car – income category 2	31	29
Car – income category 3		32
Train – income category 1	56	56
Train – income category 2	59	56
Train – income category 3		61

2.16.2 Business:

Estimated coefficients for nested logit models for business with three constants (t-ratios between brackets): APRIL-type models with specific departure time scheduling penalties and participation time penalties and log cost: income categories

File	Todbus13c.F12	Todbus13d.F12
Title	TOD MODEL	TOD MODEL
Converged	True	True
Observations	3812	3812
Final log (L)	-3492.0	-3488.2
D.O.F.	19	21
$Rho^2(0)$	0.278	0.279
$Rho^2(c)$	0.071	0.072
Prepared	20 Jun 01	20 Jun 01
Estimated	20 Jun 01	20 Jun 01
Scaling	1.0000	1.0000
train_c	-1.57 (-9.5)	-1.64 (-9.7)
T_caralt_c	-1.63 (-8.1)	-1.59 (-7.8)
TrTswi_C	-1.37 (-17.1)	-1.37 (-17.2)
costinc1	0.0015 (0.7)	0.0017 (0.8)
costinc2	-0.0042 (-3.5)	-0.0083 (-3.0)
ctime_bus	-0.0088 (-7.7)	-0.0088 (-7.6)
ttime_bus	-0.0132 (-11.4)	-0.0129 (-11.0)
DepEarlyC	-0.0196 (-12.5)	-0.0196 (-12.6)
DepEarlyT	-0.0089 (-4.5)	-0.0092 (-4.6)
DepEarlyN	-0.0205 (-13.6)	-0.0205 (-13.6)
DepLateC	-0.0225 (-13.8)	-0.0226 (-13.8)
DepLateT	-0.0017 (-1.4)	-0.0018 (-1.4)
DepLateN	-0.0219 (-13.5)	-0.0219 (-13.5)
StLongerC	-0.0102 (-6.7)	-0.0100 (-6.5)
StLongerT	-0.0066 (-4.7)	-0.0065 (-4.6)
StShorterC	-0.0077 (-4.5)	-0.0075 (-4.4)
StShorterT	-0.0073 (-6.2)	-0.0073 (-6.3)
tcostinc1	-0.0062 (-1.3)	-0.0061 (-1.3)
tcostinc2	0.0012 (0.6)	-0.0055 (-1.7)
costinc3		-0.0031 (-2.6)
tcostinc3		0.0040 (1.9)

Values of time (guilders/hour)

	Model 13c	Model 13d
Car – income category 1	/	/
Car – income category 2	125	63.6
Car – income category 3		170
Train – income category 1	/	/
Train – income category 2	/	140
Train – income category 3		/

2.16.3 Education

Estimated coefficients for nested logit models for education with three constants (t-ratios between brackets): APRIL-type models with specific departure time scheduling penalties and participation time penalties: income categories

File	Todedu13c.F12		Todedu13d.F12	
Title	TOD MODEL		TOD MODEL	
Converged	True		True	
Observations	1250		1250	
Final log (L)	-883.8		-872.3	
D.O.F.	16		18	
Rho²(0)	0.398		0.406	
Rho²(c)	0.102		0.114	
Prepared	20 Jun 01		20 Jun 01	
Estimated	20 Jun 01		20 Jun 01	
Scaling	1.0000		1.0000	
train_c	1.52	(3.7)	1.33	(3.1)
T_caralt_c	-3.28	(-7.3)	-3.66	(-7.4)
TrTswi_C	-1.56	(-16.6)	-1.58	(-16.6)
StLonger	-0.0058	(-3.5)	-0.0057	(-3.4)
Ccost_Edu	0	(*)	0	(*)
Tcost_Edu	0	(*)	0	(*)
costinc1	-0.0532	(-5.5)	-0.0603	(-5.5)
costinc2	-0.0676	(-4.5)	-0.130	(-5.9)
ctime_edu	-0.0118	(-3.2)	-0.0093	(-2.4)
ttime_edu	-0.0316	(-8.6)	-0.0331	(-8.9)
DepEarlyC	-0.0146	(-2.2)	-0.0149	(-2.2)
DepEarlyT	-0.0116	(-4.3)	-0.0109	(-4.0)
DepLateC	-0.0177	(-2.4)	-0.0169	(-2.3)
DepLateT	-0.0064	(-4.0)	-0.0062	(-3.8)
StShorterC	-0.0160	(-1.2)	-0.0140	(-1.1)
StShorterT	-0.0041	(-3.5)	-0.0035	(-2.9)
tcostinc1	-0.0058	(-1.4)	-0.0053	(-1.2)
tcostinc2	-0.0386	(-5.1)	-0.0747	(-6.1)
costinc3			-0.0232	(-1.3)
tcostinc3			0.0235	(1.1)

Values of time (guilders/hour)

	Model 13c	Model 13d
Car – income category 1	13.3	9.2
Car – income category 2	10.4	42.9
Car – income category 3		24
Train – income category 1	/	/
Train – income category 2	49	26.5
Train – income category 3		/

2.16.4 'Other' purposes

Estimated coefficients for nested logit models for 'other' with three constants (t-ratios between brackets): APRIL-type models with specific departure time scheduling penalties and participation time penalties: income categories

File	Todoth13b.F12		Todoth13d.F12	
Title	TOD MODEL		TOD MODEL	
Converged	True		True	
Observations	3224		3224	
Final log (L)	-3263.4		-3257.6	
D.O.F.	17		19	
$Rho^2(0)$	0.198		0.200	
$Rho^2(c)$	0.033		0.034	
Prepared	20 Jun 01		20 Jun 01	
Estimated	20 Jun 01		20 Jun 01	
Scaling	1.0000		1.0000	
train_c	-1.71	(-10.9)	-1.69	(-10.8)
T_caralt_c	-0.849	(-4.0)	-0.906	(-4.2)
TrTswi_C	-0.654	(-7.7)	-0.652	(-7.7)
Ccost_Oth	0	(*)	0	(*)
Tcost_Oth	0	(*)	0	(*)
costinc1	-0.0123	(-5.7)	-0.0118	(-5.4)
costinc2	-0.0028	(-0.6)	-0.0053	(-1.2)
ctime_Oth	-0.0104	(-8.2)	-0.0104	(-8.2)
ttime_oth	-0.0113	(-8.9)	-0.0111	(-8.8)
DepEarlyC	-0.0111	(-12.3)	-0.0109	(-12.2)
DepEarlyT	-0.0012	(-1.2)	-0.0014	(-1.4)
DepLateC	-0.0152	(-9.7)	-0.0151	(-9.6)
DepLateT	-0.0045	(-2.8)	-0.0045	(-2.8)
StLongerC	-0.0076	(-6.1)	-0.0077	(-6.2)
StLongerT	-0.0055	(-5.3)	-0.0054	(-5.2)
StShorterC	-0.0104	(-6.6)	-0.0105	(-6.6)
StShorterT	-0.0049	(-3.6)	-0.0050	(-3.7)
tcostinc1	-0.0213	(-6.4)	-0.0220	(-6.5)
tcostinc2	-0.0148	(-3.0)	-0.0143	(-2.7)
costinc3			0.0088	(0.9)
tcostinc3			-0.0198	(-1.3)

Values of time (guilders/hour)

	Model 13c	Model 13d
Car – income category 1	51	52
Car – income category 2	222	117
Car – income category 3		/
Train – income category 1	328	30
Train – income category 2	46	47
Train – income category 3		34

Discussion of outcomes (for all four purposes)

The models with split income coefficients can be compared against the preferred models so far: com9e, bus12 (and best linear utility specification: model 7j), edu2j and oth2d. For car users travelling for commuting only, several income category specific cost coefficients give satisfactory results. The higher the income of the respondents is, the higher the value of time is. For train users travelling for commuting, the different cost coefficients are almost equal. The model with separate coefficients for compensated and non-compensated commuters (com9e) performed better. For the three other purposes, the results of this test are not satisfactory: either the values of time are too high, or the cost coefficients are not significant, or travellers with a high income are indicated to have a lower value of time than travellers with a low income.

2.17 Tests 16: tests on errors component.

The general idea of the error components model is explained in the memo on model structure of May 2000.

The error components logit (EClogit) or mixed MNL (multinomial logit) model has been put forward by several authors in the late nineties as a highly flexible, yet practical, model type. It is no less general than the MNP (multinomial probit) model in that it can also estimate a complete variance-covariance matrix. Unlike MNP it can also handle asymmetric disturbances. EClogit can approximate the MNP; MNP is the limiting case of EClogit. According to McFadden and Train (1997), EClogit can approximate MNP as closely as one pleases. It can also approximate any other discrete choice model based on random utility maximisation, including OGEV (ordered generalized extreme value) and PCL (paired combinatorial logit). Therefore, although MNP, OGEV and PCL are not special cases of EClogit, EClogit can serve as an approximation for these. We therefore have chosen to use EClogit in this project (also see section 4).

The basic idea of any error components model is that it parametrises the variance-covariance matrix:

$$U_k = \sum_r \beta_r . x_{kr} + \sum_s \sum_t \gamma_s . w_{st}^k . \xi_t + \varepsilon_k \qquad (1)$$

In which, as in the MNL model:
U_k: utility for decision-maker from alternative k;
β_r: parameter to be estimated for r-th attribute;
ε_k: error term; follows extreme value type 1 distribution;
x_{kr}: measured attribute r for alternative k.

But the following new components are added to MNL:
ξ_t: error component, distributed $f(0,\Sigma)$, there can be several error components;
γ_s: parameter to be estimated;
w^k: a general weighting matrix, based on data and/or fixed by the analyst, for alternative k, with rows s corresponding to the coefficients γ and colums t corresponding to the error components ξ.

If ξ and ε follow the multivariate normal distribution, this model is MNP. In the EClogit specification with ε Gumbel distributed however, the choice probabilities *conditional on the error components* take the familiar MNL form. The unconditional choice probabilities are derived by integration of the conditional MNL choice probabilities over the distribution of the error components. The latter distribution is usually evaluated using Monte Carlo simulation (drawing from the distribution of ξ). The commonly used estimation method is called simulated maximum likelihood. Different assumptions on the structure of the variance-covariance matrix for error components can lead to different model specifications:

- MNL and NL are a special case of EClogit (NL by approximation);
- The varying and random coefficients model can be written as EClogit models;
- The model can be used for data sets with repeated measurements for the same individual (it therefore is an alternative to estimating the t-values using the Jackknife method) by including individual-specific components; the same specification can be used for panel data;

It can approximate all other known discrete choice random utility models (e.g. MNP, OGEV, PCL).

The error components used are:

- A component that is proportional to the shift in departure time in the considerably earlier alternative (U_1, U_5, U_9): the greater the shift, the lower the correlation between alternatives should be (coefficient ectime1);
- A component that is proportional to the shift in departure time in the considerably later alternative (U_2, U_6, U_{10}): the greater the shift, the lower the correlation between alternatives should be (coefficient ectime2);
- A component for mode shift (U_3, U_7, U_{11}): to test the hypothesis that shifting time is easier than shifting mode (coefficient ecmode);
- A component that is proportional to the change in cost in the considerably earlier alternative (U_1, U_5, U_9): the greater the shift, the lower the correlation between alternatives should be (coefficient eccost1);
- A component that is proportional to the change in cost in the considerably later alternative (U_2, U_6, U_{10}): the greater the shift, the lower the correlation between alternatives should be (coefficient eccost2);
- A component that is proportional to the change in travel time in the considerably earlier alternative (U_1, U_5, U_9): the greater the shift, the lower the correlation between alternatives should be (coefficient ectravel2);
- A component that is proportional to the change in travel time in the considerably later alternative(U_2, U_6, U_{10}): the greater the shift, the lower the correlation between alternatives should be (coefficient ectravel2);

For all error components: the closer the coefficient is to zero, the higher the degree of substitution.

As an example, the first four utility functions (also see page 6-7) in a model with error components for early and late time shift and mode shift wil look like:
In which:

$$U_0 = \alpha\ CARTIME_0 + \beta^0\ EARLY_0 + \gamma^0\ LATE_0 + \beta^r\ REARLY_0 + \gamma^r\ RLATE_0 + \delta\ CARCOST_0 + \ldots$$

$$U_1 = \alpha\ CARTIME_1 + \beta^0\ EARLY_1 + \beta^r\ REARLY_1 + \delta\ CARCOST_1 + \gamma_1\ TIMDIF_1\ \xi_1 + \ldots$$

$$U_2 = \alpha\ CARTIME_2 + \gamma^0\ LATE_2 + \gamma^r\ RLATE_2 + \delta\ CARCOST_2 + \gamma_2\ TIMDIF_2\ \xi_2 + \ldots$$

$$U_3 = \alpha\ PTTIME_3 + \beta^0\ EARLY_3 + \gamma^0\ LATE_3 + \beta^r\ REARLY_3 + \gamma^r\ RLATE_3 + \delta\ PTCOST_3 + \gamma_3\ \xi_3 + \ldots\ldots$$

γ_1, γ_2 and γ_3 are the extra coefficients to be estimated
$TIMEDIF_1$ and $TIMEDIF_2$: difference between presented ToD and observed ToD in minutes
ξ_1 , ξ_2 and ξ_3: error components drawn from normal distribution.

The error components were simulated from the normal distribution using 1000 pseudo-random draws (Halton numbers have been used as well, these give shorter run times, but sometimes do not produce convergence in cases where pseudo-random draws did).

2.17.1 Commuters:

Model 1 has two departure time difference error components coefficients and one mode change error components coefficient. Model 2 has one cost difference error components coefficient (eccost) and one mode change error components coefficient. Model 4 has only two departure time difference error components coefficient. Model 5 has two time difference error component

coefficients, two cost difference error component coefficients and one mode change error component coefficient.

Estimated coefficients for error components logit models for commuting with three constants (t-ratios between brackets): APRIL-type models with specific departure time scheduling penalties and participation time penalties

File	eccom01.f12		eccom02.f12		eccom04.f12		eccom05.f12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True	
Observations	6180		6180		6180		6180	
Final log (L)	-5809.4		-5884.9		-5823.1		-5796.9	
D.O.F.	19		18		18		21	
$Rho^2(0)$	0.260		0.251		0.259		0.262	
$Rho^2(c)$	0.000		-0.013		-0.002		0.002	
Prepared	8 May 01		7 Jun 01		13 Jun 01		13 Jun 01	
Estimated	8 May 01		7 Jun 01		13 Jun 01		13 Jun 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
train_c	-5.05	(-3.1)	-1.29	(-5.1)	-1.20	(-10.3)	-6.79	(-3.6)
T_caralt_c	-4.90	(-3.6)	-1.62	(-6.2)	-1.56	(-9.6)	-6.11	(-4.3)
TrTswi_C	-1.54	(-17.2)	-1.60	(-18.5)	-1.49	(-18.2)	-1.69	(-16.4)
Ccost_Com	-0.0421	(-3.7)	-0.0134	(-6.7)	-0.0138	(-8.9)	-0.0532	(-4.4)
CTraNocomp	-0.0444	(-4.2)	-0.0235	(-3.2)	-0.0282	(-4.2)	-0.0425	(-3.0)
CTracomp	-0.0138	(-3.0)	-0.0071	(-2.8)	-0.0086	(-3.7)	-0.0116	(-1.7)
ctime_com	-0.0036	(-1.7)	-0.0057	(-6.2)	-0.0066	(-7.1)	-0.0020	(-1.0)
ttime_com	-0.0225	(-5.0)	-0.0108	(-9.0)	-0.0116	(-10.0)	-0.0268	(-5.5)
DepEarlyF	-0.0333	(-9.2)	-0.0166	(-13.9)	-0.0247	(-13.9)	-0.0371	(-10.3)
DepEarlyNF	-0.0336	(-9.7)	-0.0155	(-12.2)	-0.0247	(-13.3)	-0.0364	(-9.3)
DepLateF	-0.0324	(-8.9)	-0.0146	(-15.6)	-0.0221	(-13.4)	-0.0368	(-9.1)
DepLateNF	-0.0407	(-9.5)	-0.0193	(-15.3)	-0.0295	(-13.1)	-0.0447	(-9.5)
StLongerF	-0.0149	(-9.8)	-0.0111	(-9.0)	-0.0132	(-10.1)	-0.0158	(-9.7)
SLongerNF	-0.0167	(-10.2)	-0.0126	(-9.6)	-0.0150	(-10.5)	-0.0171	(-10.1)
StShorterF	-0.0078	(-7.2)	-0.0050	(-6.1)	-0.0069	(-7.1)	-0.0082	(-7.1)
SShorterNF	-0.0144	(-9.7)	-0.0102	(-8.9)	-0.0119	(-9.6)	-0.0148	(-9.7)
ecmode1	-4.86	(-3.3)	0.579	(1.0)			6.32	(4.1)
eccost			0.0320	(3.7)				
ectime1	-0.0208	(-7.9)			0.0145	(12.6)	-0.0225	(-8.8)
ectime2	-0.0199	(-8.0)			-0.0128	(-8.7)	0.0222	(7.8)
eccost1							0.0998	(3.7)
eccost2							0.0469	(3.3)

Values of time (guilders/hour)

	Model 1	Model 2	Model 4	Model 5
Car	5	26	29	2
Train – Compensation	98	91	105	137
Train –No compensation	30	28	25	38

Model 7 has two travel time difference error component coefficients.

Estimated coefficients for error components logit models for commuting with three constants (t-ratios between brackets): APRIL-type models with specific departure time scheduling penalties and participation time penalties

File	eccom07.F12
Title	TOD MODEL
Converged	True
Observations	6180
Final log (L)	-5888.2
D.O.F.	18
Rho²(0)	0.250
Rho²(c)	-0.014
Prepared	20 Jun 01
Estimated	20 Jun 01
Scaling	1.0000
train_c	-1.17 (-10.3)
T_caralt_c	-1.54 (-9.7)
TrTswi_C	-1.53 (-19.2)
Ccost_Com	-0.0129 (-8.5)
ctime_com	-0.0057 (-6.4)
ttime_com	-0.0103 (-9.9)
DepEarlyF	-0.0164 (-14.0)
DepEarlyNF	-0.0154 (-12.1)
DepLateF	-0.0143 (-16.1)
DepLateNF	-0.0189 (-15.4)
StLongerF	-0.0112 (-9.0)
SLongerNF	-0.0128 (-9.6)
StShorterF	-0.0049 (-6.1)
SShorterNF	-0.0100 (-8.8)
CTraNocomp	-0.0278 (-4.3)
CTracomp	-0.0085 (-3.7)
ectravel1	0.0106 (1.4)
ectravel2	-0.0022 (-0.3)

Values of time (guilders/hour)

	Model 7
Car	27
Train - Non compensated	22
Train – Compensated	72

Discussion of outcomes

All five error component models, except model 7 have a loglikelihood value that is significantly higher than the preferred (multinomial logit with three constants) model com9e. In Model 7 the error component coefficients are not significant. The best results in terms of likelihood are given by model 5 but the value of time given by model 1 (with a slightly worse likelihood) is better. The sign of the error component coefficient is of no importance (it is a result of random draws), but we expect that both (earlier and later) departure time shift error components will be of about the same size. This is the case in models 1 and 5 and to a lesser degree in model 4.

2.17.2 Business

Model 1 has two departure time difference error components coefficients and one mode change error components coefficient. Model 2 has two cost difference error components coefficients and one mode change error components coefficient. Model 3 has only two cost difference error components coefficients. Model 4 has two departure time difference error component coefficients.

Estimated coefficients for error components logit models for business with three constants (t-ratios between brackets): APRIL-type models with specific departure time scheduling penalties and participation time penalties

File	ecbus01.F12		ecbus02.F12		ecbus03.F12		ecbus04.F12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True	
Observations	3812		3812		3812		3812	
Final log (L)	-3482.1		-3498.5		-3499.8		-3485.1	
D.O.F.	20		20		19		19	
$Rho^2(0)$	0.280		0.276		0.276		0.279	
$Rho^2(c)$	0.074		0.069		0.069		0.073	
Prepared	19 Jun 01		19 Jun 01		19 Jun 01		19 Jun 01	
Estimated	19 Jun 01		19 Jun 01		19 Jun 01		19 Jun 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
train_c	-2.05	(-6.2)	-1.77	(-6.5)	-1.50	(-9.6)	-1.52	(-9.7)
T_caralt_c	-2.19	(-6.0)	-1.92	(-6.3)	-1.63	(-8.2)	-1.65	(-8.3)
TrTswi_C	-1.36	(-16.4)	-1.44	(-17.1)	-1.44	(-17.2)	-1.37	(-16.8)
Ccost_Bus	-0.0043	(-3.2)	-0.0038	(-3.2)	-0.0035	(-3.3)	-0.0035	(-3.3)
Tcost_Bus	-0.0112	(-3.9)	-0.0087	(-3.1)	-0.0085	(-3.3)	-0.0103	(-4.1)
ctime_bus	-0.0114	(-8.3)	-0.0102	(-8.1)	-0.0097	(-8.5)	-0.0103	(-8.9)
ttime_bus	-0.0143	(-8.6)	-0.0132	(-9.0)	-0.0122	(-10.4)	-0.0123	(-10.3)
DepEarlyC	-0.0267	(-10.9)	-0.0204	(-12.5)	-0.0201	(-12.7)	-0.0249	(-11.8)
DepEarlyT	-0.0159	(-5.5)	-0.0082	(-4.0)	-0.0084	(-4.2)	-0.0146	(-5.6)
DepEarlyN	-0.0249	(-13.0)	-0.0207	(-13.6)	-0.0206	(-13.6)	-0.0239	(-13.5)
DepLateC	-0.0268	(-10.3)	-0.0233	(-13.6)	-0.0227	(-14.0)	-0.0245	(-11.5)
DepLateT	-0.0052	(-2.2)	-0.0033	(-2.4)	-0.0033	(-2.4)	-0.0038	(-1.8)
DepLateN	-0.0280	(-11.3)	-0.0222	(-13.5)	-0.0220	(-13.5)	-0.0265	(-11.8)
StLongerC	-0.0111	(-6.5)	-0.0103	(-6.4)	-0.0100	(-6.6)	-0.0105	(-6.8)
StLongerT	-0.0081	(-5.3)	-0.0061	(-4.3)	-0.0059	(-4.3)	-0.0076	(-5.2)
StShorterC	-0.0086	(-4.6)	-0.0077	(-4.5)	-0.0077	(-4.5)	-0.0082	(-4.6)
StShorterT	-0.0086	(-6.7)	-0.0088	(-6.3)	-0.0088	(-6.3)	-0.0082	(-6.7)
ectime1	0.0114	(7.3)					0.0104	(7.4)
ectime2	-0.0059	(-1.9)					-0.0035	(-0.9)
ecmode1	1.30	(3.4)	0.897	(2.4)				
eccost1			0.0020	(0.1)	0.0022	(0.1)		
eccost2			0.0372	(3.1)	0.0372	(3.2)		

Value of time (guilders/hour)

	Model 1	Model 2	Model 3	Model 4
Car	159	161	166	176
Train	77	91	86	71

Model 5 has two travel time difference error component coefficients.

Estimated coefficients for error components logit models for business with three constants (t-ratios between brackets): APRIL-type models with specific departure time scheduling penalties and participation time penalties

File	ecbus05.F12
Title	TOD MODEL
Converged	True
Observations	3812
Final log (L)	-3497.5
D.O.F.	20
Rho²(0)	0.277
Rho²(c)	0.070
Prepared	20 Jun 01
Estimated	20 Jun 01
Scaling	1.0000
train_c	-1.86 (-6.6)
T_caralt_c	-2.00 (-6.2)
TrTswi_C	-1.43 (-17.4)
Ccost_Bus	-0.0040 (-3.2)
Tcost_Bus	-0.0106 (-3.8)
ctime_bus	-0.0107 (-8.1)
ttime_bus	-0.0135 (-8.9)
DepEarlyC	-0.0209 (-12.3)
DepEarlyT	-0.0081 (-3.9)
DepEarlyN	-0.0208 (-13.6)
DepLateC	-0.0244 (-13.0)
DepLateT	-0.0026 (-2.1)
DepLateN	-0.0222 (-13.6)
StLongerC	-0.0107 (-6.4)
StLongerT	-0.0062 (-4.4)
StShorterC	-0.0088 (-4.7)
StShorterT	-0.0080 (-6.7)
ecmodel	1.03 (2.8)
ectravel1	-9.7e-4 (-0.1)
ectravel2	-0.0268 (-3.3)

Value of time (guilders/hour)

	Model 5
Car	160
Train	76

Discussion of outcomes

The travel time difference error components and the cost difference error components are not significant and do not improve the models. The first model presented gives the best results. It is also significantly better in terms of loglikelihood value then the same model without error components (todbus7j)

2.17.3 Education

For education and other, there is only one error component coefficient for the cost difference between the peak and the retimed alternative. We tried to include two coefficients but the dataset was inadequate to estimate these separately.

Estimated coefficients for error components logit models for education with three constants (t-ratios between brackets): APRIL-type models with specific departure time scheduling penalties and participation time penalties

File	ecedu01.f12		ecedu02.f12	
Title	TOD MODEL		TOD MODEL	
Converged	True		True	
Observations	1250		1250	
Final log (L)	-898.2		-898.2	
D.O.F.	16		15	
Rho²(0)	0.388		0.388	
Rho²(c)	0.087		0.087	
Prepared	19 Jun 01		19 Jun 01	
Estimated	19 Jun 01		19 Jun 01	
Scaling	1.0000		1.0000	
train_c	1.51	(3.7)	1.51	(3.7)
T_caralt_c	-3.49	(-8.0)	-3.49	(-8.0)
TrTswi_C	-1.57	(-16.9)	-1.57	(-16.9)
StLonger	-0.0056	(-3.4)	-0.0056	(-3.4)
StShorter	-0.0048	(-4.1)	-0.0048	(-4.1)
Ccost_Edu	-0.0296	(-4.5)	-0.0296	(-4.5)
Tcost_Edu	-0.0184	(-6.7)	-0.0184	(-6.7)
ctime_edu	-0.0128	(-4.4)	-0.0128	(-4.4)
ttime_edu	-0.0258	(-8.6)	-0.0258	(-8.6)
DepEarlyC	-0.0176	(-2.4)	-0.0176	(-2.4)
DepEarlyT	-0.0112	(-4.0)	-0.0111	(-4.1)
DepLateC	-0.0180	(-2.6)	-0.0180	(-2.6)
DepLateT	-0.0067	(-4.2)	-0.0067	(-4.2)
ectime1	0.0013	(0.2)		
ectime2	-1.2e-4	(-0.0)		
ecmode1	-0.0261	(-0.1)	0.0526	(0.1)
eccost			0.0012	(0.1)

Value of time (guilders/hour)

	Model 1	Model 2
Car	26	26
Train	84	84

Discussion of outcomes

For this purpose, it seems better not to include any error component in the model as none of the coefficients tested is significant.

2.17.4 Other purposes

Model 1 has two departure time difference error components coefficients and one mode change error components coefficient. Model 2 has one cost difference error components coefficient and one mode change error components coefficient. Model 3 has two cost difference error components coefficients and one mode change error components coefficient.

Estimated coefficients for error components logit models for 'other' with three constants (t-ratios between brackets): APRIL-type models with specific departure time scheduling penalties and participation time penalties

File	ecoth01.f12		ecoth02.f12		ecoth03.f12	
Title	TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True	
Observations	3224		3224		3224	
Final log (L)	-3197.8		-3267.0		-3265.9	
D.O.F.	18		17		18	
$Rho^2(0)$	0.215		0.198		0.198	
$Rho^2(c)$	0.052		0.032		0.032	
Prepared	8 May 01		19 Jun 01		20 Jun 01	
Estimated	8 May 01		19 Jun 01		20 Jun 01	
Scaling	1.0000		1.0000		1.0000	
train_c	-1.80	(-5.9)	-1.67	(-10.8)	-1.67	(-10.8)
T_caralt_c	-0.975	(-3.9)	-0.840	(-4.0)	-0.864	(-4.0)
TrTswi_C	-0.455	(-4.9)	-0.653	(-7.6)	-0.658	(-7.7)
Ccost_Oth	-0.0130	(-4.5)	-0.0116	(-5.4)	-0.0115	(-5.3)
Tcost_Oth	-0.0194	(-6.1)	-0.0199	(-6.9)	-0.0200	(-6.9)
ctime_Oth	-0.0112	(-8.0)	-0.0105	(-8.3)	-0.0109	(-8.3)
ttime_oth	-0.0139	(-9.2)	-0.0120	(-9.8)	-0.0124	(-9.7)
DepEarlyC	-0.0334	(-9.5)	-0.0112	(-12.3)	-0.0112	(-12.3)
DepEarlyT	-0.0194	(-5.9)	-0.0012	(-1.3)	-0.0012	(-1.2)
DepLateC	-0.0279	(-8.9)	-0.0154	(-9.8)	-0.0155	(-9.8)
DepLateT	-0.0184	(-5.1)	-0.0045	(-2.8)	-0.0046	(-2.8)
StLongerC	-0.0097	(-6.6)	-0.0075	(-6.1)	-0.0077	(-6.1)
StLongerT	-0.0099	(-5.8)	-0.0055	(-5.3)	-0.0056	(-5.3)
StShorterC	-0.0123	(-7.1)	-0.0104	(-6.6)	-0.0108	(-6.6)
StShorterT	-0.0079	(-4.6)	-0.0049	(-3.6)	-0.0050	(-3.6)
ectime1	-0.0179	(-9.0)				
ectime2	0.0200	(4.9)				
ecmode1	-0.553	(-0.9)	-0.0044	(-0.0)	0.0140	(0.0)
eccost1			-0.0050	(-0.3)		
ectravel1					0.0025	(0.4)
ectravel2					0.0171	(2.1)

Value of time (guilders/hour)

	Model 1	Model 2	Model 3
Car	52	54	57
Train	43	36	37

Discussion of outcomes

Just as for the other purposes, the cost difference error components coefficients are not significant. Model 1 without ecmode1 would give the best results. It is significantly better than the best multinomial logit model so far (oth2d) in terms of likelihood and the two departure time error components are of about the same size.

2.18 Test 17: models with socio economic variables

The best models without error components we obtained were used to produce ALOGIT apply tables, to examine how well the model could reproduce the observations across a number of dimensions. This was done to identify socio-economic variables for inclusion in the model.

Because we condition on car availability, we did not include a car to licences ratio in the utility functions.

2.18.1 Commuters

Estimated coefficients for multinomial logit models for commuters with three constants (t-ratios between brackets): APRIL-type models with specific departure time scheduling penalties and participation time penalties: adding socio-economic variables

File	todcom9e.f12	todcom14.f12
Title	TOD MODEL	TOD MODEL
Converged	True	True
Observations	6180	6180
Final log (L)	-5888.5	-5525.0
D.O.F.	16	21
$Rho^2(0)$	0.250	0.297
$Rho^2(c)$	-0.014	0.049
Prepared	4 May 01	19 Jun 01
Estimated	4 May 01	19 Jun 01
Scaling	1.0000	1.0000
train_c	-1.17 (-10.3)	-1.16 (-9.9)
T_caralt_c	-1.54 (-9.8)	-1.54 (-9.8)
TrTswi_C	-1.53 (-19.2)	-1.70 (-18.1)
Ccost_Com	-0.0128 (-8.5)	-0.0123 (-8.1)
CTraNocomp	-0.0279 (-4.3)	-0.0302 (-4.7)
CTracomp	-0.0085 (-3.7)	-0.0119 (-5.1)
ctime_com	-0.0058 (-6.6)	-0.0110 (-11.9)
ttime_com	-0.0104 (-10.0)	-0.0129 (-12.5)
DepEarlyF	-0.0163 (-14.1)	-0.0132 (-11.4)
DepEarlyNF	-0.0152 (-12.2)	-0.0094 (-7.6)
DepLateF	-0.0143 (-16.1)	-0.0118 (-13.5)
DepLateNF	-0.0189 (-15.4)	-0.0138 (-11.7)
StLongerF	-0.0111 (-9.1)	-0.0087 (-7.3)
SLongerNF	-0.0127 (-9.7)	-0.0082 (-6.4)
StShorterF	-0.0049 (-6.1)	-0.0032 (-4.1)
SShorterNF	-0.0100 (-8.8)	-0.0078 (-6.9)
Age40m		-0.711 (-14.2)
partime		-0.636 (-8.0)
T_solo		0.661 (3.9)
C_solo		-0.233 (-2.4)
Educlow		-1.06 (-12.8)

We added five socio economic dummies to the base model:

- Age40m: respondents younger than 40 years old, car earlier and later alternatives (U_1, U_2, U_9, U_{10}) only, young respondents are less likely to travel outside the peak hours.
- Partime: respondents working part time (less than 32 hours/week), car and train earlier and later alternatives, part time workers are less likely to change their behaviour regarding their departure time.
- T_solo: single workers travelling by train, train earlier and later alternatives (U_5, U_6), single workers travelling by train are more likely to change their behaviour regarding their departure time.
- C_solo: single workers travelling by car (not necessarily solo-drivers, this is not about car occupancy, but about household composition), car earlier and later alternatives, single workers travelling by car are less likely to change their behaviour regarding their departure time. The sign of this variable is counter intuitive and we shall not keep it in the models.
- Educlow: highest educational level reached by respondent is 'lager beroepsonderwijs, vglo, lavo, mavo, mulo', car and train earlier and later alternatives, (U_1, U_2, U_5, U_6, U_9, U_{10}) respondents with a low education level are less likely to travel outside the peak hours.

Values of time (guilders/hour).

	Model 9e	Model 14
Car	27	53
Train – non compensated	22	25.6
Train – compensated	73	65

Estimated coefficients for multinomial logit models for commuters with three constants (t-ratios between brackets): APRIL-type models with specific departure time scheduling penalties and participation time penalties: adding socio-economic variables

File	todcom14b.f12
Title	TOD MODEL
Converged	True
Observations	6180
Final log (L)	-5520.4
D.O.F.	22
Rho²(0)	0.297
Rho²(c)	0.050
Prepared	20 Jun 01
Estimated	20 Jun 01
Scaling	1.0000
train_c	-1.16 (-9.9)
T_caralt_c	-1.49 (-9.4)
TrTswi_C	-1.66 (-17.5)
Ccost_Com	-0.0122 (-8.0)
CTraNocomp	-0.0296 (-4.6)
CTracomp	-0.0121 (-5.2)
ctime_com	-0.0112 (-12.1)
ttime_com	-0.0129 (-12.5)
DepEarlyF	-0.0129 (-11.1)
DepEarlyNF	-0.0093 (-7.5)
DepLateF	-0.0116 (-13.2)
DepLateNF	-0.0137 (-11.6)
StLongerF	-0.0085 (-7.1)
SLongerNF	-0.0082 (-6.5)
StShorterF	-0.0032 (-4.0)
SShorterNF	-0.0078 (-7.0)
Age40m	-0.693 (-13.8)
partime	-0.625 (-7.8)
T_solo	0.686 (4.0)
C_solo	-0.212 (-2.2)
Educlow	-1.06 (-12.8)
Whome	-0.210 (-3.0)

In this model another socio-economic variable has been added:

- Whome: if the respondent works often at home, in the earlier and later and the switch mode alternatives for both car and train users (U_1, U_2, U_3, U_5, U_6, U_7, U_9, U_{10}, U_{11}). Respondents working at home are less likely to change their departure time.

Discussion of outcomes

The inclusion of socio-economic variables greatly and significantly increased the likelihood (model 14 compared to model 9e). The new varables tested are all significant (before jackknife) Adding another variable (whome) gives a further significant increase. We find that younger persons and parttime workers have a lower likelihood of shifting to earlier or later periods. Single workers travelling by train have an increased flexibility with regards to time of day choice. respondents with a low education level are less likely to travel outside the peak hours. Respondents working at home are less likely to change their departure time.

2.18.2 Business

Estimated coefficients for multinomial logit models for business with three constants (t-ratios between brackets): APRIL-type models with specific departure time scheduling penalties and participation time penalties: adding socio-economic variables

File	todbus71.f12	todbus14.f12
Title	TOD MODEL	TOD MODEL
Converged	True	True
Observations	3812	3812
Final log (L)	-3502.5	-3444.0
D.O.F.	17	20
Rho²(0)	0.276	0.288
Rho²(c)	0.068	0.084
Prepared	18 May 01	20 Jun 01
Estimated	18 May 01	20 Jun 01
Scaling	1.0000	1.0000
train_c	-1.51 (-9.6)	-1.62 (-10.3)
T_caralt_c	-1.64 (-8.2)	-1.63 (-8.2)
TrTswi_C	-1.41 (-17.5)	-1.13 (-13.2)
Ccost_Bus	-0.0035 (-3.3)	-0.0031 (-2.9)
Tcost_Bus	-0.0102 (-4.1)	-0.0110 (-4.4)
ctime_bus	-0.0100 (-8.8)	-0.0119 (-10.1)
ttime_bus	-0.0121 (-10.3)	-0.0129 (-10.9)
DepEarlyC	-0.0200 (-12.7)	-0.0179 (-11.3)
DepEarlyT	-0.0082 (-4.1)	-0.0084 (-4.2)
DepEarlyN	-0.0206 (-13.7)	-0.0194 (-12.8)
DepLateC	-0.0225 (-14.0)	-0.0194 (-12.2)
DepLateT	-0.0024 (-2.0)	-0.0022 (-1.8)
DepLateN	-0.0221 (-13.5)	-0.0209 (-12.7)
StLongerC	-0.0100 (-6.6)	-0.0089 (-5.8)
StLongerT	-0.0062 (-4.5)	-0.0060 (-4.4)
StShorterC	-0.0077 (-4.5)	-0.0065 (-3.8)
StShorterT	-0.0078 (-6.6)	-0.0078 (-6.6)
Age40m		-0.520 (-6.3)
C_solo		-0.779 (-3.8)
Educmidd		-0.383 (-5.0)

We added three socio economic dummies to the base model:

- Age40m: respondents younger than 40 years old, car and train earlier and later alternatives: young respondents are less likely to change their behaviour, i.e. to travel outside the peak.
- C_solo: single workers, car earlier and later alternatives only, single workers travelling by car are less likely to travel outside the peak.
- Educmidd: highest education level reached is 'middelbaar beroepsonderwijs, havo, mms, hbs', car and train earlier and later alternative, respondents with a low education level are less likely to change behaviour.

Value of time (guilders/hour)

	Model 71	Model 14
Car	171	230
Train	71	70

Discussion of outcomes:

The model with three extra socio-economic variables is significantly better in terms of likelihood value than the model that was used as the base here. Moreover the estimated coefficients for the socio-economic variables are significant (before jackknifing). Younger persons and single workers traveling by car are less likely to shift to off-peak. The same goes for persons with low to medium education levels (possibly caused by the type of jobs, which give less rooms for flexibility).

2.18.3 Education

Estimated coefficients for multinomial logit models for education with three constants (t-ratios between brackets): APRIL-type models with specific departure time scheduling penalties and participation time penalties: adding socio-economic variables

File	Todedu2i.F12		Todedu14.F12	
Title	TOD MODEL		TOD MODEL	
Converged	True		True	
Observations	1250		1250	
Final log (L)	-898.3		-886.4	
D.O.F.	13		15	
$Rho^2(0)$	0.388		0.396	
$Rho^2(c)$	0.087		0.099	
Prepared	18 May 01		20 Jun 01	
Estimated	18 May 01		20 Jun 01	
Scaling	1.0000		1.0000	
train_c	1.51	(3.7)	2.62	(4.9)
T_caralt_c	-3.49	(-8.0)	-3.52	(-7.5)
TrTswi_C	-1.57	(-16.9)	-1.27	(-8.2)
StLonger	-0.0056	(-3.4)	-0.0057	(-3.4)
StShorter	-0.0048	(-4.1)	-0.0049	(-4.2)
Ccost_Edu	-0.0296	(-4.5)	-0.0303	(-4.5)
Tcost_Edu	-0.0184	(-6.7)	-0.0188	(-6.7)
ctime_edu	-0.0128	(-4.4)	-0.0116	(-3.9)
ttime_edu	-0.0258	(-8.6)	-0.0256	(-8.6)
DepEarlyC	-0.0175	(-2.4)	-0.0105	(-1.4)
DepEarlyT	-0.0111	(-4.1)	-0.0105	(-3.9)
DepLateC	-0.0180	(-2.6)	-0.0102	(-1.3)
DepLateT	-0.0067	(-4.2)	-0.0065	(-4.1)
T_Age25			-0.396	(-2.5)
Educlow			1.89	(3.9)

We added two dummies:

- T_age25: the respondent is less than 25 year old, train earlier and later alternatives, young respondents are less likely to travel outside the peak hours.
- Educlow: highest educational level reached is 'lager beroepsonderwijs, vglo, mulo, mavo, lavo', car observed peak alternative (U_0, U_8), respondent with a low education level are more likely to travel during the peak hours.

Value of time (guilders/hour)

	Model 71	Model 14
Car	26	23
Train	84	82

Discusion of outcomes

Again the likelihood was increased significantly by adding the socio-economic dummy variables, which obtain significant coefficients (before jackknife). Young respondents are less likely to travel outside the peak hours. Persons with a low education level (going mostly to schools with fixed school hours starting and ending in the peak periods) have a higher probability of selecting the peak alternative.

2.18.4 'Other' purposes

Estimated coefficients for multinomial logit models for 'other' with three constants (t-ratios between brackets): APRIL-type models with specific departure time scheduling penalties and participation time penalties: adding socio-economic variables

File	todoth2d.f12		todoth14.f12	
Title	TOD MODEL		TOD MODEL	
Converged	True		True	
Observations	3224		3224	
Final log (L)	-3267.1		-3106.2	
D.O.F.	15		19	
$Rho^2(0)$	0.198		0.237	
$Rho^2(c)$	0.032		0.079	
Prepared	16 May 01		20 Jun 01	
Estimated	16 May 01		20 Jun 01	
Scaling	1.0000		1.0000	
train_c	-1.67	(-10.8)	-1.28	(-7.7)
T_caralt_c	-0.839	(-4.0)	-0.480	(-2.0)
TrTswi_C	-0.652	(-7.7)	-0.498	(-5.6)
Ccost_Oth	-0.0116	(-5.4)	-0.0100	(-4.6)
Tcost_Oth	-0.0199	(-7.0)	-0.0211	(-7.1)
ctime_Oth	-0.0105	(-8.3)	-0.0146	(-11.0)
ttime_oth	-0.0120	(-9.8)	-0.0136	(-10.5)
DepEarlyC	-0.0112	(-12.3)	-0.0088	(-10.3)
DepEarlyT	-0.0012	(-1.3)	-0.0013	(-1.3)
DepLateC	-0.0154	(-9.8)	-0.0108	(-6.9)
DepLateT	-0.0045	(-2.8)	-0.0036	(-2.2)
StLongerC	-0.0075	(-6.1)	-0.0055	(-4.4)
StLongerT	-0.0055	(-5.3)	-0.0055	(-5.1)
StShorterC	-0.0104	(-6.6)	-0.0079	(-4.8)
StShorterT	-0.0049	(-3.6)	-0.0050	(-3.6)
shopping			-1.24	(-4.4)
hwife			-0.568	(-7.3)
C_60plus			-0.806	(-9.1)
Educlow			-0.636	(-6.7)

Value of time (guilders/hour)

	Model 71	Model 14
Car	54	88
Train	36	39

We added four dummies:

- Shopping: shopping is the main purpose of the tour, mode change alternative (car and train: U_3, U_7, U_{11}), respondents whose purpose is shopping are less likely to change mode.
- Hwife: the respondent is a housewife, car and train earlier and later alternatives, a housewife is less likely to change behaviour regarding her/his departure time. One can assume that a housewife has some constraints at home and cannot easily adapt her departure time.
- C_60plus: the respondent is older than 60 years old, car earlier and later alternatives only, respondents who are older than 60 years old are less likely to change departure time to avoid the traffic jam in the peak hours.
- Educlow: the highest educational level reached by the respondent is 'lager beroepsonderwijs, vglo, mulo, mavo, lavo', car earlier and later and switch mode alternatives, respondents with a low education level are less likely to change behaviour regarding departure time.

Discussion of outcomes

The model with the added socio-economic variables has a very significantly higher likelihood than the base model and the coefficients (before jackknife) are significant. Respondents with shopping as main purpose do not easily shift mode. A housewife has a lower probability of being able to shift departure time , presumably because of time constraints at home. Older people and persons with a low education level have more difficulty in shifting departure time (the latter also to shift mode)

2.19 Test 18: Seat availability

In the following models we added a variable 'PTSeatav', which is the seat availability in public transport. It is the number of times that a traveller has a seat out of ten trips. This attribute was presented in the SP experiments, as one of the public transport attributes.

Estimated coefficients for multinomial logit models with three constants (t-ratios between brackets): APRIL-type models with specific departure time scheduling penalties and participation time penalties: adding seat availability; commuting, business, education and 'other' respectively

File	todcom17.F12		todbus17.F12		todedu16.F12		todoth17.F12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True	
Observations	6180		3812		1250		3224	
Final log (L)	-5520.9		-3417.4		-852.0		-3165.5	
D.O.F.	23		20		13		17	
Rho^2 (0)	0.297		0.293		0.420		0.223	
Rho^2 (c)	0.050		0.091		0.134		0.062	
Prepared	10 Jul 01		10 Jul 01		10 Jul 01		10 Jul 01	
Estimated	10 Jul 01		10 Jul 01		10 Jul 01		10 Jul 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
train_c	-1.18	(-10.0)	-3.13	(-6.0)	3.21	(6.1)	-1.48	(-9.2)
T_caralt_c	-1.46	(-9.1)	-0.137	(-0.3)	-3.29	(-7.0)	-0.700	(-3.3)
TrTswi_C	-1.69	(-17.6)	-1.15	(-13.6)	-1.56	(-16.7)	-0.453	(-5.1)
Ccost_Com	0	(*)						
CTraNocomp	-0.0302	(-4.7)						
CTracomp	-0.0118	(-5.0)						
costinc1	-0.0137	(-7.4)						
costinc2	-0.0090	(-5.3)						
ctime_com	-0.0115	(-12.4)						
ttime_com	-0.0129	(-12.4)						
DepEarlyC	0	(*)	-0.0182	(-11.6)			-0.0097	(-10.9)
DepEarlyT	0	(*)	-0.0082	(-4.0)	-0.0103	(-3.9)	-0.0013	(-1.4)
DepEarlyF	-0.0130	(-11.2)						
DepEarlyNF	-0.0093	(-7.5)						
DepLateC	0	(*)	-0.0206	(-12.7)			-0.0117	(-7.5)
DepLateT	0	(*)	-0.0025	(-2.0)	-0.0059	(-3.6)	-0.0038	(-2.3)
DepLateF	-0.0118	(-13.4)						
DepLateNF	-0.0139	(-11.7)						
StLongerF	-0.0085	(-7.1)						
SLongerNF	-0.0082	(-6.4)						
StShorterF	-0.0032	(-4.1)						
SShorterNF	-0.0079	(-7.0)						
Totherc	0	(*)						
Age40m	-0.721	(-14.9)	-0.610	(-9.1)				
partime	-0.630	(-7.9)						
T_solo	0.679	(4.0)						
PTSeatav	0.0119	(3.1)	0.0033	(1.2)	0.0040	(1.0)	-8.5e-4	(-0.3)
Educlow	-1.05	(-12.7)			2.45	(5.1)	-0.961	(-11.0)
Whome	-0.236	(-3.4)						
Ccost_Bus			-0.761	(-6.8)				
Tcost_Bus			-0.515	(-5.7)				
ctime_bus			-0.0111	(-9.7)				
ttime_bus			-0.0145	(-12.0)				
DepEarlyN			-0.0171	(-11.3)				
DepLateN			-0.0178	(-10.9)				
StLongerC			-0.0093	(-6.1)			-0.0058	(-4.7)
StLongerT			-0.0058	(-4.2)			-0.0058	(-5.5)
StShorterC			-0.0064	(-3.7)			-0.0087	(-5.4)
StShorterT			-0.0079	(-6.7)			-0.0044	(-3.3)
Educmidd			-0.270	(-3.4)				
StLonger					-0.0061	(-3.8)		
StShorter					-0.0036	(-3.2)		
Ccost_Edu					-0.0878	(-6.3)		
ctime_edu					-0.0130	(-3.4)		
ttime_edu					-0.0365	(-10.2)		
Tothere					-0.0511	(-8.3)		
Costoth							-0.0136	(-8.0)
ctime_Oth							-0.0121	(-9.9)
ttime_oth							-0.0144	(-11.7)
hwife							-0.604	(-7.8)

Discussion of outcomes

The variable PTSeatav for seat availability in public transport is significant and has the right sign only for commuting. Below in model cveccom12, we included this variable in the commuting

model with error components and it became less significant. In a model where we applied a jack knife run, this variable was not significant anymore. We therefore decided not to include it in the best detailed model.

Estimated coefficients for logit models for commuting with three constants (t-ratios between brackets): APRIL-type models with specific departure time scheduling penalties and participation time penalties: adding seat availability; multinomial and error components model respectively

File	todcom17.F12	cveccom12.F12
Title	TOD MODEL	TOD MODEL
Converged	True	True
Observations	6180	6180
Final log (L)	-5520.9	-5253.1
D.O.F.	23	25
$Rho^2(0)$	0.297	0.331
$Rho^2(c)$	0.050	0.096
Prepared	10 Jul 01	6 Aug 01
Estimated	10 Jul 01	6 Aug 01
Scaling	1.0000	1.0000
train_c	-1.18 (-10.0)	-1.27 (-10.7)
T_caralt_c	-1.46 (-9.1)	-1.68 (-10.2)
TrTswi_C	-1.69 (-17.6)	-1.10 (-10.5)
CTraNocomp	-0.0302 (-4.7)	-0.0345 (-5.0)
CTracomp	-0.0118 (-5.0)	-0.0121 (-5.1)
costinc1	-0.0137 (-7.4)	-0.0153 (-8.0)
costinc2	-0.0090 (-5.3)	-0.0107 (-6.3)
ctime_com	-0.0115 (-12.4)	-0.0147 (-14.3)
ttime_com	-0.0129 (-12.4)	-0.0174 (-15.5)
DepEarlyF	-0.0130 (-11.2)	-0.0154 (-14.9)
DepEarlyNF	-0.0093 (-7.5)	-0.0167 (-14.1)
DepLateF	-0.0118 (-13.4)	-0.0189 (-16.0)
DepLateNF	-0.0139 (-11.7)	-0.0291 (-15.7)
StLongerF	-0.0085 (-7.1)	-0.0095 (-6.6)
SLongerNF	-0.0082 (-6.4)	-0.0075 (-4.8)
StShorterF	-0.0032 (-4.1)	-0.0040 (-3.8)
SShorterNF	-0.0079 (-7.0)	-0.0057 (-4.2)
Age40m	-0.721 (-14.9)	-0.512 (-9.9)
partime	-0.630 (-7.9)	-0.461 (-5.5)
T_solo	0.679 (4.0)	0.762 (4.2)
PTSeatav	0.0119 (3.1)	0.0102 (2.1)
Educlow	-1.05 (-12.7)	-0.856 (-9.9)
Whome	-0.236 (-3.4)	-0.162 (-2.2)
ectime1		-0.0087 (-11.0)
ectime2		0.0109 (9.0)

2.20 Test 19: frequency of public transport per hour

We included in the following model a new variable 'Frequency' which is the frequency of public transport per hour. This variable too was presented as one of the attributes of the public transport alternatives in the SP.

Estimated coefficients for multinomial logit models with three constants (t-ratios between brackets): APRIL-type models with specific departure time scheduling penalties and participation time penalties: adding frequency; commuting, business, education and 'other' respectively

File	todcom91.f12		todbus7n.f12		Todedu2k.F12		todoth2i.F12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True	
Observations	6180		3812		1250		3224	
Final log (L)	-5888.0		-3492.4		-823.1		-3266.6	
D.O.F.	17		19		13		16	
Rho²(0)	0.250		0.278		0.440		0.198	
Rho²(c)	-0.013		0.071		0.164		0.032	
Prepared	14 Jun 01		14 Jun 01		27 Aug 01		14 Jun 01	
Estimated	14 Jun 01		14 Jun 01		27 Aug 01		14 Jun 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
train_c	-1.32	(-7.2)	-1.76	(-6.6)	3.35	(6.1)	-1.87	(-7.1)
T_caralt_c	-1.42	(-7.1)	-2.14	(-7.5)	-3.47	(-7.0)	-0.669	(-2.4)
TrTswi_C	-1.48	(-15.5)	-1.54	(-13.6)	-1.17	(-9.7)	-0.578	(-5.0)
Frequency	0.0717	(1.0)	-0.197	(-1.8)	-0.103	(-0.9)	0.0982	(0.9)
Ccost_Com	-0.0128	(-8.5)						
CTraNocomp	-0.0279	(-4.3)						
CTracomp	-0.0086	(-3.7)						
ctime_com	-0.0058	(-6.6)						
ttime_com	-0.0104	(-10.0)						
DepEarlyC	0	(*)	-0.0192	(-12.4)			-0.0112	(-12.3)
DepEarlyT	0	(*)	-0.0091	(-4.5)	-0.0121	(-7.0)	-0.0012	(-1.3)
DepEarlyF	-0.0163	(-14.1)						
DepEarlyNF	-0.0152	(-12.2)						
DepLateC	0	(*)	-0.0218	(-13.7)			-0.0154	(-9.8)
DepLateT	0	(*)	-0.0026	(-2.1)	-0.0098	(-6.4)	-0.0045	(-2.8)
DepLateF	-0.0143	(-16.1)						
DepLateNF	-0.0189	(-15.4)						
StLongerF	-0.0111	(-9.1)						
SLongerNF	-0.0127	(-9.7)						
StShorterF	-0.0049	(-6.1)						
SShorterNF	-0.0100	(-8.8)						
Totherc	0	(*)						
StLonger			0.312	(2.7)	-0.0022	(-1.2)		
Ccost_Bus			-0.0033	(-3.1)				
Tcost_Bus			-0.0097	(-3.9)				
ctime_bus			-0.0097	(-8.6)				
ttime_bus			-0.0124	(-10.7)				
DepEarlyN			-0.0210	(-13.8)				
DepLateN			-0.0224	(-13.7)				
StLongerC			-0.0098	(-6.5)			-0.0075	(-6.1)
StLongerT			-0.0063	(-4.5)			-0.0055	(-5.3)
StShorterC			-0.0074	(-4.4)			-0.0104	(-6.6)
StShorterT			-0.0080	(-6.7)			-0.0049	(-3.6)
StShorter					-0.0031	(-2.5)		
Ccost_Edu					-0.0865	(-6.1)		
ctime_edu					-0.0122	(-3.2)		
ttime_edu					-0.0353	(-9.5)		
Tothere					-0.0503	(-8.1)		
Educlow					2.47	(5.2)		
Ccost_Oth							-0.0116	(-5.4)
Tcost_Oth							-0.0199	(-7.0)
ctime_Oth							-0.0105	(-8.3)
ttime_oth							-0.0120	(-9.8)

Discussion of outcomes

The added variable for frequency in public transport is not significant (even before jackknife) in any of the models presented. We decided not to include it in the best detailed models. The non-significance of seat availability and frequency might have to do with the big shifts in departure time that were offered on many of the screens in the SP (the trading in terms of departure time and travel time and cost might be dominating the picture).

2.21 Best detailed models for each purposes

Summary of findings so far:

Many different specifications for the detailed model were tested:

- Error components logit generally outperformed multinomial and nested logit, except for education;
- A separate model for non-home-based business travel did not give acceptable coefficients (probably due to the limited number of observations); this was merged with home-based business tours;
- For commuting, but not for all other purposes, quadratic scheduling penalties (not reported here) gave better results than linear scheduling terms only (to get comparable values of time and other trade-off values, in the tables below we present only linear models);
- For business travel, but not for the other purposes, logarithmic cost performed better than linear cost;
- Splitting the cost coefficients by income group did not produce satisfactory results, except for commuting;
- A cost of zero for holders of seasonal passes worked best for education and 'other purposes', not for commuting and business;
- For train commuters, cost coefficients that differentiate between employees receiving compensation and employees not receiving compensation gave plausible values and a significant improvement in likelihood. Delay coefficients that differentiate between employees with and without flexible work hours did the same for commuters by train and car.
- A number of socio-economic variables have been successfully included in the utility functions.

We present below the best TOD models obtained for each of the four purposes. Results are presented first for models without Jackknife (called 'original model') and with Jackknife estimation. The Jackknife was used here to correct for the repeated measurements bias, which leads to overstated t-ratios and may correct for other specification errors as well.

2.21.1 Commuting

The best detailed model for commuters has two income specific cost coefficients for car users and two different cost coefficients for train users: one for compensated travellers and one for non compensated travelers. There are specific delay and participation penalty coefficients according to the working time flexibility of the respondents. Two error components coefficients were included (one for departure time differences for the earlier and one for the later alternatives).

Estimated coefficients for error components logit models for commuting with three constants (t-ratios between brackets): APRIL-type models with specific departure time scheduling penalties and participation time penalties; results without jackknife and with jackknife respectively

File	cveccom08.F12	jcveccom08.j12
Title	TOD MODEL	TOD MODEL JackKnife Subsample
Converged	True	True
Observations	6156	6156
Final log (L)	-5216.1	-5216.1
D.O.F.	24	24
$Rho^2(0)$	0.333	0.333
$Rho^2(c)$	0.096	0.096
Prepared	14 Aug 01	14 Aug 01
Estimated	14 Aug 01	14 Aug 01
Scaling	1.0000	1.0000
train_c	-1.30 (-10.9)	-1.15 (-2.5)
T_caralt_c	-1.64 (-9.9)	-1.63 (-3.3)
TrTswi_C	-1.06 (-10.2)	-1.05 (-6.6)
CTraNocomp	-0.0375 (-5.4)	-0.0429 (-2.8)
CTracomp	-0.0132 (-5.4)	-0.0142 (-2.2)
costinc1	-0.0143 (-7.5)	-0.0130 (-1.7)
costinc2	-0.0100 (-5.8)	-0.0111 (-2.6)
ctime_com	-0.0139 (-13.2)	-0.0141 (-5.2)
ttime_com	-0.0155 (-12.7)	-0.0162 (-3.6)
DepEarlyF	-0.0159 (-14.9)	-0.0153 (-5.7)
DepEarlyNF	-0.0172 (-14.2)	-0.0166 (-5.9)
DepLateF	-0.0210 (-15.6)	-0.0191 (-3.3)
DepLateNF	-0.0304 (-15.7)	-0.0290 (-6.6)
StLongerF	-0.0096 (-6.5)	-0.0098 (-4.7)
SLongerNF	-0.0074 (-4.7)	-0.0071 (-2.6)
StShorterF	-0.0038 (-3.6)	-0.0041 (-4.2)
SShorterNF	-0.0063 (-4.5)	-0.0055 (-4.0)
Totherc	0 (*)	
Age40m	-0.498 (-9.5)	-0.510 (-5.8)
partime	-0.447 (-5.3)	-0.471 (-2.8)
T_solo	0.771 (4.2)	0.761 (3.0)
Educlow	-0.886 (-10.0)	-0.895 (-5.5)
Whome	-0.139 (-1.9)	-0.158 (-0.8)
ectime1	-0.0089 (-11.2)	-0.0093 (-5.0)
ectime2	0.0123 (10.1)	0.0117 (2.8)

Value of time (guilders/hour)

	Original estimates	Jackknife estimates
Car – Income category 1	58	65
Car – Income category 2	83	76
Train – Compensated	71	69
Train – Non compensated	25	23

Scheduling trade-off ratios

Variable and Mode	Schedule penalty coefficient divided by travel time coefficient	
	Original model	Jackknife
Early schedule penalty – Car – Flexible hours	1.14	1.08
Early schedule penalty – Car – Non flexible hours	1.23	1.17
Early schedule penalty – Train– Flexible hours	1.02	0.94
Early schedule penalty – Train– Non flexible hours	1.11	1.02
Late schedule penalty – Car– Flexible hours	1.51	1.35
Late schedule penalty – Car – Non flexible hours	2.18	2.05
Late schedule penalty – Train– Flexible hours	1.35	1.17
Late schedule penalty – Train– Non flexible hours	1.96	1.79
Increased participation penalty – Car– Flexible hours	0.69	0.69
Increased participation penalty – Car– Non flexible hours	0.53	0.50
Increased participation penalty – Train– Flexible hours	0.62	0.60
Increased participation penalty – Train– Non flexible hours	0.48	0.43
Decreased participation penalty – Car– Flexible hours	0.57	0.29
Decreased participation penalty – Car– Non flexible hours	0.45	0.39
Decreased participation penalty – Train– Flexible hours	0.24	0.25
Decreased participation penalty – Train– Non flexible hours	0.41	0.34

Discussion of outcomes

The number of observations for commuting is slightly lower than before (6180), because some respondents with odd answers (outliers, e.g. in terms of preferred departure time)) were discovered and subsequently removed. After the jackknifing, some coefficients that were clearly significant are only marginally significant at the 95% level (e.g. Whome).

The values of time found here are clearly higher than the values used in The Netherlands for project evaluation (about 17 guilders/hour). This has been found for some other TOD models as well and is also found for the other purposes in this study (except business). It appears that cost differences are not as strong in persuading travellers to shift time as are time differences, perhaps because the time differences already imply a change to activity schedules.

Most of the ratios of the schedule delay penalty coefficients, both for too early and too late, to travel time are between 1 and 1.5: half an hour earlier or later at work gives the same disutility as 30-45 minutes travel time.

The first empirical TOD studies in the US (in the 80ties) had as one of the main outcomes (which has been transferred to many other countries since) that for commuting 30 minutes travel time is just as bad as 30-60 minutes earlier or 10 - 30 minutes late. The previous stated preference survey in The Netherlands (1989) and the UK 1994/1995 Value of time study found that on average for commuting 30 minutes travel time is just as bad as 60 minutes earlier or 30-60 minutes late (scheduling trade-off ratios generally between 0.5 and 1 for commuting). The new 2001 estimation results for commuting indicate that 30 minutes travel time is not as bad as 30 minutes earlier or later.

In other words TOD shifting appears to be less sensitive now than in 1989, perhaps because many travellers have already shifted to less preferred TOD periods in response to increasing congestion. The disutility from arriving early is now very similar to that of being late. The above discussion referred to the outward leg. For the participation time decision, working too long or too short is generally preferred to an equivalent amount of travel time.

2.21.2 Business

In the best model we obtained, there are two error component coefficients: one for mode change and one for departure time difference both for the earlier and the later retimed alternatives. There are mode and trip specific delay coefficients but only mode specific participation penalty coefficients. The costs are in logarithms.

Estimated coefficients for error components logit models for business with three constants (t-ratios between brackets): APRIL-type models with specific departure time scheduling penalties and participation time penalties; results without jackknife and with jackknife respectively

File	cvecbus07.F12	cvecbus07.j12
Title	TOD MODEL	TOD MODEL JackKnife Subsample
Converged	True	True
Observations	3812	3812
Final log (L)	-3322.4	-3322.4
D.O.F.	21	21
Rho²(0)	0.313	0.313
Rho²(c)	0.116	0.116
Prepared	15 Oct 01	24 Oct 01
Estimated	15 Oct 01	24 Oct 01
Scaling	1.0000	1.0000
train_c	-3.87 (-4.9)	-4.00 (-3.1)
T_caralt_c	-1.07 (-1.5)	-1.11 (-0.8)
TrTswi_C	-0.696 (-6.8)	-0.699 (-2.5)
Ccost_Bus	-0.790 (-5.3)	-0.803 (-2.4)
Tcost_Bus	-0.578 (-5.3)	-0.589 (-2.4)
ctime_bus	-0.0151 (-9.2)	-0.0154 (-4.1)
ttime_bus	-0.0185 (-9.6)	-0.0185 (-3.6)
DepEarlyC	-0.0200 (-13.5)	-0.0199 (-4.6)
DepEarlyT	-0.0140 (-7.1)	-0.0134 (-1.9)
DepEarlyN	-0.0206 (-12.0)	-0.0211 (-7.0)
DepLateC	-0.0252 (-14.3)	-0.0252 (-4.8)
DepLateT	-0.0104 (-5.9)	-0.0106 (-1.9)
DepLateN	-0.0232 (-11.3)	-0.0235 (-5.0)
StLongerC	-0.0086 (-4.5)	-0.0083 (-1.7)
StLongerT	-0.0037 (-1.9)	-0.0041 (-1.2)
StShorterC	-0.0060 (-3.0)	-0.0056 (-1.2)
StShorterT	-0.0078 (-5.3)	-0.0079 (-2.9)
Age40m	-0.553 (-7.8)	-0.559 (-3.7)
Educmidd	-0.179 (-2.2)	-0.174 (-1.3)
ectime1	-0.0070 (-6.7)	-0.0089 (-2.3)
ecmode1	1.65 (4.6)	1.92 (2.7)

Values of time (guilders/hour)

	Original estimates	Jack knife estimates
Car	92	92
Train	75	73

Scheduling trade-off ratios

Variable and Mode	Schedule penalty coefficient divided by travel time coefficient	
	Original model	Jackknife
Early schedule penalty – Car	1.32	1.29
Early schedule penalty – Car – Non home based trips	1.36	1.37
Early schedule penalty – Train	0.76	0.72
Late schedule penalty – Car	1.67	1.64
Late schedule penalty – Car – Non home based trips	1.54	1.53
Late schedule penalty – Train	0.56	0.57
Increased participation penalty – Car	0.57	0.54
Increased participation penalty – Train	0.20	0.22
Decreased participation penalty – Car	0.40	0.36
Decreased participation penalty – Train	0.42	0.43

Discussion of outcomes

In the jackknife estimates of the business model, the coefficient for the longer participation penalty for car and the coefficient for the shorter penalty for train are only significant at the 90% confidence level. All other coefficients, except one of the intercept terms, are significant at the 95% level and have the expected signs. Again younger persons are less likely to shift to off-peak. The same goes for persons with low to medium education levels (possibly caused by the type of jobs, which give less room for flexibility).

The values of time are slightly higher than the officially recommended values. Several of the outward leg scheduling penalty coefficients exceed the travel time coefficients, whereas for participation time, the penalty coefficients are lower than those for travel time.

2.21.3 Education

In the model presented for education, some of the scheduling variables were clearly not significant. These have been removed and the model has been re-estimated without those variables. There are now only train delay coefficients and common participation penalty coefficients for both train and car. For the travel purpose of eduction there are only a few observations on car drivers, not enough for a separate model. We tested including those with car drivers for other purposes (2.12.4). This model had insignificant outcomes for car time and some scheduling variables (see discussion of outcomes in 2.12.4). We therefore prefer to combine these car users for education with train travellers within education, which also gives a clearer distinction of purposes.

Estimated coefficients for error components logit models for education with three constants (t-ratios between brackets): APRIL-type models with specific departure time scheduling penalties and participation time penalties; results without jackknife and with jackknife respectively

File	cvTodedu21.F12	jkcvTodedu21.j12
Title	TOD MODEL	TOD MODEL JackKnife Subsample
Converged	True	True
Observations	1250	1250
Final log (L)	-823.5	-823.5
D.O.F.	12	12
Rho²(0)	0.439	0.439
Rho²(c)	0.163	0.163
Prepared	25 Jul 01	14 Aug 01
Estimated	25 Jul 01	14 Aug 01
Scaling	1.0000	1.0000
train_c	3.23 (6.1)	3.66 (1.9)
T_caralt_c	-3.36 (-7.1)	-3.42 (-2.3)
TrTswi_C	-1.11 (-10.8)	-1.15 (-6.0)
StLonger	-0.0022 (-1.2)	-0.0024 (-0.7)
StShorter	-0.0032 (-2.6)	-0.0031 (-2.1)
Ccost_Edu	-0.0869 (-6.1)	-0.0831 (-2.4)
ctime_edu	-0.0122 (-3.2)	-0.0140 (-2.0)
ttime_edu	-0.0353 (-9.5)	-0.0375 (-7.1)
DepEarlyT	-0.0123 (-7.1)	-0.0107 (-1.9)
DepLateT	-0.0099 (-6.5)	-0.0088 (-2.2)
TrainCo	-0.0505 (-8.2)	-0.0431 (-2.6)
Educlow	2.47 (5.2)	2.17 (2.0)

Value of time (guilders/hour)

	Original estimates	Jack knife estimates
Car	8	10
Train	42	52

Scheduling trade-off ratios

Variable and Mode	Schedule penalty coefficient divided by travel time coefficient	
	Original model	Jackknife
Early schedule penalty – Train	0.35	0.28
Late schedule penalty – Train	0.28	0.23
Increased participation penalty – Car	0.18	0.17
Increased participation penalty – Train	0.06	0.06
Decreased participation penalty – Car	0.26	0.22
Decreased participation penalty – Train	0.09	0.08

Discussion of outcomes

Some coefficients that are only significant at the 90% level (after jackknifing) have been kept. StLonger however clearly is not significant. Persons with a low education level (going mostly to schools with fixed school hours starting and ending in the peak periods) have a higher probability of selecting the peak alternative. The values of time for car are in line with official recommendations, but those for train are particularly high. For education all scheduling and participation penalty coefficients represent a lower disutility than travel time. We recall here that the tour cost for 'vastrecht' was fixed to 0.

2.21.4 'Other' purposes

In this model we decided to include only one cost category because after the jack knife run, the car cost coefficient was not significant anymore. The model has two error components, both for departure time differences. All scheduling variables (for departure time of the outbound leg and for participation time) are split between car and train.

Estimated coefficients for error components logit models for 'other' with three constants (t-ratios between brackets): APRIL-type models with specific departure time scheduling penalties and participation time penalties; results without jackknife and with jackknife respectively

File	cvecoth07.f12	jcvecoth07.j12
Title	TOD MODEL	TOD MODEL JackKnife Subsample
Converged	True	True
Observations	3224	3224
Final log (L)	-3010.8	-3004.6
D.O.F.	18	18
$Rho^2(0)$	0.261	0.262
$Rho^2(c)$	0.108	0.109
Prepared	25 Jul 01	15 Aug 01
Estimated	25 Jul 01	15 Aug 01
Scaling	1.0000	1.0000
train_c	-1.76 (-10.6)	-1.78 (-4.3)
T_caralt_c	-0.849 (-3.8)	-0.689 (-1.2)
TrTswi_C	-0.265 (-2.7)	-0.125 (-0.5)
Cost	-0.0129 (-7.2)	-0.0092 (-0.9)
ctime_Oth	-0.0156 (-11.2)	-0.0157 (-2.6)
ttime_oth	-0.0179 (-12.4)	-0.0170 (-4.4)
DepEarlyC	-0.0197 (-13.3)	-0.0193 (-6.5)
DepEarlyT	-0.0094 (-5.5)	-0.0121 (-3.1)
DepLateC	-0.0249 (-13.9)	-0.0264 (-5.5)
DepLateT	-0.0124 (-5.2)	-0.0174 (-2.9)
StLongerC	-0.0059 (-4.0)	-0.0056 (-3.1)
StLongerT	-0.0090 (-5.5)	-0.0077 (-3.3)
StShorterC	-0.0050 (-2.5)	-0.0051 (-2.6)
StShorterT	-0.0056 (-3.2)	-0.0057 (-1.6)
hwife	-0.342 (-4.2)	-0.340 (-3.4)
Educlow	-0.639 (-6.9)	-0.624 (-3.5)
ectime1	0.0104 (10.2)	0.0100 (6.0)
ectime2	-0.0107 (-4.4)	0.0178 (3.3)

Value of time (guilders/hour)

	Original estimates	Jack knife estimates
Car	73	102
Train	83	111

Scheduling trade-off ratios

Variable and Mode	Schedule penalty coefficient divided by travel time coefficient	
	Original model	Jackknife
Early schedule penalty – Car	1.26	1.23
Early schedule penalty – Train	0.52	0.71
Late schedule penalty – Car	1.59	1.68
Late schedule penalty – Train	0.69	1.02
Increased participation penalty – Car	0.38	0.36
Increased participation penalty – Train	0.50	0.45
Decreased participation penalty – Car	0.32	0.32
Decreased participation penalty – Train	0.31	0.33

Discussion of outcomes

All the coefficients have the sign we expected and are significant at 95%, except for cost, two alternative-specific constants and one of the participation time penalties for train. The departure time difference component coefficients have about the same size. A housewife has a lower probability of being able to shift departure time (presumably because of time constraints at home). Persons with a low education level have more difficulty in shifting departure time as well. In Table 9 are the trade-off values for 'other purposes'. The values of time are clearly higher than the officially recommended values (about 11 guilders). Three out of the four scheduling delay penalty coefficients exceed the travel time coefficient and all the participation penalty coefficients are lower than the travel time coefficient. Just as for education, the tour cost for 'vastrecht' was fixed to 0. There is a common cost coefficient.

2.22 Test 20: separate road pricing coefficients

After having discussed the estimation results –as presented above- with the client, the client requested two additional tests. There are reported here as tests 20 and 20.

The total car cost are the sum of car operating cost (notably fuel cost) and road pricing fees. In this test we estimated coefficients for car costs and road pricing fees separately. For each purpose the original 'best-detailed' model is given before jack-knife procedure. The second model is estimated with the coefficient **Rdprt** (the road pricing fee).

Note that for the purpose **commute** two car cost coefficients were estimated for each income-category. Hence, two road price coefficients were estimated accordingly.

2.22.1 Commuting

Estimated coefficients for error components logit models for commuting with three constants (t-ratios between brackets): APRIL-type models with specific departure time scheduling penalties and participation time penalties: adding separate road pricing coefficients

File	cveccom08.F12		cveccom08rp.F12	
Title	TOD MODEL		TOD MODEL	
Converged	True		True	
Observations	6156		6156	
Final log (L)	-5216.1		-5213.8	
D.O.F.	24		26	
$Rho^2(0)$	0.333		0.333	
$Rho^2(c)$	0.096		0.097	
Prepared	27 Sep 01		15 Oct 01	
Estimated	27 Sep 01		15 Oct 01	
Scaling	1.0000		1.0000	
train_c	-1.30	(-10.9)	-1.33	(-10.9)
T_caralt_c	-1.64	(-9.9)	-1.64	(-9.9)
TrTswi_C	-1.06	(-10.2)	-1.05	(-10.0)
Ccost_Com	0	(*)	0	(*)
CTraNocomp	-0.0375	(-5.4)	-0.0379	(-5.4)
CTracomp	-0.0132	(-5.4)	-0.0129	(-5.3)
costinc1	-0.0143	(-7.5)	-0.0135	(-6.9)
costinc2	-0.0100	(-5.8)	-0.0100	(-5.7)
ctime_com	-0.0139	(-13.2)	-0.0139	(-13.1)
ttime_com	-0.0155	(-12.7)	-0.0155	(-12.6)
DepEarlyF	-0.0159	(-14.9)	-0.0162	(-14.8)
DepEarlyNF	-0.0172	(-14.2)	-0.0175	(-14.2)
DepLateF	-0.0210	(-15.6)	-0.0213	(-15.4)
DepLateNF	-0.0304	(-15.7)	-0.0308	(-15.7)
StLongerF	-0.0096	(-6.5)	-0.0096	(-6.5)
SLongerNF	-0.0074	(-4.7)	-0.0075	(-4.7)
StShorterF	-0.0038	(-3.6)	-0.0039	(-3.6)
SShorterNF	-0.0063	(-4.5)	-0.0064	(-4.5)
Age40m	-0.498	(-9.5)	-0.508	(-9.6)
partime	-0.447	(-5.3)	-0.454	(-5.4)
T_solo	0.771	(4.2)	0.772	(4.2)
Educlow	-0.886	(-10.0)	-0.893	(-10.1)
Whome	-0.139	(-1.9)	-0.145	(-2.0)
ectime1	-0.0089	(-11.2)	-0.0091	(-11.3)
ectime2	0.0123	(10.1)	0.0125	(10.1)
Rdprti1			-0.0451	(-3.2)
Rdprti2			-0.0126	(-1.1)

Discussion of outcomes

For commuting, the road pricing coefficient for the lowest income group is significant. In absolute values, it is clearly greater than the car cost coefficient for this group: the sensitivity to a guilder for road pricing is greater than for a guilder on car cost. For the other income group, the road pricing fee has no significant influence.

The Chi^2 tests give the following results:

-2(-5216.1+5213.8)=4.6. The critical value at a 95% confidence interval with 2 degrees of freedom is 5.99. We cannot reject the hypothesis of the roadpricing coefficients being equal to the carcost.

2.22.2 Business

Estimated coefficients for error components logit models for business with three constants (t-ratios between brackets): APRIL-type models with specific departure time scheduling penalties and participation time penalties: adding separate road pricing coefficients

File	cvecbus07.F12		cvecbus07rp.F12	
Title	TOD MODEL		TOD MODEL	
Converged	True		True	
Observations	3812		3812	
Final log (L)	-3318.4		-3308.3	
D.O.F.	21		22	
$Rho^2(0)$	0.314		0.316	
$Rho^2(c)$	0.117		0.120	
Prepared	1 Oct 01		9 Oct 01	
Estimated	1 Oct 01		9 Oct 01	
Scaling	1.0000		1.0000	
train_c	-4.43	(-5.0)	-4.61	(-4.7)
T_caralt_c	-0.672	(-0.9)	-0.484	(-0.7)
TrTswi_C	-0.701	(-6.8)	-0.731	(-7.1)
Ccost_Bus	-0.932	(-5.6)	-1.03	(-5.5)
Tcost_Bus	-0.611	(-5.4)	-0.644	(-5.5)
ctime_bus	-0.0151	(-9.2)	-0.0157	(-9.2)
ttime_bus	-0.0191	(-9.5)	-0.0199	(-9.3)
DepEarlyC	-0.0201	(-13.5)	-0.0184	(-12.2)
DepEarlyT	-0.0140	(-7.1)	-0.0137	(-6.9)
DepEarlyN	-0.0202	(-11.9)	-0.0194	(-11.3)
DepLateC	-0.0254	(-14.3)	-0.0244	(-13.8)
DepLateT	-0.0106	(-5.9)	-0.0106	(-5.9)
DepLateN	-0.0226	(-11.0)	-0.0214	(-10.3)
StLongerC	-0.0086	(-4.5)	-0.0082	(-4.2)
StLongerT	-0.0037	(-1.9)	-0.0038	(-1.9)
StShorterC	-0.0060	(-3.0)	-0.0056	(-2.8)
StShorterT	-0.0078	(-5.3)	-0.0077	(-5.3)
Age40m	-0.549	(-7.7)	-0.503	(-7.0)
Educmidd	-0.172	(-2.1)	-0.157	(-1.9)
ectime1	-0.0070	(-6.7)	-0.0069	(-6.5)
ecmode1	1.76	(4.7)	1.90	(4.8)
Rdprt			0.0761	(3.9)

Discussion of outcomes

The road pricing coefficient has the wrong sign. The split between car cost and road pricing fees does not lead to an improvement for business travel.

2.22.3 Education

Estimated coefficients for error components logit models for education with three constants (t-ratios between brackets): APRIL-type models with specific departure time scheduling penalties and participation time penalties: adding separate road pricing coefficients

File	cvTodedu2l.F12		cvTodedu2lrp.F12	
Title	TOD MODEL		TOD MODEL	
Converged	True		True	
Observations	1250		1250	
Final log (L)	-823.5		-821.9	
D.O.F.	12		13	
$Rho^2(0)$	0.439		0.440	
$Rho^2(c)$	0.163		0.165	
Prepared	9 Oct 01		9 Oct 01	
Estimated	9 Oct 01		9 Oct 01	
Scaling	1.0000		1.0000	
train_c	3.23	(6.1)	3.32	(6.0)
T_caralt_c	-3.36	(-7.1)	-3.36	(-7.0)
TrTswi_C	-1.11	(-10.8)	-1.12	(-10.8)
StLonger	-0.0022	(-1.2)	-0.0022	(-1.2)
StShorter	-0.0032	(-2.6)	-0.0032	(-2.6)
Ccost_Edu	-0.0869	(-6.1)	-0.0909	(-6.3)
ctime_edu	-0.0122	(-3.2)	-0.0120	(-3.1)
ttime_edu	-0.0353	(-9.5)	-0.0360	(-9.6)
DepEarlyT	-0.0123	(-7.1)	-0.0123	(-7.1)
DepLateT	-0.0099	(-6.5)	-0.0099	(-6.5)
Tothere	-0.0505	(-8.2)	-0.0520	(-8.2)
Educlow	2.47	(5.2)	2.26	(4.6)
Rdprt			0.0166	(0.2)

Discussion of outcomes

Here the road pricing coefficioent is not significant. The preferred model is the one with one car cost variable.

2.22.4 Other

Estimated coefficients for error components logit models for 'other' with three constants (t-ratios between brackets): APRIL-type models with specific departure time scheduling penalties and participation time penalties: adding separate road pricing coefficients

File	cvecoth07.F12	cvecoth07rp.F12
Title	TOD MODEL	TOD MODEL
Converged	True	True
Observations	3224	3224
Final log (L)	-3004.6	-3001.5
D.O.F.	18	19
$Rho^2(0)$	0.262	0.263
$Rho^2(c)$	0.109	0.110
Prepared	15 Oct 01	15 Oct 01
Estimated	15 Oct 01	15 Oct 01
Scaling	1.0000	1.0000
train_c	-1.75 (-10.6)	-1.81 (-10.8)
T_caralt_c	-0.810 (-3.6)	-0.809 (-3.6)
TrTswi_C	-0.176 (-1.8)	-0.169 (-1.7)
carco	-0.0124 (-6.9)	-0.0122 (-6.8)
Ccost_Oth	0 (*)	0 (*)
Tcost_Oth	0 (*)	0 (*)
ctime_Oth	-0.0155 (-11.1)	-0.0155 (-11.0)
ttime_oth	-0.0173 (-12.0)	-0.0174 (-12.0)
DepEarlyC	-0.0190 (-13.3)	-0.0196 (-13.4)
DepEarlyT	-0.0120 (-6.9)	-0.0122 (-7.0)
DepLateC	-0.0247 (-13.7)	-0.0255 (-13.9)
DepLateT	-0.0136 (-5.4)	-0.0137 (-5.4)
StLongerC	-0.0056 (-3.8)	-0.0056 (-3.9)
StLongerT	-0.0070 (-3.5)	-0.0071 (-3.5)
StShorterC	-0.0049 (-2.5)	-0.0051 (-2.6)
StShorterT	-0.0064 (-3.5)	-0.0064 (-3.5)
hwife	-0.347 (-4.2)	-0.350 (-4.3)
Educlow	-0.643 (-7.0)	-0.664 (-7.1)
ectime1	0.0097 (10.2)	0.0099 (10.3)
ectime2	-0.0109 (-4.5)	-0.0109 (-4.5)
Rdprt		-0.0633 (-3.1)

Discussion of outcomes

For 'other' purposes, the road pricing coefficient is significant. In absolute values, it is clearly greater than the cost coefficient (Carco): the sensitivity to a guilder for road pricing is greater than for a guilder on car cost.

-2(-3004.6+3001.5)=6.2. The critical value at a 95% confidence interval with 1 degree of freedom is 3.84. We can reject the hypothesis of the roadpricing coefficient being equal to the carcost.

2.23 Test 21 Splitting the purpose 'other'

The purpose *Other* is an aggregated set of more detailed purposes. In the dataset, there is a distinction between the following four sub-purposes:

1. visiting (vis)
2. shopping (shp)
3. recreation (rec)
4. other (and)

The best detailed model for purpose *Other* was re-estimated with four subsamples for the four subpurposes. The estimates of the models are given below.

Estimated coefficients for error components logit models with three constants (t-ratios between brackets): APRIL-type models with specific departure time scheduling penalties and participation time penalties: all 'other' and four sub-purposes respectively

File	cvecoth07.F12		cvecvis07.F12		cvecshp07.F12		cvecrec07.F12		cvecand07.F12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True		True	
Observations	3224		1227		810		456		731	
Final log (L)	-3004.6		-1125.2		-750.9		-344.4		-572.7	
D.O.F.	18		18		18		18		18	
$Rho^2(0)$	0.262		0.286		0.255		0.387		0.382	
$Rho^2(c)$	0.109		0.120		0.117		0.278		0.177	
Prepared	5 Oct 01		10 Oct 01		10 Oct 01		10 Oct 01		10 Oct 01	
Estimated	5 Oct 01		10 Oct 01		10 Oct 01		10 Oct 01		10 Oct 01	
Scaling	1.0000		1.0000		1.0000		1.0000		1.0000	
train_c	-1.75	(-10.6)	-2.65	(-7.3)	-3.29	(-4.9)	-2.97	(-4.2)	-0.631	(-1.9)
T_caralt_c	-0.810	(-3.6)	0.824	(1.7)	-1.57	(-2.1)	2.04	(3.5)	-3.72	(-5.3)
TrTswi_C	-0.176	(-1.8)	-0.421	(-2.5)	0.146	(0.7)	0.907	(3.5)	-1.14	(-3.9)
Cost	-0.0124	(-6.9)	-0.0216	(-9.0)	-0.0043	(-0.5)	0.0103	(1.3)	-0.0236	(-2.8)
Ccost_Oth	0	(*)	0	(*)	0	(*)	0	(*)	0	(*)
Tcost_Oth	0	(*)	0	(*)	0	(*)	0	(*)	0	(*)
ctime_Oth	-0.0155	(-11.1)	-0.0029	(-1.4)	-0.0356	(-4.8)	-0.0307	(-6.0)	-0.0371	(-8.6)
ttime_oth	-0.0173	(-12.0)	-0.0065	(-3.1)	-0.0270	(-3.7)	-0.0108	(-2.8)	-0.0463	(-9.4)
DepEarlyC	-0.0190	(-13.3)	-0.0172	(-7.5)	-0.0164	(-5.7)	-0.0252	(-5.2)	-0.0310	(-7.4)
DepEarlyT	-0.0120	(-6.9)	-0.0153	(-4.4)	-0.0114	(-3.3)	-0.0265	(-3.7)	-0.0099	(-2.3)
DepLateC	-0.0247	(-13.7)	-0.0232	(-9.9)	-0.0466	(-5.5)	-0.0152	(-3.7)	-0.0457	(-8.1)
DepLateT	-0.0136	(-5.4)	-0.0056	(-2.1)	-0.0198	(-2.4)	-0.0163	(-2.8)	-0.0412	(-4.3)
StLongerC	-0.0056	(-3.8)	-0.0065	(-3.2)	-0.0016	(-0.6)	-0.0075	(-1.4)	-0.0102	(-2.3)
StLongerT	-0.0070	(-3.5)	-0.0047	(-1.2)	-0.0067	(-1.8)	-0.0084	(-1.4)	-0.0015	(-0.3)
StShorterC	-0.0049	(-2.5)	-0.0042	(-1.6)	0.0043	(0.7)	-0.0365	(-3.9)	-0.0044	(-0.7)
StShorterT	-0.0064	(-3.5)	-0.0066	(-2.3)	-0.0245	(-3.0)	-0.0120	(-2.3)	0.0025	(0.6)
hwife	-0.347	(-4.2)	-0.220	(-1.7)	-0.0100	(-0.1)	-1.28	(-4.8)	-0.902	(-3.6)
Educlow	-0.643	(-7.0)	0.0583	(0.4)	-0.591	(-2.5)	-2.85	(-7.2)	-0.818	(-4.2)
ectime1	0.0097	(10.2)	-0.0095	(-6.2)	0.0072	(3.8)	0.0130	(4.2)	0.0125	(4.4)
ectime2	-0.0109	(-4.5)	-2.6e-4	(-0.0)	-0.0362	(-3.7)	-0.0020	(-0.3)	0.0256	(5.4)

The Value of Time of the original model and the four models based on subsamples are given in the following table (significant VOT's only):

Value of time (guilders/hour)

VOT	Original	Visiting	Shopping	Recreation	Other
Car	75	-	-	-	94
Train	84	18	-	-	118

VOT(car) = ctime_Oth/Cost, VOT(train)=ttime_Oth/Cost

Discussion of outcomes

Many coefficients are insignificant. The number of observations for the subsamples are too small for significant estimation results. There is no reason to divide the purpose Other into more differentiated motives.

3 Elasticity analysis

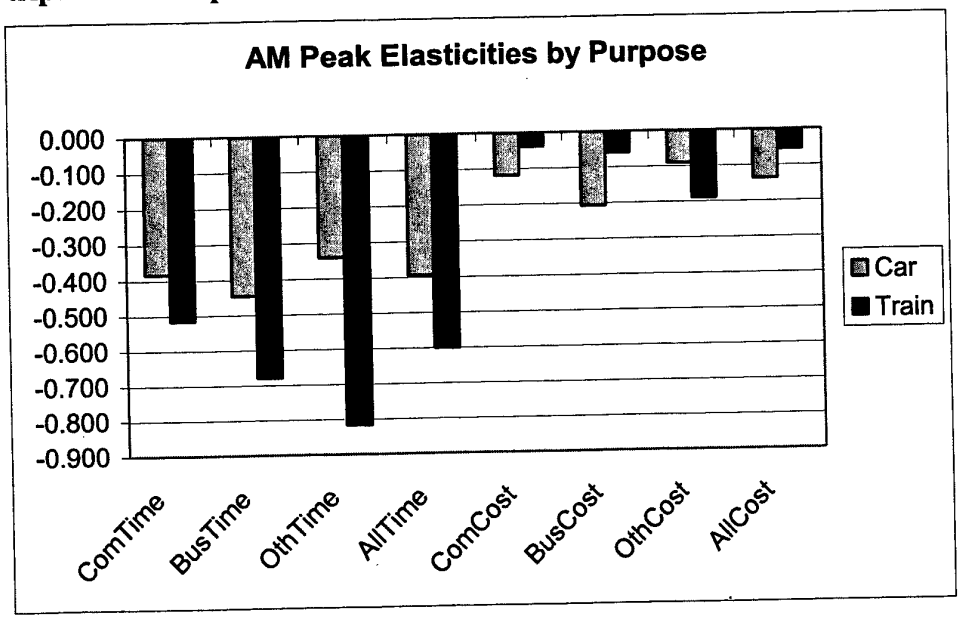
To get an impression of the sensitivities of the error components models, we calculated time and cost elasticities for all four purposes on the basis of the best detailed models. The elasticities were calculated as the effects of a 10% increase in cost or in travel time on the departure time for both modes. Two different sorts elasticites were calculated:

- 'Direct' elasticities: the effect of an increase in time or cost if the departure time for the outward leg is between 7:00 and 9:00 on the departure time for the outward leg. Alternatively, the effect of an increase in time or cost if the departure time for the return leg is between 16:00 and 18:00 on the departure time for the return leg.
- 'Cross' elasticities: the effect of an increase in time or cost if the departure time for the outward leg is between 7:00 and 9:00 on the departure time for the return leg. Alternatively, the effect of an increase in time or cost if the departure time for the return leg is between 16:00 and 18:00 on the departure time for the outward leg

In the figures presented below, time or cost have been increased for both the retimed alternatives and the mode change alternative, therefore mode transfers can sometimes outweigh time transfers and an increase in cost or time can have a net positive effect.

We present below a selection of charts based on the elasticities calculated. The elasticities in the charts give the impact of a change in travel time or cost on the number of trips per period (e.g morning peak: 7:00-9:00, or evening peak 16:00-18:00). All the elasticities are included in appendix at the end of the report.

Effects of changes in travel time or cost in the AM peak period (7:00-9:00) on the number of trips in the AM peak



All purpose have a negative cost elasticities: when the cost increases during the peak, travellers change their departure time. All the time elasticities also have the right sign. All car users, independent of their purpose have about the same time elasticities. The train users travelling from

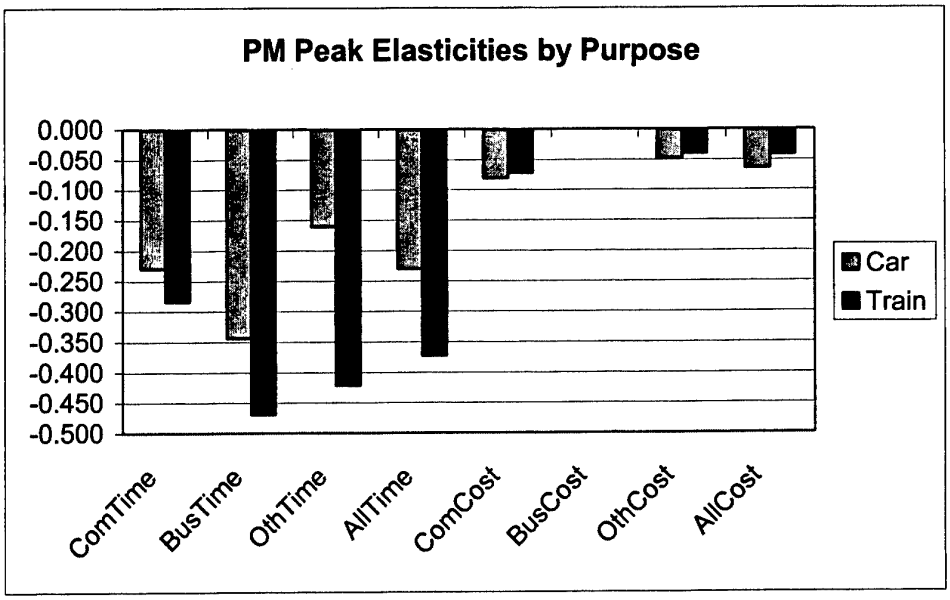
home to work have the smallest elasticities (in absolute value), train travellers with 'other' purposes have the highest time elasticity. When the travel time increases, the commuters change their departure time less easily than other respondents (especially when travelling by train). Train users have higher elasticities than car users: they are more sensitive to travel time changes.

The cost elasticities are smaller than the time elasticities: respondents are more likely to switch departure time period due to increase in the travel time than to increases in travel costs.

Due to the small number of car users travelling for education, the outcomes for this purpose were not satisfactory and we don't present them in this report.

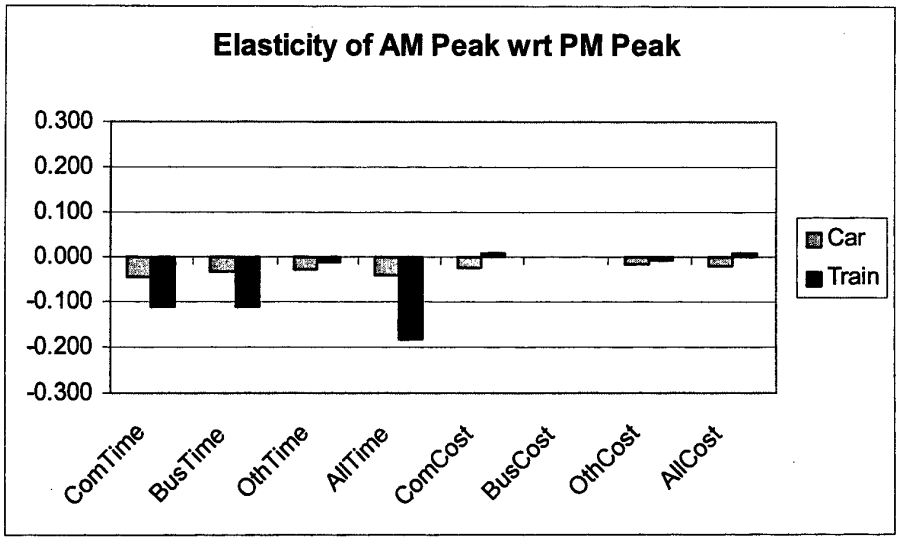
'All' purposes look reasonable but one has to remember the mixing fractions are not necessarily correct as sample sizes are based on the surveys quotas and not on total flows.

Effects of changes in travel time or cost in the PM peak period (16:00-18:00) on the number of trips in the PM peak



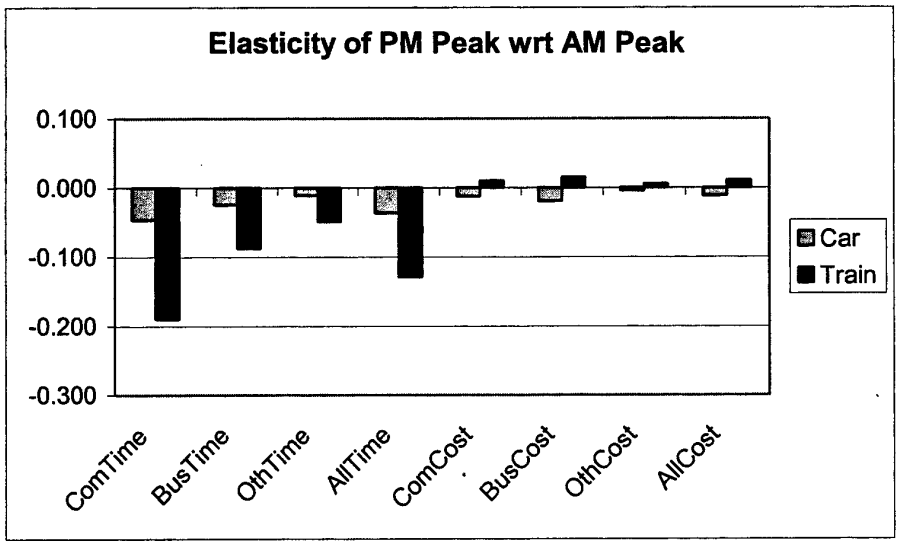
All elasticities, time and cost elasticities are negative as expected. Here again, as for the AM peak elasticities, the time elasticities are smaller than the cost elasticities. Commuters travelling by train have smaller time elasticities than the other travellers.

Effects of changes in travel time or cost in the PM peak period (16:00-18:00) on the number of trips in the AM peak

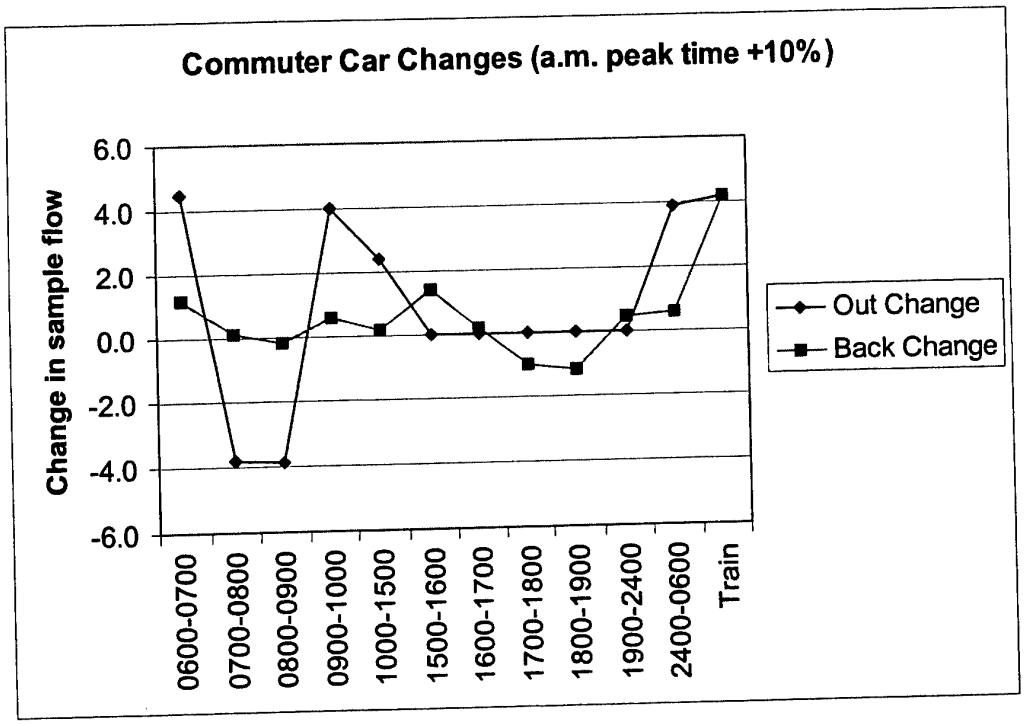


The time elasticities are higher for train users than for car users. The cost elasticities do not make much sense as they are very small: changing cost in the PM peak period doesn't influence the AM departure time choice. The same goes for the impact of changes in the AM peak on the PM peak (see chart below)

Effects of changes in travel time or cost in the AM peak period (16:00-18:00) on the number of trips in the PM peak



Changes in travel time (AM peak travel time +10%), car users, commuters only.

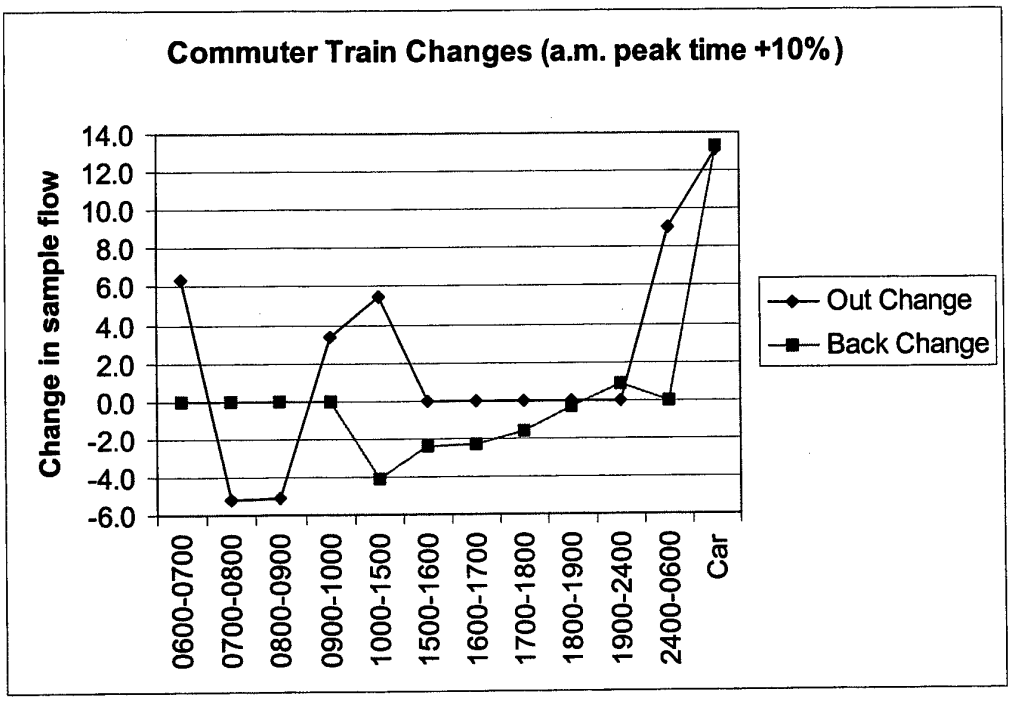


This chart shows the effect in sample flow of an increase in the AM peak travel time (between 7:00 and 9:00) on the outward leg departure time ('out change' in the graph) and on the return leg departure time ('back change') for commuters travelling by car only. On the vertical axis are the percentage changes in the number of trips, using the estimation sample. Note that only the points in the graph indicate a value, the lines are drawn to improve readibility.

Given the small number of choices for train in the base for this purpose, not as many go to the train as to neighbouring periods, of course this is also affected by the fact that the train is also slowing down. If the outward leg travel time increases, commuters will change their departure time and depart during a neighbouring period, both of which increase by more than 4%. One can also notice that quite a few make major shifts in outbound leg to 10:00-15:00 or 24:00-6:00. As one could expect, this change has no impact on the travellers departing during the afternoon and the evening (15:00 to 24:00).

The effect on the return leg departure time is less important than on the outward leg, less travellers are switching period. We can notice interesting changes in profiles both out and return, e.g. small increases in returns between 6:00 and 7:00 and between 9:00 and 10:00 are presumably people returning home in a.m. peak, while increases in returns between 15:00 and 16:00 and between 19:00 and 24:00 are people affected on their outbound leg.

Changes in travel, train users, commuters only



The chart above is similar to the previous one but deals with train users only. Here the car is much more important as an alternative relative to time shifts. One could assume that train users are more scheduling-time constrained than car users and it is easier for them to change mode than departure time. Also we should keep in mind when comparing the above two figures that only for a limited number of trips where car (if available) is a good alternative there are good train connections.

Shift to neighbouring periods are even larger than on the previous chart for the outward leg as well as for the return leg. No train users return in a.m. peak (night workers use cars), so all return shifts are consequent on outward effect. One can note how these are earlier than for car users.

4 Model with eleven time periods for implementation in the LMS.

The second objective of this project was to estimate a simplified model that can be integrated into the LMS version 7. This simplified model will explain mode and TOD choices using the 11 time periods required by AVV. It can be implemented as a generalised extreme value model, which can generate the logsum variable to be included in the LMS mode/destination choice models.

The 11 time periods are the following:

- Period 1: 6:00-7:00;
- Period 2: 7:00-8:00;
- Period 3: 8:00-9:00;
- Period 4: 9:00-10:00;
- Period 5: 10:00-15:00;
- Period 6: 15:00-16:00;
- Period 7: 16:00-17:00;
- Period 8: 17:00-18:00;
- Period 9: 18:00-19:00;
- Period 10: 19:00-24:00;
- Period 11: 0:00-6:00.

In order to be implemented into the LMS, the data used in the simplified model are less accurate than the ones used for the detailed model. The tours are allocated to time periods according to the mid-point in time of the outward trips. Then, the duration is calculated as a difference between the two period mid-points. The differences between preferred and actual departure time are also defined as differences in period mid-points.

4.1 Multinomial 11 time periods model

We first tried to estimate a model with eleven time periods totally independent from the detailed model presented in the first sections of this report (all coefficients in the utility functions of this model were estimated, independently of the outcomes of the detailed models). We estimated a model with 22 utility functions, 11 for car and 11 for train. However, we rapidly abandoned it as several key variables in the model did not have the expected right sign. Therefore, it was preferable to calculate utilities using the parameters from the detailed model and the variables prepared for the 11 time periods model. For this we used the estimation results of the best detailed models reported in chapter 2. We included the utilities we obtained, using the coefficients from the detailed model (but multinomial logit, not the error components) and the variables calculated for the 11 periods into an 11 time period model using a scale factor (scale). This model has 22 utility functions (11 for car and 11 for train), period specific constants (per1_c to per11_c of which per2_c is eliminated to normalise the constants) and one mode change constant (chmode). So the simplified model uses the same coefficients as the detailed model and additionally 21 constants and 1 scale factor. The scale factor gives (a transformation of) the variance of the random component of the model.

An example of such a utility function (for period 1 and car: subscript 1_c) is the following:

$$U_{1\_c} = PER_{1\_c} + (SCALE)\,(V_{1\_c}) + Log(Max(1, NOALTER_{1\_c}))$$

The parameters to be estimated are the constant PER_{1_c} and the scale coefficient SCALE. V_{1_c} is the utility from the detailed model for the car mode in period 1. The last term needs to be added because several of the alternatives presented on a single screen in the SP and used in the detailed model can relate to the same period ($NOALTER_{1\_c}$ is the number of alternatives that refer to time period 1 for car).

As we did for the detailed model, we estimated a separate model for each purpose. We present below the results of the multinomial 11 time periods models.

4.1.1 Commuting and business

Four models are presented below, the first two deal with commuting and the last two with business. In the first model presented for each purpose we used the 'simplified' data and the second model is based on detailed original data.

Estimated coefficients for simplified multinomial logit models (t-ratios between brackets): commuting on simplified data, commuting on detailed data, business on simplified data and business on detailed data respectively

File	TODcom12.F12		TODcom13.F12		busPER12.F12		busPER13.F12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True	
Observations	6074		6074		3683		3683	
Final log (L)	-4826.1		-4265.8		-2748.9		-2649.4	
D.O.F.	12		12		11		11	
Rho²(0)	0.318		0.397		0.335		0.359	
Rho²(c)	0.268		0.353		0.274		0.300	
Prepared	27 Nov 01		27 Nov 01		27 Nov 01		27 Nov 01	
Estimated	27 Nov 01		27 Nov 01		27 Nov 01		27 Nov 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
per1_c	-0.462	(-8.9)	-0.219	(-3.9)	-1.01	(-10.0)	-0.846	(-8.3)
per3_c	0.110	(2.2)	-0.0988	(-1.8)	0.441	(6.0)	0.361	(4.8)
per4_c	-0.312	(-4.5)	-0.323	(-4.2)	-0.157	(-1.8)	-0.188	(-2.1)
per5_c	0.209	(2.0)	-0.127	(-1.3)	-0.168	(-1.8)	-0.417	(-4.6)
per6_c	-0.734	(-1.0)	-2.06	(-2.3)	-0.856	(-3.5)	-1.01	(-4.3)
per7_c	-1.14	(-1.3)	-3.43	(-3.1)	-0.344	(-1.1)	-0.585	(-1.9)
per8_c	0.882	(1.2)	-3.73	(-3.2)	-0.0311	(-0.1)	-0.588	(-1.4)
per9_c	-0.406	(-0.4)	-5.46	(-3.6)	-0.853	(-1.2)	-1.76	(-2.3)
per10_c	1.63	(1.7)	-5.64	(-3.1)				
per11_c	-0.630	(-5.1)	-0.850	(-8.7)	-1.05	(-5.5)	-1.75	(-9.4)
Chmode	-0.440	(-9.7)	-0.0937	(-1.7)	-0.390	(-7.2)	-0.514	(-8.5)
scale	0.374	(31.7)	0.808	(39.5)	0.433	(26.4)	0.658	(26.8)

Discussion of outcomes

As expected, the likelihood of the second model presented is much better than that of the first model: models based on accurate time variables give better results than models based on simplified, ' rounded' data. The scale coefficient ('scale' above) is significantly less than one for the model based on simplified data and smaller than in the model based on detailed data.

4.1.2 *Education and 'other purposes'*

Estimated coefficients for simplified multinomial logit models (t-ratios between brackets): education on simplified data, education on detailed data, 'other' on simplified data and 'other' on detailed data respectively

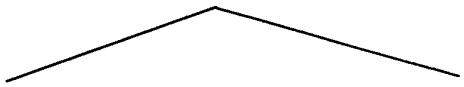
File	eduPER12.F12		eduPER13.F12		othPER12.F12		othPER13.F12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True	
Observations	1205		1205		3033		3033	
Final log (L)	-591.4		-548.0		-1987.0		-1787.2	
D.O.F.	12		12		12		12	
$Rho^2(0)$	0.530		0.565		0.364		0.428	
$Rho^2(c)$	0.355		0.402		0.261		0.336	
Prepared	27 Nov 01		27 Nov 01		29 Nov 01		29 Nov 01	
Estimated	27 Nov 01		27 Nov 01		29 Nov 01		29 Nov 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
per1_c	-1.38	(-5.7)	-0.965	(-3.8)	-0.911	(-5.1)	-0.524	(-2.7)
per3_c	-0.188	(-1.2)	-0.471	(-2.9)	0.300	(2.4)	0.103	(0.7)
per4_c	-0.536	(-2.9)	-0.886	(-4.4)	0.432	(3.7)	0.176	(1.2)
per5_c	0.191	(0.9)	-0.518	(-2.8)	0.189	(1.5)	0.0296	(0.2)
per6_c	-2.43	(-3.6)	-2.37	(-3.4)	-0.455	(-2.4)	-0.556	(-2.6)
per7_c	-2.82	(-4.0)	-2.79	(-3.7)	-0.295	(-1.4)	-0.790	(-3.0)
per8_c	-1.50	(-1.7)	-1.94	(-1.8)	-0.337	(-1.4)	-2.21	(-6.1)
per9_c	-0.655	(-0.6)	-0.915	(-0.7)	0.716	(2.7)	-1.28	(-3.3)
per10_c	0.241	(0.2)	-0.921	(-0.6)	1.19	(3.8)	-1.32	(-2.9)
per11_c	-1.23	(-2.0)	-2.01	(-3.3)	-0.854	(-3.1)	-0.382	(-1.3)
Chmode	-0.0335	(-0.2)	-0.142	(-0.8)	-0.639	(-9.1)	-0.144	(-1.8)
scale	0.753	(14.7)	0.986	(15.8)	0.247	(18.2)	0.596	(21.2)

Discussion of outcomes

The same conclusions as for commuting and business can be drawn here.

4.2 *Tree logit 11 time periods*

We present below four models for each purpose, first the two multinomial models presented above and then two nested logit, the first one based on the 'simplified' data and the second one on the detailed data. The nest structure used is the following: The nest coefficient is denoted 'moscale' in the estimation results below



Car– 11 time periods Train – 11 time periods

- Commuting

Estimated coefficients for simplified tree logit models (t-ratios between brackets): commuting

File	TODcom12.F12		TODcom13.F12		TODcom14.F12		TODcom14b.F12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True	
Observations	6074		6074		6074		6074	
Final log (L)	-4826.1		-4265.8		-4698.6		-4244.5	
D.O.F.	12		12		13		13	
Rho²(0)	0.318		0.397		0.336		0.400	
Rho²(c)	0.268		0.353		0.287		0.356	
Prepared	27 Nov 01		27 Nov 01		27 Nov 01		27 Nov 01	
Estimated	27 Nov 01		27 Nov 01		27 Nov 01		27 Nov 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
per1_c	-0.462	(-8.9)	-0.219	(-3.9)	-0.501	(-10.7)	-0.273	(-5.0)
per3_c	0.110	(2.2)	-0.0988	(-1.8)	0.0921	(2.1)	-0.0844	(-1.6)
per4_c	-0.312	(-4.5)	-0.323	(-4.2)	-0.327	(-5.2)	-0.345	(-4.7)
per5_c	0.209	(2.0)	-0.127	(-1.3)	-0.113	(-1.2)	-0.276	(-2.8)
per6_c	-0.734	(-1.0)	-2.06	(-2.3)	-0.888	(-1.2)	-2.08	(-2.4)
per7_c	-1.14	(-1.3)	-3.43	(-3.1)	-1.30	(-1.6)	-3.41	(-3.2)
per8_c	0.882	(1.2)	-3.73	(-3.2)	0.943	(1.4)	-3.55	(-3.2)
per9_c	-0.406	(-0.4)	-5.46	(-3.6)	-0.472	(-0.5)	-5.33	(-3.7)
per10_c	1.63	(1.7)	-5.64	(-3.1)	1.58	(1.6)	-5.36	(-3.1)
per11_c	-0.630	(-5.1)	-0.850	(-8.7)	-0.839	(-7.7)	-0.955	(-10.0)
Chmode	-0.440	(-9.7)	-0.0937	(-1.7)	-0.0297	(-0.9)	0.0645	(1.3)
scale	0.374	(31.7)	0.808	(39.5)	0.318	(29.8)	0.735	(33.3)
moscale					1.90	(28.6)	1.29	(26.3)

- Business

Estimated coefficients for simplified tree logit models (t-ratios between brackets): business

File	busPER12.F12		busPER13.F12		busPER14.F12		busPER14b.F12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True	
Observations	3683		3683		3683		3683	
Final log (L)	-2748.9		-2649.4		-2707.5		-2645.5	
D.O.F.	11		11		12		12	
Rho²(0)	0.335		0.359		0.345		0.360	
Rho²(c)	0.274		0.300		0.285		0.301	
Prepared	27 Nov 01		27 Nov 01		27 Nov 01		27 Nov 01	
Estimated	27 Nov 01		27 Nov 01		27 Nov 01		27 Nov 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
per1_c	-1.01	(-10.0)	-0.846	(-8.3)	-1.03	(-10.9)	-0.871	(-8.7)
per3_c	0.441	(6.0)	0.361	(4.8)	0.415	(6.3)	0.363	(5.0)
per4_c	-0.157	(-1.8)	-0.188	(-2.1)	-0.163	(-2.1)	-0.196	(-2.3)
per5_c	-0.168	(-1.8)	-0.417	(-4.6)	-0.321	(-3.6)	-0.459	(-5.1)
per6_c	-0.856	(-3.5)	-1.01	(-4.3)	-0.922	(-4.1)	-1.04	(-4.5)
per7_c	-0.344	(-1.1)	-0.585	(-1.9)	-0.446	(-1.6)	-0.632	(-2.1)
per8_c	-0.0311	(-0.1)	-0.588	(-1.4)	-0.138	(-0.4)	-0.631	(-1.6)
per9_c	-0.853	(-1.2)	-1.76	(-2.3)	-1.08	(-1.5)	-1.83	(-2.4)
per11_c	-1.05	(-5.5)	-1.75	(-9.4)	-1.25	(-6.7)	-1.81	(-9.7)
Chmode	-0.390	(-7.2)	-0.514	(-8.5)	-0.309	(-7.8)	-0.478	(-8.6)
scale	0.433	(26.4)	0.658	(26.8)	0.359	(21.7)	0.609	(20.9)
moscale					1.57	(21.5)	1.15	(19.6)

- Education

Estimated coefficients for simplified tree logit models (t-ratios between brackets): education

File	eduPER13.F12		eduPER14.L12		eduPER14.F12		eduPER14b.F12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True	
Observations	1205		1205		1205		1205	
Final log (L)	-548.0		-591.4		-575.4		-540.5	
D.O.F.	12		12		13		13	
$Rho^2(0)$	0.565		0.530		0.543		0.571	
$Rho^2(c)$	0.402		0.355		0.373		0.411	
Prepared	27 Nov 01		27 Nov 01		27 Nov 01		27 Nov 01	
Estimated	27 Nov 01		27 Nov 01		27 Nov 01		27 Nov 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
per1_c	-0.965	(-3.8)	-1.38	(-5.7)	-1.51	(-6.4)	-1.11	(-4.5)
per3_c	-0.471	(-2.9)	-0.188	(-1.2)	-0.121	(-0.9)	-0.362	(-2.4)
per4_c	-0.886	(-4.4)	-0.536	(-2.9)	-0.581	(-3.3)	-0.864	(-4.6)
per5_c	-0.518	(-2.8)	0.191	(0.9)	-0.0696	(-0.4)	-0.629	(-3.6)
per6_c	-2.37	(-3.4)	-2.43	(-3.6)	-2.19	(-3.4)	-2.24	(-3.3)
per7_c	-2.79	(-3.7)	-2.82	(-4.0)	-2.67	(-4.0)	-2.70	(-3.7)
per8_c	-1.94	(-1.8)	-1.50	(-1.7)	-1.59	(-2.1)	-2.09	(-1.9)
per9_c	-0.915	(-0.7)	-0.655	(-0.6)	-0.537	(-0.6)	-0.822	(-0.7)
per10_c	-0.921	(-0.6)	0.241	(0.2)	0.357	(0.3)	-0.707	(-0.5)
per11_c	-2.01	(-3.3)	-1.23	(-2.0)	-1.67	(-2.7)	-2.24	(-3.7)
Chmode	-0.142	(-0.8)	-0.0335	(-0.2)	-0.208	(-2.2)	-0.257	(-2.2)
scale	0.986	(15.8)	0.753	(14.7)	0.650	(14.0)	0.871	(13.7)
moscale					2.14	(8.1)	1.70	(7.6)

- Other

Estimated coefficients for simplified tree logit models (t-ratios between brackets): 'other'

File	othPER12.F12		othPER13.F12		othPER14.F12		othPER14b.F12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True	
Observations	3033		3033		3033		3033	
Final log (L)	-1987.0		-1787.2		-1941.6		-1764.9	
D.O.F.	12		12		13		13	
$Rho^2(0)$	0.364		0.428		0.379		0.435	
$Rho^2(c)$	0.261		0.336		0.278		0.344	
Prepared	29 Nov 01		29 Nov 01		27 Nov 01		27 Nov 01	
Estimated	29 Nov 01		29 Nov 01		27 Nov 01		27 Nov 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
per1_c	-0.911	(-5.1)	-0.524	(-2.7)	-0.951	(-5.5)	-0.603	(-3.2)
per3_c	0.300	(2.4)	0.103	(0.7)	0.337	(2.9)	0.129	(1.0)
per4_c	0.432	(3.7)	0.176	(1.2)	0.433	(4.0)	0.206	(1.5)
per5_c	0.189	(1.5)	0.0296	(0.2)	0.232	(2.0)	0.0611	(0.4)
per6_c	-0.455	(-2.4)	-0.556	(-2.6)	-0.292	(-1.6)	-0.467	(-2.3)
per7_c	-0.295	(-1.4)	-0.790	(-3.0)	-0.143	(-0.7)	-0.690	(-2.7)
per8_c	-0.337	(-1.4)	-2.21	(-6.1)	-0.212	(-0.9)	-1.97	(-5.7)
per9_c	0.716	(2.7)	-1.28	(-3.3)	0.807	(3.1)	-1.11	(-3.0)
per10_c	1.19	(3.8)	-1.32	(-2.9)	1.03	(3.5)	-1.35	(-3.1)
per11_c	-0.854	(-3.1)	-0.382	(-1.3)	-1.05	(-3.9)	-0.592	(-2.1)
Chmode	-0.639	(-9.1)	-0.144	(-1.8)	-0.280	(-5.1)	0.0373	(0.6)
scale	0.247	(18.2)	0.596	(21.2)	0.214	(16.5)	0.520	(18.9)
moscale					1.66	(21.3)	1.44	(19.6)

Discussion of outcomes

For all purposes the likelihood of the nest structure is better than the multinomial logit one. However, the nest coefficient (moscale) is always higher than one which shows that the structure tested is not appropriate (not consistent with random utility maximisation). It is interesting to note that this coefficient is lower in the model based on detailed data than in the one based on simplified data. As noted above, the accuracy of the data gives a stronger model. The coefficient 'scale' is high for education and close to one.

Several nest structures were tested for each purposes separately:

- Structure 1 : morning/evening choice on top, then mode choice, and at the third level time period choice;
- Structure 2 : mode choice on top, then morning/evening choice, and at the third level time period choice;
- Structure 3 : morning/evening choice on top, then time period choice, and at the third level mode choice.

For each structure defined four variants of the morning/evening choice were tested:

- Variant 1: choice between morning periods, evening periods and other periods. Other includes periods 10 (19:00-24:00), 11 (0:00-6:00) and 5 (10:00 –15:00);
- Variant 2: choice between morning periods and evening periods only, period 5 (10:00-15:00) included in morning nest;
- Variant 3: choice between morning periods and evening periods only, period 5 (10:00-15:00) included in evening nest;
- Variant 4: choice between morning periods, evening periods and other periods. Other includes periods 10 (19:00-24:00), 11 (0:00-6:00).

We present 12 different models for each purpose. In the results presented, 'T1_M' gives the nest coefficient for mode nests in the morning/evening choice, 'M_T2' gives the nest coefficient for period nests in the mode choice, 'M_T1' gives the nest coefficient for morning/evening nests in the mode choice, 'T1_T2' gives the nest coefficient for period nests in the morning/evening choice and 'T2_M' gives the nest coefficient for mode nests in the period choice.

4.2.1 Commuting

- Results with structure1.

The first model has variant 1, the second one, variant 2, etc.

Estimated coefficients for simplified tree logit models (t-ratios between brackets): commuting: structure 1, variants 1-4

File	TODcom17.F12		TODcom21.F12		TODcom22.F12		TODcom20.F12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True	
Observations	6074		6074		6074		6074	
Final log (L)	-4651.1		-4698.6		-4681.6		-4625.1	
D.O.F.	14		14		14		14	
Rho² (0)	0.343		0.336		0.338		0.346	
Rho² (c)	0.295		0.287		0.290		0.299	
Prepared	27 Nov 01		27 Nov 01		27 Nov 01		27 Nov 01	
Estimated	27 Nov 01		27 Nov 01		27 Nov 01		27 Nov 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
per1_c	-0.461	(-9.0)	-0.501	(-10.7)	-0.472	(-9.7)	-0.482	(-9.6)
per3_c	0.0998	(2.0)	0.0921	(2.1)	0.0921	(2.0)	0.105	(2.2)
per4_c	-0.253	(-3.6)	-0.327	(-5.2)	-0.312	(-4.7)	-0.212	(-3.1)
per5_c	-0.763	(-4.6)	-0.114	(-1.2)	-0.678	(-4.2)	0.415	(3.5)
per6_c	-1.23	(-1.3)	-0.952	(-1.3)	-1.13	(-1.4)	-0.286	(-0.3)
per7_c	-1.41	(-1.3)	-1.36	(-1.6)	-1.41	(-1.6)	-0.587	(-0.5)
per8_c	1.16	(1.3)	0.865	(1.1)	1.34	(1.6)	1.63	(1.6)
per9_c	-0.208	(-0.2)	-0.559	(-0.6)	0.0840	(0.1)	0.143	(0.1)
per10_c	3.29	(2.2)	1.48	(1.4)	2.24	(2.0)	4.11	(2.4)
per11_c	-1.61	(-8.7)	-0.839	(-7.7)	-0.636	(-5.3)	-2.38	(-9.6)
Chmode	-0.0293	(-0.8)	-0.0298	(-0.9)	-0.0311	(-0.9)	-0.0270	(-0.7)
scale	0.440	(26.3)	0.318	(29.7)	0.370	(27.3)	0.422	(28.4)
M_T2	1.65	(25.3)	1.90	(28.6)	1.79	(26.8)	1.67	(26.2)
T1_M	0.352	(17.9)	0.559	(3.8)	0.394	(16.6)	0.296	(15.8)

- Results with structure 2.

The first model has variant 1, the second one, variant 2, etc.

Estimated coefficients for simplified tree logit models (t-ratios between brackets): commuting: structure 2, variants 1-4

File	TODcom16.F12		TODcom18.F12		TODcom19.F12		TODcom16b.F12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True	
Observations	6074		6074		6052		6074	
Final log (L)	-4645.8		-4698.6		-4664.8		-4624.9	
D.O.F.	14		14		14		14	
Rho²(0)	0.343		0.336		0.338		0.346	
Rho²(c)	0.295		0.287		0.291		0.299	
Prepared	27 Nov 01		27 Nov 01		27 Nov 01		27 Nov 01	
Estimated	27 Nov 01		27 Nov 01		27 Nov 01		27 Nov 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
per1_c	-0.484	(-9.4)	-0.501	(-10.7)	-0.485	(-10.0)	-0.492	(-9.7)
per3_c	0.104	(2.1)	0.0921	(2.1)	0.0975	(2.1)	0.103	(2.1)
per4_c	-0.271	(-3.8)	-0.327	(-5.2)	-0.316	(-4.8)	-0.228	(-3.3)
per5_c	-0.660	(-4.5)	-0.114	(-1.2)	-0.698	(-4.5)	0.373	(3.2)
per6_c	-1.01	(-1.1)	-0.920	(-1.2)	-1.32	(-1.8)	-0.160	(-0.2)
per7_c	-1.24	(-1.2)	-1.33	(-1.6)	-1.61	(-1.8)	-0.498	(-0.5)
per8_c	1.23	(1.4)	0.876	(1.1)	-0.438	(-0.5)	1.67	(1.7)
per9_c	-0.167	(-0.1)	-0.543	(-0.5)	0.341	(0.3)	0.176	(0.1)
per10_c	3.30	(2.2)	1.51	(1.4)	2.58	(2.0)	3.99	(2.4)
per11_c	-1.46	(-8.8)	-0.839	(-7.7)	-0.661	(-5.5)	-2.05	(-9.7)
Chmode	-0.0369	(-0.9)	-0.0297	(-0.9)	-0.0310	(-0.9)	-0.0314	(-0.8)
scale	0.429	(25.6)	0.318	(29.7)	0.368	(27.2)	0.417	(28.0)
T1_T2	0.582	(19.2)	1.04	(3.9)	0.670	(17.6)	0.511	(17.9)
M_T1	2.73	(20.7)	1.82	(3.9)	2.62	(17.7)	3.20	(18.2)

- Results with structure 3.

The first model has variant 1, the second one, variant 2, etc.

Estimated coefficients for simplified tree logit models (t-ratios between brackets): commuting: structure 3, variants 1-4

File	TODcom24.F12		TODcom23.F12		TODcom23b.F12		TODcom25.F12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		False	
Observations	6074		6074		6074		6074	
Final log (L)	-4676.9		-4753.6		-4724.3		-4826.1	
D.O.F.	14		14		14		14	
Rho²(0)	0.339		0.328		0.332		0.318	
Rho²(c)	0.291		0.279		0.284		0.268	
Prepared	27 Nov 01		27 Nov 01		27 Nov 01		27 Nov 01	
Estimated	27 Nov 01		27 Nov 01		27 Nov 01		27 Nov 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
per1_c	-0.828	(-7.3)	-1.22	(-8.3)	-0.986	(-7.6)	-0.462	(-1.0)
per3_c	0.223	(2.4)	0.288	(2.5)	0.250	(2.4)	0.110	(0.7)
per4_c	-0.462	(-3.3)	-0.835	(-4.9)	-0.672	(-4.4)	-0.312	(-1.6)
per5_c	-1.31	(-4.0)	0.224	(0.9)	-1.22	(-3.4)	0.209	(0.3)
per6_c	-2.26	(-1.3)	-2.24	(-1.3)	-2.51	(-1.5)	-0.734	(-0.9)
per7_c	-2.37	(-1.2)	-2.86	(-1.4)	-2.79	(-1.5)	-1.14	(-1.2)
per8_c	2.23	(1.3)	2.53	(1.3)	3.08	(1.7)	0.882	(0.5)
per9_c	-0.0775	(-0.0)	-0.723	(-0.3)	0.677	(0.3)	-0.406	(-0.4)
per10_c	7.09	(2.4)	4.78	(1.9)	5.65	(2.4)	1.63	(0.5)
per11_c	-2.97	(-7.8)	-1.77	(-5.6)	-1.04	(-3.6)	-0.630	(-0.5)
Chmode	-0.0746	(-1.1)	-0.0803	(-1.1)	-0.0854	(-1.2)	-0.440	(-1.5)
scale	0.878	(18.6)	0.865	(17.6)	0.861	(17.8)	0.374	(0.8)
T2_M	0.564	(16.7)	0.422	(16.1)	0.489	(15.9)	1.00	(1.1)
T1_T2	0.530	(19.3)	0.993	(3.9)	0.654	(17.8)	1.00	(2.0)

Models based on structure 1 or 2 give satisfactory results in terms of likelihood, but the nest coefficient for mode choice (M_T2 and M_T1) is always higher than one, which means that

structure is not suitable for this model. Therefore, we re-estimated structure 1 with M_T2 fixed at 1.

- Results with structure 1, M_T2 fixed at 1.

The first model has variant 1, the second one, variant 2, etc.

Estimated coefficients for simplified tree logit models (t-ratios between brackets): commuting: structure 1, M_T2 fixed at 1, variants 1-4

File	TODcom26.F12		TODcom27.F12		TODcom28.F12		TODcom29.F12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True	
Observations	6074		6074		6074		6074	
Final log (L)	-4719.1		-4826.0		-4779.0		-4700.4	
D.O.F.	13		13		13		13	
$Rho^2(0)$	0.333		0.318		0.325		0.336	
$Rho^2(c)$	0.284		0.268		0.275		0.287	
Prepared	27 Nov 01		27 Nov 01		27 Nov 01		27 Nov 01	
Estimated	27 Nov 01		27 Nov 01		27 Nov 01		27 Nov 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
per1_c	-0.413	(-7.4)	-0.462	(-8.9)	-0.423	(-7.9)	-0.436	(-7.9)
per3_c	0.114	(2.1)	0.110	(2.2)	0.109	(2.1)	0.123	(2.3)
per4_c	-0.220	(-2.8)	-0.312	(-4.5)	-0.292	(-4.0)	-0.163	(-2.2)
per5_c	-0.818	(-4.2)	0.212	(2.0)	-0.704	(-3.7)	0.887	(7.2)
per6_c	-1.07	(-1.0)	-0.658	(-0.8)	-1.12	(-1.3)	0.193	(0.2)
per7_c	-1.17	(-1.0)	-1.05	(-1.2)	-1.31	(-1.3)	-0.0796	(-0.1)
per8_c	1.16	(1.1)	1.02	(1.2)	1.46	(1.6)	1.81	(1.6)
per9_c	-0.0468	(-0.0)	-0.261	(-0.2)	0.404	(0.4)	0.483	(0.3)
per10_c	4.15	(2.3)	1.79	(1.6)	2.63	(2.2)	5.09	(2.5)
per11_c	-1.79	(-8.3)	-0.630	(-5.1)	-0.322	(-2.4)	-2.66	(-9.3)
Chmode	-0.329	(-6.7)	-0.440	(-9.7)	-0.391	(-8.3)	-0.339	(-7.1)
scale	0.531	(31.6)	0.374	(31.5)	0.445	(30.7)	0.505	(33.2)
M_T2	1.00	(*)	1.00	(*)	1.00	(*)	1.00	(*)
T1_M	0.484	(19.8)	0.920	(3.9)	0.593	(18.3)	0.421	(17.1)

Discussion of outcomes

The best model obtained for commuting (the model with the best likelihood) is the model with structure 2 and variant 4 (model todcom16), but this model has a nest coefficient for the morning/evening choice (M_T1) higher than one. We would prefer then to select structure 3, variant 1 (todcom24).

4.2.2 Business

- Results with structure 1.

Estimated coefficients for simplified tree logit models (t-ratios between brackets): business: structure 1, variants 1-4

File	busPER17.F12		busPER21.F12		busPER22.F12		busPER20.F12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True	
Observations	3683		3683		3683		3683	
Final log (L)	-2718.4		-2708.3		-2722.5		-2708.7	
D.O.F.	13		13		13		13	
Rho²(0)	0.343		0.345		0.342		0.345	
Rho²(c)	0.282		0.285		0.281		0.284	
Prepared	27 Nov 01		27 Nov 01		27 Nov 01		27 Nov 01	
Estimated	27 Nov 01		27 Nov 01		27 Nov 01		27 Nov 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
per1_c	-1.04	(-10.2)	-1.03	(-10.8)	-1.02	(-10.5)	-1.03	(-10.8)
per3_c	0.425	(5.9)	0.415	(6.3)	0.420	(6.1)	0.409	(6.1)
per4_c	-0.188	(-2.2)	-0.164	(-2.1)	-0.174	(-2.1)	-0.168	(-2.1)
per5_c	-0.465	(-3.9)	-0.324	(-3.6)	-0.341	(-3.3)	-0.313	(-3.5)
per6_c	-1.14	(-4.0)	-0.968	(-4.3)	-0.968	(-4.1)	-0.955	(-3.7)
per7_c	-0.607	(-1.8)	-0.456	(-1.6)	-0.468	(-1.6)	-0.462	(-1.5)
per8_c	-0.335	(-0.8)	-0.167	(-0.5)	-0.168	(-0.5)	-0.201	(-0.5)
per9_c	-1.15	(-1.6)	-1.11	(-1.6)	-1.06	(-1.5)	-1.13	(-1.6)
per11_c	-1.50	(-6.6)	-1.24	(-6.7)	-1.15	(-6.1)	-1.78	(-4.0)
Chmode	-0.374	(-7.7)	-0.315	(-8.0)	-0.334	(-7.7)	-0.327	(-8.2)
scale	0.454	(15.3)	0.359	(21.3)	0.396	(16.0)	0.368	(20.7)
M_T2	1.30	(16.0)	1.58	(21.1)	1.42	(17.3)	1.55	(20.6)
T1_M	0.606	(15.3)	0.670	(5.3)	0.665	(15.9)	0.554	(7.6)

- Results with structure 2.

Estimated coefficients for simplified tree logit models (t-ratios between brackets): business: structure 2, variants 1-4

File	busPER16.F12		busPER18.F12		busPER19.F12		busPER16b.F12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True	
Observations	3683		3683		3683		3683	
Final log (L)	-2695.4		-2642.0		-2645.4		-2706.2	
D.O.F.	13		13		13		13	
Rho²(0)	0.348		0.361		0.360		0.346	
Rho²(c)	0.288		0.302		0.301		0.285	
Prepared	27 Nov 01		27 Nov 01		27 Nov 01		27 Nov 01	
Estimated	27 Nov 01		27 Nov 01		27 Nov 01		27 Nov 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
per1_c	-1.07	(-10.3)	-0.867	(-8.6)	-0.868	(-8.7)	-1.03	(-10.8)
per3_c	0.444	(6.1)	0.363	(4.9)	0.363	(5.0)	0.416	(6.2)
per4_c	-0.174	(-2.0)	-0.191	(-2.2)	-0.193	(-2.3)	-0.164	(-2.0)
per5_c	-0.537	(-4.4)	-0.441	(-4.9)	-0.443	(-4.4)	-0.314	(-3.5)
per6_c	-1.14	(-3.9)	-1.11	(-3.3)	-1.02	(-4.3)	-0.896	(-3.6)
per7_c	-0.644	(-1.8)	-0.845	(-2.1)	-0.619	(-2.0)	-0.442	(-1.4)
per8_c	-0.350	(-0.9)	-0.944	(-1.9)	-0.615	(-1.5)	-0.150	(-0.4)
per9_c	-1.16	(-1.6)	-2.13	(-2.6)	-1.82	(-2.4)	-1.08	(-1.5)
per11_c	-1.55	(-6.7)	-1.81	(-9.6)	-1.81	(-9.7)	-1.69	(-4.3)
Chmode	-0.356	(-7.3)	-0.479	(-8.4)	-0.474	(-8.4)	-0.311	(-7.7)
scale	0.462	(15.4)	0.625	(20.8)	0.602	(16.8)	0.368	(20.7)
T1_T2	0.704	(14.0)	0.571	(5.0)	1.02	(15.1)	0.826	(8.0)
M_T1	1.86	(17.6)	1.97	(5.1)	1.14	(15.8)	1.87	(8.1)

- Results with structure 3.

Estimated coefficients for simplified tree logit models (t-ratios between brackets): business: structure 3, variants 1-4

File	busPER24.F12		busPER23.F12		busPER23b.F12		busPER25.F12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True	
Observations	3683		3683		3683		3683	
Final log (L)	-2726.8		-2742.5		-2737.7		-2739.7	
D.O.F.	13		13		13		13	
Rho²(0)	0.341		0.337		0.338		0.338	
Rho²(c)	0.280		0.276		0.277		0.276	
Prepared	27 Nov 01		27 Nov 01		27 Nov 01		27 Nov 01	
Estimated	27 Nov 01		27 Nov 01		27 Nov 01		27 Nov 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
per1_c	-1.10	(-7.4)	-1.36	(-7.8)	-1.23	(-7.5)	-1.33	(-7.7)
per3_c	0.470	(5.1)	0.601	(5.5)	0.539	(5.3)	0.579	(5.4)
per4_c	-0.191	(-1.9)	-0.207	(-1.8)	-0.191	(-1.8)	-0.207	(-1.8)
per5_c	-0.517	(-3.6)	-0.257	(-2.0)	-0.384	(-2.8)	-0.244	(-2.0)
per6_c	-1.26	(-3.6)	-1.13	(-3.4)	-1.17	(-3.9)	-1.09	(-2.9)
per7_c	-0.686	(-1.7)	-0.483	(-1.2)	-0.529	(-1.4)	-0.495	(-1.1)
per8_c	-0.398	(-0.9)	-0.0186	(-0.0)	-0.126	(-0.3)	-0.0985	(-0.2)
per9_c	-1.14	(-1.4)	-1.09	(-1.2)	-1.02	(-1.2)	-1.13	(-1.2)
per11_c	-1.63	(-5.8)	-1.50	(-5.1)	-1.25	(-4.6)	-2.52	(-3.7)
Chmode	-0.443	(-7.3)	-0.448	(-7.2)	-0.439	(-7.1)	-0.453	(-7.3)
scale	0.558	(14.1)	0.551	(13.5)	0.551	(13.8)	0.554	(13.6)
T2_M	0.952	(12.5)	0.760	(12.9)	0.854	(12.1)	0.779	(13.0)
T1_T2	0.689	(15.1)	0.968	(5.3)	0.824	(16.1)	0.750	(7.6)

- Results with structure 1, M_T2 fixed at 1.

Estimated coefficients for simplified tree logit models (t-ratios between brackets): business: structure 1, M_T2 fixed at 1, variants 1-4

File	busPER26.F12		busPER27.F12		busPER28.F12		busPER29.F12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True	
Observations	3683		3683		3683		3683	
Final log (L)	-2727.0		-2748.8		-2739.6		-2745.0	
D.O.F.	12		12		12		12	
Rho²(0)	0.341		0.335		0.338		0.336	
Rho²(c)	0.280		0.274		0.276		0.275	
Prepared	27 Nov 01		27 Nov 01		27 Nov 01		27 Nov 01	
Estimated	27 Nov 01		27 Nov 01		27 Nov 01		27 Nov 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
per1_c	-1.04	(-9.6)	-1.01	(-10.0)	-1.03	(-9.8)	-1.01	(-9.9)
per3_c	0.444	(5.7)	0.441	(6.0)	0.452	(5.9)	0.435	(5.8)
per4_c	-0.184	(-1.9)	-0.157	(-1.8)	-0.166	(-1.8)	-0.162	(-1.9)
per5_c	-0.504	(-3.7)	-0.164	(-1.7)	-0.351	(-2.9)	-0.162	(-1.7)
per6_c	-1.21	(-3.7)	-0.848	(-3.3)	-1.04	(-4.1)	-0.842	(-2.8)
per7_c	-0.666	(-1.7)	-0.343	(-1.1)	-0.464	(-1.5)	-0.370	(-1.0)
per8_c	-0.402	(-0.9)	-0.0348	(-0.1)	-0.144	(-0.4)	-0.105	(-0.3)
per9_c	-1.10	(-1.5)	-0.857	(-1.2)	-0.901	(-1.2)	-0.913	(-1.2)
per11_c	-1.56	(-6.3)	-1.05	(-5.5)	-1.00	(-5.0)	-2.02	(-3.7)
Chmode	-0.434	(-7.5)	-0.390	(-7.2)	-0.408	(-7.3)	-0.400	(-7.3)
scale	0.540	(21.8)	0.434	(26.1)	0.491	(22.1)	0.447	(25.6)
M_T2	1.00	(*)	1.00	(*)	1.00	(*)	1.00	(*)
T1_M	0.677	(16.6)	0.916	(5.4)	0.786	(17.7)	0.718	(7.6)

Discussion of outcomes

The best model obtained for business (the model with the best likelihood) is the model with structure 2 and variant 2 (model busper18), but this model has a nest coefficient for morning/evening choice (M_T1) higher than one. We would prefer then to select model 3, variant 1 (busper24). But it is important to note that the simplified model 4 (especially variant 1), which is

a simplification of structure 1 but also of 3, are very nearly as good as model 3. Model structure 4 is more attractive for LMS implementation.

4.2.3 Education

- Results with structure 1.

Estimated coefficients for simplified tree logit models (t-ratios between brackets): education: structure 1, variants 1, 3, 4

File	eduPER17.F12		eduPER22.F12		eduPER20.F12	
Title	TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True	
Observations	1205		1206		1206	
Final log (L)	-573.4		-571.1		-573.8	
D.O.F.	14		14		14	
$Rho^2(0)$	0.544		0.547		0.545	
$Rho^2(c)$	0.375		0.379		0.376	
Prepared	27 Nov 01		27 Nov 01		27 Nov 01	
Estimated	27 Nov 01		27 Nov 01		27 Nov 01	
Scaling	1.0000		1.0000		1.0000	
per1_c	-1.43	(-5.6)	-1.36	(-5.2)	-1.48	(-6.2)
per3_c	-0.166	(-1.1)	-0.196	(-1.3)	-0.130	(-1.0)
per4_c	-0.645	(-3.3)	-0.662	(-3.3)	-0.563	(-3.2)
per5_c	-0.341	(-1.3)	-0.378	(-1.4)	8.3e-5	(0.0)
per6_c	-2.38	(-2.9)	-2.97	(-4.1)	-0.763	(-0.4)
per7_c	-2.83	(-3.4)	-3.44	(-4.5)	-1.20	(-0.6)
per8_c	-1.52	(-1.6)	-1.94	(-2.2)	-0.268	(-0.1)
per9_c	-0.441	(-0.4)	-0.206	(-0.2)	0.589	(0.3)
per10_c	0.590	(0.5)	0.867	(0.7)	1.71	(0.7)
per11_c	-1.95	(-2.9)	-1.70	(-2.2)	-6.08	(-1.3)
Chmode	-0.249	(-2.3)	-0.271	(-2.3)	-0.223	(-2.3)
scale	0.755	(10.9)	0.811	(10.7)	0.673	(13.7)
M_T2	1.90	(7.1)	1.76	(6.9)	2.10	(7.9)
T1_M	0.403	(7.0)	0.397	(7.0)	0.235	(2.0)

- Results with structure 2.

Estimated coefficients for simplified tree logit models (t-ratios between brackets): education: structure 2, variants 1, 3, 4

File	eduPER16.F12		eduPER19.F12		eduPER16b.F12	
Title	TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True	
Observations	1205		1205		1205	
Final log (L)	-571.6		-568.3		-573.0	
D.O.F.	14		14		14	
$Rho^2(0)$	0.546		0.549		0.545	
$Rho^2(c)$	0.377		0.380		0.375	
Prepared	27 Nov 01		27 Nov 01		27 Nov 01	
Estimated	27 Nov 01		27 Nov 01		27 Nov 01	
Scaling	1.0000		1.0000		1.0000	
per1_c	-1.40	(-5.6)	-1.33	(-5.2)	-1.48	(-6.2)
per3_c	-0.174	(-1.2)	-0.206	(-1.3)	-0.129	(-0.9)
per4_c	-0.671	(-3.4)	-0.683	(-3.3)	-0.562	(-3.2)
per5_c	-0.339	(-1.3)	-0.356	(-1.4)	0.0021	(0.0)
per6_c	-2.42	(-3.0)	-2.93	(-4.1)	-0.213	(-0.1)
per7_c	-2.89	(-3.5)	-3.41	(-4.6)	-0.667	(-0.3)
per8_c	-1.64	(-1.9)	-1.85	(-2.2)	0.167	(0.1)
per9_c	-0.346	(-0.3)	-0.233	(-0.2)	0.655	(0.3)
per10_c	0.961	(0.7)	0.807	(0.7)	2.36	(1.1)
per11_c	-1.95	(-2.9)	-1.63	(-2.2)	-7.14	(-1.5)
Chmode	-0.238	(-2.2)	-0.243	(-2.1)	-0.219	(-2.2)
scale	0.764	(10.9)	0.825	(10.7)	0.673	(13.7)
T1_T2	0.748	(9.5)	0.687	(10.1)	0.440	(2.3)
M_T1	2.48	(7.4)	2.52	(7.7)	4.72	(2.3)

- Results with structure 3.

Estimated coefficients for simplified tree logit models (t-ratios between brackets): education: structure 3, variants 1, 3, 4

File	eduPER24.F12		eduPER23b.F12		eduPER25.F12	
Title	TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True	
Observations	1206		1206		1206	
Final log (L)	-581.1		-577.1		-584.0	
D.O.F.	14		14		14	
Rho²(0)	0.539		0.542		0.537	
Rho²(c)	0.368		0.372		0.365	
Prepared	27 Nov 01		27 Nov 01		27 Nov 01	
Estimated	27 Nov 01		27 Nov 01		27 Nov 01	
Scaling	1.0000		1.0000		1.0000	
per1_c	-1.74	(-3.6)	-1.52	(-3.4)	-2.24	(-4.2)
per3_c	-0.301	(-1.4)	-0.319	(-1.5)	-0.276	(-1.2)
per4_c	-0.880	(-2.9)	-0.836	(-2.8)	-0.858	(-2.7)
per5_c	-0.359	(-1.0)	-0.368	(-1.0)	0.197	(0.6)
per6_c	-3.42	(-2.8)	-3.98	(-4.1)	-1.06	(-0.3)
per7_c	-3.88	(-3.1)	-4.49	(-4.4)	-1.45	(-0.5)
per8_c	-2.02	(-1.5)	-2.38	(-2.0)	0.0641	(0.0)
per9_c	-0.142	(-0.1)	-0.0568	(-0.0)	1.40	(0.4)
per10_c	1.51	(0.8)	1.30	(0.8)	3.50	(0.9)
per11_c	-2.47	(-2.4)	-1.78	(-1.6)	-10.1	(-1.3)
Chmode	-0.245	(-1.2)	-0.248	(-1.3)	-0.237	(-1.2)
scale	1.14	(7.9)	1.14	(7.9)	1.13	(7.8)
T2_M	0.753	(6.8)	0.808	(6.8)	0.644	(7.1)
T1_T2	0.705	(9.2)	0.645	(9.8)	0.463	(2.1)

- Results with structure 1, M_T2 fixed at 1.

Estimated coefficients for simplified tree logit models (t-ratios between brackets): education: structure 1, M_T2 fixed at 1, variants 1, 3, 4

File	eduPER26.F12		eduPER28.F12		eduPER29.F12	
Title	TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True	
Observations	1205		1206		1206	
Final log (L)	-582.6		-578.1		-588.8	
D.O.F.	13		13		13	
Rho²(0)	0.537		0.541		0.533	
Rho²(c)	0.365		0.371		0.360	
Prepared	27 Nov 01		27 Nov 01		27 Nov 01	
Estimated	27 Nov 01		27 Nov 01		27 Nov 01	
Scaling	1.0000		1.0000		1.0000	
per1_c	-1.20	(-4.6)	-1.13	(-4.3)	-1.32	(-5.4)
per3_c	-0.254	(-1.5)	-0.283	(-1.6)	-0.196	(-1.3)
per4_c	-0.669	(-3.0)	-0.680	(-3.0)	-0.511	(-2.7)
per5_c	-0.281	(-0.9)	-0.287	(-1.0)	0.300	(1.3)
per6_c	-2.75	(-2.9)	-3.50	(-4.6)	-0.421	(-0.2)
per7_c	-3.18	(-3.3)	-3.98	(-5.0)	-0.801	(-0.3)
per8_c	-1.59	(-1.5)	-2.12	(-2.2)	0.264	(0.1)
per9_c	-0.380	(-0.3)	-0.129	(-0.1)	1.06	(0.4)
per10_c	1.01	(0.7)	0.990	(0.8)	2.51	(0.9)
per11_c	-1.78	(-2.4)	-1.26	(-1.5)	-7.55	(-1.3)
Chmode	-0.133	(-0.8)	-0.169	(-1.0)	-0.0641	(-0.4)
scale	0.923	(12.9)	0.979	(13.1)	0.787	(14.7)
M_T2	1.00	(*)	1.00	(*)	1.00	(*)
T1_M	0.654	(9.9)	0.611	(10.6)	0.404	(1.9)

Discussion of outcomes

The models for variant 2 did not converge for education. The best model obtained for education (the model with the best likelihood) is the model with structure 2 and variant 3 (model eduper19). However, this model has a morning/evening (M_T1) nest coefficient higher than one, we prefer

then the model based on structure 3, variant 3 (eduper23b). Again, the simplified structure 4 (especially variant 3, model eduper28) is nearly as good as structure 3. Structure 4 is more suited for implementation in the LMS.

4.2.4 'Other' purposes

- Results with structure 1.

Estimated coefficients for simplified tree logit models (t-ratios between brackets): 'other': structure 1, variants 1-4

File	othPER17.F12		othPER21.F12		othPER22.F12		othPER20.F12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True	
Observations	3033		3033		3033		3033	
Final log (L)	-1933.6		-1943.7		-1933.3		-1943.5	
D.O.F.	14		14		14		14	
Rho²(0)	0.381		0.378		0.382		0.378	
Rho²(c)	0.281		0.277		0.281		0.278	
Prepared	27 Nov 01		27 Nov 01		27 Nov 01		27 Nov 01	
Estimated	27 Nov 01		27 Nov 01		27 Nov 01		27 Nov 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
per1_c	-1.01	(-5.3)	-0.949	(-5.5)	-0.991	(-5.3)	-0.948	(-5.5)
per3_c	0.320	(2.6)	0.337	(2.9)	0.331	(2.7)	0.337	(2.9)
per4_c	0.361	(3.0)	0.433	(4.0)	0.377	(3.2)	0.432	(4.0)
per5_c	0.126	(0.9)	0.232	(2.0)	0.177	(1.3)	0.231	(2.0)
per6_c	-0.430	(-1.9)	-0.311	(-1.6)	-0.560	(-2.7)	-0.317	(-1.7)
per7_c	-0.239	(-1.0)	-0.170	(-0.8)	-0.331	(-1.4)	-0.179	(-0.8)
per8_c	-0.211	(-0.8)	-0.209	(-0.8)	-0.246	(-0.9)	-0.221	(-0.9)
per9_c	0.881	(3.0)	0.802	(3.0)	0.883	(3.1)	0.763	(2.9)
per10_c	1.49	(3.8)	1.03	(3.3)	1.32	(3.9)	1.09	(3.6)
per11_c	-1.08	(-3.5)	-1.04	(-3.9)	-0.954	(-3.1)	-1.02	(-2.7)
Chmode	-0.150	(-2.4)	-0.300	(-5.4)	-0.163	(-2.7)	-0.289	(-5.3)
scale	0.314	(9.4)	0.214	(15.8)	0.297	(10.9)	0.212	(14.7)
M_T2	1.68	(15.6)	1.66	(20.6)	1.67	(17.0)	1.68	(20.3)
T1_M	0.439	(11.9)	0.613	(8.8)	0.459	(12.8)	0.615	(9.6)

- Results with structure 2.

Estimated coefficients for simplified tree logit models (t-ratios between brackets): 'other': structure 2, variants 1-4

File	othPER16.F12		othPER18.F12		othPER19.F12		othPER16b.F12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True	
Observations	3033		3033		3033		3033	
Final log (L)	-1940.0		-1941.5		-1939.3		-1941.6	
D.O.F.	14		14		14		14	
Rho²(0)	0.379		0.379		0.380		0.379	
Rho²(c)	0.279		0.278		0.279		0.278	
Prepared	27 Nov 01		27 Nov 01		27 Nov 01		27 Nov 01	
Estimated	27 Nov 01		27 Nov 01		27 Nov 01		27 Nov 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
per1_c	-1.02	(-5.5)	-0.959	(-5.5)	-1.02	(-5.5)	-0.951	(-5.5)
per3_c	0.342	(2.8)	0.334	(2.9)	0.348	(2.9)	0.337	(2.9)
per4_c	0.421	(3.7)	0.432	(4.0)	0.424	(3.7)	0.433	(4.0)
per5_c	0.228	(1.8)	0.231	(2.0)	0.246	(2.0)	0.232	(2.0)
per6_c	-0.311	(-1.6)	-0.262	(-1.3)	-0.381	(-1.9)	-0.293	(-1.6)
per7_c	-0.142	(-0.6)	-0.108	(-0.5)	-0.205	(-0.9)	-0.143	(-0.7)
per8_c	-0.194	(-0.8)	-0.173	(-0.7)	-0.227	(-0.9)	-0.212	(-0.9)
per9_c	0.868	(3.1)	0.849	(3.1)	0.842	(3.1)	0.807	(3.1)
per10_c	1.16	(3.5)	1.08	(3.4)	1.20	(3.7)	1.03	(3.4)
per11_c	-1.03	(-3.6)	-1.06	(-3.9)	-1.08	(-3.7)	-1.05	(-2.8)
Chmode	-0.282	(-4.7)	-0.278	(-5.0)	-0.284	(-4.7)	-0.280	(-5.0)
scale	0.251	(9.4)	0.216	(15.9)	0.253	(10.5)	0.214	(14.8)
T1_T2	0.864	(12.2)	0.949	(9.0)	0.847	(13.1)	1.00	(10.3)
M_T1	1.78	(16.4)	1.74	(8.8)	1.82	(16.0)	1.66	(10.2)

- Results with structure 3.

Estimated coefficients for simplified tree logit models (t-ratios between brackets): 'other': structure 3, variants 1-4

File	othPER24.F12		othPER23.F12		othPER23b.F12		othPER25.F12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True	
Observations	3033		3033		3033		3033	
Final log (L)	-1958.7		-1985.3		-1962.4		-1984.9	
D.O.F.	14		14		14		14	
Rho²(0)	0.373		0.365		0.372		0.365	
Rho²(c)	0.272		0.262		0.271		0.262	
Prepared	27 Nov 01		27 Nov 01		27 Nov 01		27 Nov 01	
Estimated	27 Nov 01		27 Nov 01		27 Nov 01		27 Nov 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
per1_c	-1.29	(-4.0)	-1.38	(-2.8)	-1.38	(-4.1)	-1.46	(-3.0)
per3_c	0.324	(2.0)	0.403	(2.0)	0.384	(2.2)	0.417	(2.0)
per4_c	0.337	(2.0)	0.616	(2.6)	0.437	(2.5)	0.644	(2.7)
per5_c	0.114	(0.6)	0.356	(1.5)	0.316	(1.5)	0.382	(1.6)
per6_c	-0.582	(-1.7)	-0.553	(-1.7)	-1.08	(-3.5)	-0.568	(-1.7)
per7_c	-0.320	(-0.9)	-0.305	(-0.9)	-0.737	(-2.3)	-0.319	(-0.9)
per8_c	-0.275	(-0.7)	-0.178	(-0.5)	-0.495	(-1.4)	-0.193	(-0.5)
per9_c	1.18	(2.6)	1.26	(2.1)	1.04	(2.4)	1.30	(2.2)
per10_c	2.50	(3.7)	2.07	(2.4)	2.25	(3.8)	2.17	(2.5)
per11_c	-1.15	(-2.4)	-1.26	(-2.3)	-1.07	(-2.2)	-1.82	(-2.2)
Chmode	-0.292	(-2.6)	-0.514	(-3.5)	-0.347	(-3.1)	-0.486	(-3.3)
scale	0.550	(7.2)	0.384	(3.2)	0.513	(6.5)	0.409	(3.5)
T2_M	0.856	(7.6)	0.697	(3.6)	0.799	(7.0)	0.668	(3.9)
T1_T2	0.533	(12.1)	0.915	(9.1)	0.603	(13.7)	0.886	(9.9)

- Results with structure 1, M_T2 fixed at 1.

Estimated coefficients for simplified tree logit models (t-ratios between brackets): 'other': structure 1, M_T2 fixed at 1, variants 1-4

File	othPER26.F12		othPER27.F12		othPER28.F12		othPER29.F12	
Title	TOD MODEL		TOD MODEL		TOD MODEL		TOD MODEL	
Converged	True		True		True		True	
Observations	3033		3033		3033		3033	
Final log (L)	-1959.4		-1986.6		-1963.6		-1986.4	
D.O.F.	13		13		13		13	
Rho²(0)	0.373		0.364		0.372		0.365	
Rho²(c)	0.272		0.262		0.270		0.262	
Prepared	27 Nov 01		27 Nov 01		27 Nov 01		27 Nov 01	
Estimated	27 Nov 01		27 Nov 01		27 Nov 01		27 Nov 01	
Scaling	1.0000		1.0000		1.0000		1.0000	
per1_c	-1.08	(-4.9)	-0.926	(-5.1)	-1.07	(-5.1)	-0.932	(-5.1)
per3_c	0.281	(2.0)	0.295	(2.4)	0.315	(2.3)	0.295	(2.4)
per4_c	0.280	(2.0)	0.428	(3.7)	0.344	(2.6)	0.430	(3.7)
per5_c	0.0613	(0.4)	0.186	(1.5)	0.209	(1.3)	0.188	(1.5)
per6_c	-0.521	(-1.7)	-0.390	(-1.8)	-0.897	(-3.7)	-0.404	(-2.0)
per7_c	-0.296	(-0.9)	-0.225	(-0.9)	-0.621	(-2.4)	-0.246	(-1.1)
per8_c	-0.306	(-0.9)	-0.259	(-1.0)	-0.494	(-1.7)	-0.293	(-1.2)
per9_c	0.974	(2.7)	0.798	(2.8)	0.771	(2.4)	0.759	(2.7)
per10_c	2.11	(4.2)	1.29	(3.8)	1.72	(4.5)	1.26	(3.8)
per11_c	-0.971	(-2.5)	-0.871	(-3.1)	-0.824	(-2.3)	-1.16	(-2.7)
Chmode	-0.361	(-4.1)	-0.634	(-9.0)	-0.447	(-5.4)	-0.629	(-8.9)
scale	0.475	(12.2)	0.251	(17.6)	0.407	(13.0)	0.254	(16.7)
M_T2	1.00	(*)	1.00	(*)	1.00	(*)	1.00	(*)
T1_M	0.524	(12.1)	0.904	(9.3)	0.597	(13.5)	0.899	(10.2)

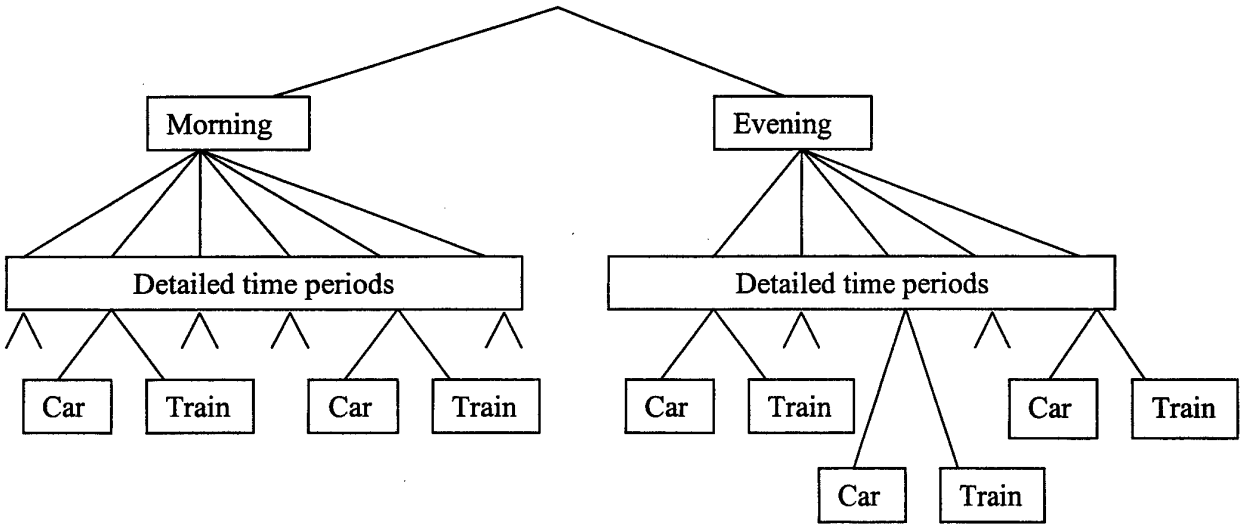
Discussion of outcomes

The best model obtained for 'other purposes (the model with the best likelihood) is the model with structure 1 and variant 3 (model othper22). However, the 'M_T2' coefficient is higher than one,

we would then prefer to propose the model with structure 3, variant 1 as the best one (othper24). Model 4 variant 1 (othper26) is nearly as good as structure 3, but is more suited for implementation in he LMS.

The theoretically best model for all purposes is structure 3. Nevertheless, for all purposes except commuting, the simplified structure 4 seems a better choice, since this strucure is much more atractive for LMS implementation. It is not implausible that the ToD should be more constrained for commuting than for other purposes. For education variant 3 appears best. While for the other purposes variant 1 or 4 is best. Probably, the difference in variants is connected with the possibility of returning before 15:00 from education tours. If the same variant would have to be chosen for all purposes, variant 1 is the best choice.

The theoretically best structure is the following. This would require considerable amendment to the LMS strcture for implementation. A simplified structure with mode nests in morning/evening nests only (no nesting below mode choice) performs nearly as well for business, education and other. Since this is much more attractive for implementation in the LMS, this is what we prefer. For commuting however, the structure below is clearly superior.



5 Summary; further work on implementation of time-of-day models; conclusions

5.1 Summary

This study has estimated two sets of models of the choice of time of travel, based exclusively on SP data:

- a detailed model, which represents the choices made by respondents among the varying alternatives presented in the SP exercises, using an error components logit (mixed logit) formulation;
- a 'simplified' model, which represents choices made by the SP respondents among 11 fixed alternatives defined over a 24-hour day, using models from the GEV family. At the time of completion of this report, simplified models had been estimated for tree (nested) logit models but not yet for models of the OGEV form.

The objective of estimating these two sets of models was to obtain the maximum understanding of the circumstances influencing the choice of time-of-day of travel through the detailed models, then to obtain as the simplified models formulae which were more closely suited to implementation in the LMS. The simplified models eliminate a number of aspects of the detailed models that would not be acceptable in a model for implementation, but, due to the circumstances and specification of the study, as well as to the inherent complexity of the problem, a number of other aspects remain in both sets of models which mean that further work will be necessary to obtain suitable models for implementation.

In particular, the following aspects of the detailed models have been purged from the simplified models.

- The use of the mixed logit formulation has been eliminated, since both estimation and application of this formulation require (in the current state of the art) simulation procedures which would be too time-consuming for application in the LMS.
- The simplified models use GEV formulations, for two reasons. First, these are much quicker to implement, because they use 'closed form' formulae which can be evaluated without simulation. Second, every GEV model is based on a generating function (G in the McFadden exposition of GEV) whose logarithm can be used to express the overall utility of the choices in the model as an input to other choices. In the multinomial logit models currently used for each choice dimension in the LMS, for example, the relevant function is the logsum; the logsum from the time-of-day model is thus used as input to the mode and destination choice models.[1]
- The detailed models use alternatives, including the 'mode switch alternative', which are defined in terms of the actual clock times presented to the SP respondents. These clock times are also used to calculate the changes in scheduling that they face. In the simplified models, modelling choice over fixed time periods, these scheduling changes are represented as differences between the mid-points of the relevant time periods.

The simplified models exploit the coefficients estimated in the detailed models, but apply an overall scale factor, add alternative-specific constants for the choice of each period on the outbound leg and for the change-mode alternative. The structure of the simplified models,

[1] The procedure is discussed in more detail below.

involving the estimation of structural coefficients, is a specific issue which is discussed in detail below.

The objective of this Chapter is to present and discuss the further changes that the simplified models require before they are ready for implementation.

5.2 Further changes to the models

Additional to the changes that have been made to the detailed models described briefly above, further changes will need to be made to the models. These changes could not be made as part of the present project, mainly for data reasons.

- Corrections are required to account for the fact that the models have been estimated on non-representative Stated Preference data. These changes are of two kinds.

  First, it is well known that SP responses are not necessarily representative of what travellers will do in reality. While the relative values attached to aspects of journeys may be represented quite well in SP data, the overall elasticity of response is generally not correct and needs to be adjusted, usually using Revealed Preference data.

  Second, the data collected for the study is *deliberately* not representative of the total travelling population, even by purpose, since quotas were set to ensure groups of special interest, such as commuters who were compensated for their travel costs, could be modelled accurately. This data design means that any statistics, such as an elasticity, calculated from the survey data are not necessarily representative of the entire travelling population. In particular the survey data focuses on the peak periods.

- Structural issues present major problems for model implementation. A mode switch alternative was included in the SP survey to give the possibility of relating mode choice to time period choice within the SP data and this feature does give the possibility of solving some of the issues.[2] However, the results that have been obtained to date do not make it easy to incorporate the new time-of-day models into the LMS structure without radical alterations. Specifically, the response scale in the time-of-day model appears to be *less* than that of the mode choice model, i.e. mode choice should apparently be placed 'below' time-of-day choice in a logit model structure. The structure of the LMS would require substantial changes to accommodate this finding. In particular, because LMS 7 incorporates variation in the relative structuring of mode and destination choice, these changes could become very complicated.

  The results obtained in the tree logit models presented in this report suggest that mode choice should have a response scale larger than that of time-of-day choice for commuting, while for other travel purposes mode choice has a scale not significantly different from that of choice of time period within the main parts of the day, but that the choice of part-of-day has a smaller response scale.

- It is one of the objectives of the new model that outward and return legs of a tour should be linked in the modelling. This linkage means that a traveller who, for example, is deterred from travelling at his or her preferred time in the morning peak may also adjust his or her return leg in the evening peak to maintain his or her desired activity time. Both the detailed and simplified models incorporate this linkage in that the alternatives offered to travellers vary in both outbound leg timing and return leg timing, with some alternatives offering variation in

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[2] The omission of this choice from the 1989 survey led to the necessity for the 'Hilton coefficient' which was estimated by group professional judgement to relate the response scale of time period choice to that of mode choice in the current LMS.

activity time while others maintain that time. In application, the presentation of alternatives could become very complicated: when 11 time periods are modelled, there are at least 66 possible combinations of these periods for the outbound and return legs; including all these alternatives in the choice model would be very complicated. An alternative and simpler approach which retains the linkage of the outbound and return legs is desirable.

Each of these issues is discussed in more detail in the following sections, followed by consideration of the changes that will be necessary to the LMS itself to incorporate these models.

5.3 The impact of RP data

It has become standard practice in the implementation of models derived from SP data to adjust them on the basis of RP data. This adjustment allows for a number of potential biases in the SP data while retaining the essential merits of that data in terms of the ability to support the estimation of models based on the presentation of hypothetical alternatives to respondents. Correction processes have become standard which adjust both the scale of responses and the base distribution of travellers over the alternatives.

The natural source of RP data for the implementation of these models is the OVG data. This data gives, for any year, a substantial number of tour records for both car drivers and train users, nationally representative (after expansion) and with detailed information about the origin, destination, purpose and timing of the tours, together with a mass of information about the traveller and his or her household.

In order to estimate a model that represents the responsiveness in travel timing of the entire national population to time and cost changes, it is necessary to be able to describe the alternatives that are available in terms of their time and cost. If it is proposed to develop assignment procedures for a large number of time periods (e.g. the 11 considered in the simplified models) then these procedures could be used to provide data for the calibration of the model; the estimation of the model would then have to wait for the development of the procedures. Otherwise existing procedures can be used to provide less accurate data for three aggregate time periods. In principle, data of this kind could be used in principle to calibrate a model using OVG RP data. The problem with a calibration of this nature is that it introduces an unknown error in that the accuracy of the times extracted from the assignment is not known. In particular, the calibration would depend on the accuracy of the time *differences* between the various time periods. Any inaccuracy in these measurements would affect the calibration of the response scale of the time-of-day model and in particular its relationship to the response scales of other component models. For these reasons modellers have consistently (over 20 years and more) advised against the use of RP data for the estimation of time-of-day models for the LMS and other major model systems.

The principle that has been adopted in the design of the present study is to avoid this problem by relating the scale of the time-of-day model to that of mode choice *in the SP data*. Then by adjusting these scales *together* to the scale of the mode choice model in the existing LMS an appropriate scale can be achieved for the time-of-day model in application. That is, the OVG data is exploited through the existing mode-destination choice models, estimated for LMS 7, which give the 'true' RP response scale for those choices.

The second role of RP data in the implementation is to adjust the data base of the SP model to make it representative of the overall national situation. This representativeness relates to the timing of the tours, in both directions. Effectively, corrections are needed to the weighting of the

SP records (i.e. the characteristics of the travellers, in particular their activity times) and the alternative-specific constants in the models (i.e. their preferences for travel times). These corrections can be done using standard adjustment procedures for SP models, adapted to the slightly unusual circumstances of time-of-day modelling.

Formulating a full specification of the procedures to be used will require a little detailed work. In particular, it will be necessary to investigate the coverage given by the SP data to the combinations of outbound and return leg timings, given the best estimate of the population distribution of the combinations which is represented by the OVG.

5.4 Structural issues

An important difficulty that arises in the implementation of these models is that of their structure. The existing LMS comprises a group of tree logit models applying mode and destination choices. To these are to be added the new GEV structures (tree logit or OGEV) which explain the time-of-day choice.

The design of the model structures in the present study was motivated by the change in the length of the peak time periods from 2 hours to 1 hour. With this change, it is certain that the ease of moving from one period to another is increased, at least on average. The fact that the Hilton coefficient is equal to 1 implies that mode choice and time-of-day choice were considered to have equal scales. If that judgement was reasonable, it must now be the case that the time-of-day scale must be larger than the mode scale and therefore that mode choice should be structured 'above' time-of-day choice in the overall structure. The use of GEV models for modelling time-of-day choice would then permit a (generalised) logsum to be taken from the time-of-day model as input to the mode and destination choice models, as in the present LMS. Depending on the relative scale values, there could have been some structural problems for travel purposes where destination choice was structured 'below' mode choice.

However, the results obtained from the present study suggest that the problems are rather more difficult. It appears that the scale of the mode choice model is in general *larger* rather than smaller than that of the time-of-day choice model, i.e. that mode choice should be placed 'below' time-of-day choice in the overall structure.

The evidence from the tree logit models that have been estimated on the SP data is quite strong: it is clear that the response scale of mode choice is significantly larger than that of time-of-day choice – at least for commuter and for the choice of the main part of the day – and therefore that mode choice should be placed 'lower' in the hierarchy than at least part of the time-of-day choice. Experiments are being made with OGEV models but these have been delayed because of problems with the experimental software that has to be used. However, it is not possible to estimate simultaneously a model with OGEV structure for time-of-day choice with a mode component, unless the mode switch alternative is incorporated in the OGEV structure. Thus it is uncertain that it will be possible to argue from the OGEV models that a different structure should be adopted, even if such a result was likely.

5.5 Outbound and return legs

It was an important component of the present study that the link between outbound and return legs of tours should be represented in the modelling. However, this can potentially give rise to considerable complication in the implementation of the model.

First, the number of potential alternatives is large. For each of the 11 time periods represented, a traveller may leave home in that period and return the same period or a later one, giving rise to 66 distinct timing alternatives. Additionally, consideration might be given to tours leaving on one day and returning in the night (or perhaps later) in the following 24-hour period; in this way we get at least 121 alternatives, which can be reduced to 76[3] if we assume that no tours span (say) 3 a.m.. This number of alternatives is unwelcome, while conversion from a model estimated using SP data with three timing and one mode choice alternative may present difficulty. The number of alternatives that arise if the model is structured in this way suggest that an alternative approach to implementation may be preferable. The use of restrictions on the number of return leg timings considered in conjunction with each outbound timing could be considered but will retain the limitation of the arbitrary assumption necessary to restrict the timings.

An alternative approach would be to de-couple the tour legs. This would imply, for example, that modelling choice of outbound leg would take account, not of the explicit alternatives for the return leg, but of *average* return leg conditions. Similar modelling would apply for the choice of return leg. Thus if, for example, road pricing was applied in the morning peak only, then the choice of return leg timing in the evening peak would be affected to the extent that activity durations spanned both peaks (i.e. primarily for work tours) and to the extent that travellers changing their morning peak time wished to maintain their activity times rather than to maintain their return leg timing. This approach would give a model which resembled the present LMS in that the tour legs were modelled separately, but which took some account of the connection between periods imposed by the distribution of activity times and travellers wishes to preserve those times.

Specifically, the model would then represent the *change* in the distribution of outbound leg timings as a function of the change in outbound leg conditions and a change in the return leg conditions, weighted for their purpose-specific impact on each outbound timing. Similarly the return leg timing changes would be represented as dependent on changes in return leg conditions and the weighted average of outbound leg conditions.

This approach appears to give a significant advance on the current independent models of outbound and return legs without requiring undue complication. Some research will be necessary to determine the best approach to modelling base activity time distributions, in which the OVG will naturally play an important role.

5.6 Issues in the implementation environment

It was foreseen in the recent development of the LMS 7 system that a re-estimation of the LMS mode and destination choice models might be necessary in the light of new time-of-day models. The way in which level-of-service measures are input as averages into the model estimation needs to be reviewed and the question of using logsums in their place could be considered. In the current model, logsums are used to measure *changes* relative to base year congestion in forecasting. If the time-of-day model remains at the 'bottom' of the demand structure, a change on this point is not essential but entirely different model structures may have to be implemented, in which case change will be necessary.

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[3] A few more alternatives can be obtained by considering returning in the same night, e.g. 1 a.m. out, 2 a.m. back as different from returning the next night, e.g. 5 a.m. out, 2 a.m. back. But these are theoretical possibilities only.

The new time-of-day models contain segmentations that are not fully represented in the current LMS segmentation, despite its considerable detail. In particular, the following points are *not* incorporated in that segmentation but do appear in the models

- flexible working hours,
- compensation by employers for travel costs and
- *vastrecht*, the holding of public transport passes.

These segmentations will need to be considered in detail before the models can be implemented.

A number of alternative approaches is available. The correlation between existing segmentations in the LMS and the time-of-day segmentations may be considerable, which would suggest that the percentages of travellers in each segment can be represented as a function of the existing segmentation. For example, it may be that higher income groups may have more flexible working hours. Any such correlation may be represented by adding a further segmentation to parts of the LMS or by using average values in the time-of-day model. Proposals that best meet the circumstances can be put forward after a few days analysis.

In any case, it will be necessary to take account of the feed-back between the demand model and the assignment procedure. Even if the time-of-day model can be placed 'below' the mode and destination choice models, it would represent an advance in the model structure and convenience of operation if the time-of-day model could be incorporated in the NSES program. Iteration over the demand-assignment system should also be reviewed in the light of more recent international thinking on this issue: the 'fictive cost' method has proved useful to date, but when the main iterative components are being renewed it would be reasonable to reconsider whether a replacement method might be more accurate.

These changes will require some re-programming of the latter phases of the LMS.

5.7 Conclusions

In this Chapter, a number of the problems concerning the implementation of the time-of-day models have been set out. However, definitive conclusions have not been reached on a number of issues. It will be necessary to take these discussions forward in further work, possibly in a preliminary study for the implementation work.

In any case, RP data, almost certainly from the OVG, needs to be used to adjust for the SP nature and non-representativeness of the data base on which these models have been estimated. It is not attractive to make the SP-RP adjustment by re-estimating the models completely, rather the scale should be adjusted so that the mode choice scale is consistent with that of the LMS and OVG data should be used only to adjust the alternative-specific constants in the model – equivalently, OVG data should be used to define the pivot-points from which the model will predict changes in behaviour. Tabulations have been made which indicate the relevant distributions over time periods.

The structure of the new LMS – with these time-of-day models – needs to be considered carefully. Integrating time-of-day choice within the mode-destination structure will present programming difficulties and possibly other complications where destination choice is structured 'below' mode choice. The interaction of the eight purposes of the LMS with the 4 purposes used in this study also needs consideration. Also the way in which slow modes, BTM and car passenger are added to car and train used in this study will present further difficulty.

The possibilities for making semi-independent models of time-of-day choice for outbound and return trips should be considered, although this works better when time-of-day choice is the 'lowest' model in the hierarchy.

Other issues concerning the LMS and adjustments that may need to be made have been raised. These do not appear to present serious difficulties.

Appendix A Detailed results of simulations with the best detailed models

This appendix contains the detailed results of simulations with the best detailed models obtained in chapter 2. These simulation results were summarised in chapter 3. For the simulation we used the estimation sample (which is not nationally representative). The column P:Base gives the distribution of SP choices over the time periods (and the alternative mode), as predicted by the model for a situation without changes to any of the variables. The number 237 for the alternative mode in the first column means that the model predicts 237 train choices for this group of travellers that in reality all used car. Compared to the limited predictive power that discrete choice models often show for predicting at the individual level, we consider this as quite a succesful forecast. For train users 167 car choices are predicted (second table). In the other five columns time or cost changes are simulated. The column P:Ctimeall gives the distribution of choices when the change in cost and time would apply to all utility functions (note that sometimes the considerably earlier and later alternatives are within the 7:00-9:00 period). The next four columns give the outcomes if the change in cost would apply only to the observed peak alternatives (e.g. U_0), only to the considerably earlier alternatives (e.g. U_1), only to the considerably later alternatives (e.g. U_2) or only to the change mode alternative (e.g. U_3). The most important comparison is between the first and second column: what is the impact of changing travel time or cost for all alternatives that are in a specific period, such as 7:00-9:00?

1. Commuting

1.1 Direct elasticities

Commuting: Time +10% in AM peak (7:00-9-00)– Effects on AM peak - Car users

User Var 1 - Scenario x Choice x umode

umode: 1 | User Var 1 | Normal Table

	P:Base	P:CTimeall	P:CTpeak	P:CTearly	P:CTlate	P:ChTime
6:00-7:00	784	819	806	784	795	787
% Change	(+0.0%)	(+4.5%)	(+2.7%)	(+0.0%)	(+1.4%)	(+0.3%)
7:00-8:00	1229	1182	1194	1213	1230	1238
% Change	(+0.0%)	(-3.8%)	(-2.8%)	(-1.3%)	(+0.1%)	(+0.7%)
8:00-9:00	1067	1025	1033	1072	1051	1077
% Change	(+0.0%)	(-3.9%)	(-3.2%)	(+0.5%)	(-1.5%)	(+1.0%)
9:00-10:00	503	524	515	511	503	506
% Change	(+0.0%)	(+4.0%)	(+2.4%)	(+1.5%)	(+0.0%)	(+0.5%)
10:00-15:00	383	392	391	384	383	384
% Change	(+0.0%)	(+2.4%)	(+2.2%)	(+0.3%)	(+0.0%)	(+0.2%)
15:00-16:00	9	9	9	9	9	9
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
16:00-17:00	8	8	8	8	8	8
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
17:00-18:00	20	20	20	20	20	20
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
18:00-19:00	4	4	4	4	4	4
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
19:00-24:00	31	31	31	31	31	31
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	357	371	369	357	359	358
% Change	(+0.0%)	(+3.9%)	(+3.3%)	(+0.0%)	(+0.5%)	(+0.3%)
Alt. mode	237	247	252	239	239	212
% Change	(+0.0%)	(+4.2%)	(+6.4%)	(+0.7%)	(+0.8%)	(-10.8%)

ALOGIT Version

Commuting: Time +10% in AM peak (7:00-9-00)– Effects on AM peak – Train users

User Var 1 - Scenario x Choice x umode

umode: 2 | User Var 1 | Normal Table

	P:Base	P:CTimeall	P:CTpeak	P:CTearly	P:CTlate	P:ChTime
6:00-7:00	149	158	158	149	149	150
% Change	(+0.0%)	(+6.3%)	(+6.1%)	(+0.0%)	(+0.1%)	(+1.0%)
7:00-8:00	487	462	469	481	487	493
% Change	(+0.0%)	(-5.2%)	(-3.7%)	(-1.3%)	(0.0%)	(+1.2%)
8:00-9:00	417	395	391	420	416	422
% Change	(+0.0%)	(-5.1%)	(-6.2%)	(+0.9%)	(-0.1%)	(+1.4%)
9:00-10:00	108	112	110	109	108	109
% Change	(+0.0%)	(+3.4%)	(+2.2%)	(+1.1%)	(+0.0%)	(+0.6%)
10:00-15:00	143	151	150	143	143	143
% Change	(+0.0%)	(+5.4%)	(+4.9%)	(+0.4%)	(+0.0%)	(+0.3%)
15:00-16:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.3%)
16:00-17:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
17:00-18:00	14	14	14	14	14	14
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
18:00-19:00	2	2	2	2	2	2
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
19:00-24:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	38	41	41	38	38	39
% Change	(+0.0%)	(+9.0%)	(+8.6%)	(+0.0%)	(+0.1%)	(+1.1%)
Alt. mode	167	189	189	168	167	152
% Change	(+0.0%)	(+13.3%)	(+13.1%)	(+0.6%)	(+0.1%)	(-8.9%)

ALOGIT Version

Commuting: Time +10% in PM peak (16:00-18-00)– Effects on PM peak – Car úsers

User Var 1 - Scenario x Choice x umode

umode = 1 | User Var 1 | Normal Table

	P:Base	P:CTtimeair	P:CTpeakr	P:CTearlyr	P:CTlater	P:ChTtimer
6:00-7:00	1	1	1	1	1	1
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
7:00-8:00	14	14	14	14	14	14
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
8:00-9:00	18	18	18	18	18	18
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
9:00-10:00	2	2	2	2	2	2
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
10:00-15:00	483	485	484	483	483	483
% Change	(+0.0%)	(+0.5%)	(+0.3%)	(+0.0%)	(+0.1%)	(+0.0%)
15:00-16:00	382	393	390	382	384	382
% Change	(+0.0%)	(+3.1%)	(+2.2%)	(+0.0%)	(+0.6%)	(+0.2%)
16:00-17:00	970	953	964	955	971	976
% Change	(+0.0%)	(-1.8%)	(-0.7%)	(-1.5%)	(+0.1%)	(+0.6%)
17:00-18:00	1201	1169	1173	1198	1194	1210
% Change	(+0.0%)	(-2.7%)	(-2.3%)	(-0.2%)	(-0.6%)	(+0.7%)
18:00-19:00	746	767	753	758	748	748
% Change	(+0.0%)	(+2.8%)	(+0.9%)	(+1.5%)	(+0.2%)	(+0.2%)
19:00-24:00	499	505	502	501	499	499
% Change	(+0.0%)	(+1.3%)	(+0.7%)	(+0.5%)	(+0.0%)	(+0.1%)
0:00-6:00	72	76	75	73	72	72
% Change	(+0.0%)	(+5.9%)	(+4.2%)	(+1.5%)	(+0.0%)	(+0.4%)
Alt. mode	237	240	248	240	239	219
% Change	(+0.0%)	(+1.3%)	(+4.7%)	(+1.2%)	(+0.7%)	(-7.6%)

ALOGIT Version

Commuting: Time +10% in PM peak (16:00-18-00)– Effects on PM peak – Train users

User Var 1 - Scenario x Choice x umode

umode = 2 | User Var 1 | Normal Table

	P:Base	P:CTtimeair	P:CTpeakr	P:CTearlyr	P:CTlater	P:ChTtimer
6:00-7:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
7:00-8:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
8:00-9:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
9:00-10:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
10:00-15:00	71	72	72	71	71	72
% Change	(+0.0%)	(+1.8%)	(+0.6%)	(+0.0%)	(+0.2%)	(+0.6%)
15:00-16:00	128	133	130	129	129	129
% Change	(+0.0%)	(+4.2%)	(+1.4%)	(+0.7%)	(+1.0%)	(+1.0%)
16:00-17:00	372	360	357	370	372	377
% Change	(+0.0%)	(-3.3%)	(-4.0%)	(-0.5%)	(+0.0%)	(+1.2%)
17:00-18:00	497	484	486	494	494	500
% Change	(+0.0%)	(-2.5%)	(-2.2%)	(-0.5%)	(-0.5%)	(+0.7%)
18:00-19:00	174	180	178	175	174	174
% Change	(+0.0%)	(+3.4%)	(+2.5%)	(+0.7%)	(+0.0%)	(+0.4%)
19:00-24:00	114	116	116	114	114	114
% Change	(+0.0%)	(+1.6%)	(+1.4%)	(+0.1%)	(+0.0%)	(+0.1%)
0:00-6:00	0	0	0	0	0	0
% Change	(+0.0%)	(+3.9%)	(+0.0%)	(+3.9%)	(+0.0%)	(+0.0%)
Alt. mode	167	177	184	169	167	156
% Change	(+0.0%)	(+6.3%)	(+10.5%)	(+1.3%)	(+0.4%)	(-6.4%)

ALOGIT Version

Commuting: Cost + 10% in AM peak (7:00-9-00)– Effects on AM peak – Car users

User Var 1 - Scenario x Choice x umode

umode = 1 | User Var 1 | Normal Table

	P:Base	P:CCostall	P:CCopeak	P:CCoearl	P:CColate	P:CComode
6:00-7:00	784	795	791	784	788	785
% Change	(+0.0%)	(+1.3%)	(+0.9%)	(+0.0%)	(+0.4%)	(+0.0%)
7:00-8:00	1229	1215	1218	1224	1229	1230
% Change	(+0.0%)	(-1.2%)	(-0.9%)	(-0.4%)	(+0.0%)	(+0.1%)
8:00-9:00	1067	1054	1055	1069	1062	1069
% Change	(+0.0%)	(-1.2%)	(-1.1%)	(+0.2%)	(-0.4%)	(+0.2%)
9:00-10:00	503	510	507	506	503	504
% Change	(+0.0%)	(+1.4%)	(+0.8%)	(+0.5%)	(+0.0%)	(+0.1%)
10:00-15:00	383	386	386	383	383	383
% Change	(+0.0%)	(+0.8%)	(+0.7%)	(+0.1%)	(+0.0%)	(+0.0%)
15:00-16:00	9	9	9	9	9	9
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
16:00-17:00	8	8	8	8	8	8
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
17:00-18:00	20	20	20	20	20	20
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
18:00-19:00	4	4	4	4	4	4
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
19:00-0:00	31	31	31	31	31	31
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	357	361	361	357	358	357
% Change	(+0.0%)	(+1.2%)	(+1.0%)	(+0.0%)	(+0.2%)	(+0.0%)
Alt. mode	237	240	243	238	238	233
% Change	(+0.0%)	(+1.0%)	(+2.2%)	(+0.3%)	(+0.3%)	(-1.8%)
All Choices	4632	4632	4632	4632	4632	4632
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

Commuting: Cost + 10% in AM peak (7:00-9-00)– Effects on AM peak - train users

User Var 1 - Scenario x Choice x umode

umode = 2 | User Var 1 | Normal Table

	P:Base	P:CCostall	P:CCopeak	P:CCoearl	P:CColate	P:CComode
6:00-7:00	149	150	150	149	149	149
% Change	(+0.0%)	(+1.2%)	(+0.8%)	(+0.0%)	(+0.0%)	(+0.4%)
7:00-8:00	487	485	484	486	487	489
% Change	(+0.0%)	(-0.4%)	(-0.6%)	(-0.3%)	(0.0%)	(+0.4%)
8:00-9:00	417	415	412	417	417	419
% Change	(+0.0%)	(-0.4%)	(-1.1%)	(+0.1%)	(0.0%)	(+0.6%)
9:00-10:00	108	109	109	108	108	108
% Change	(+0.0%)	(+1.2%)	(+0.5%)	(+0.4%)	(+0.0%)	(+0.3%)
10:00-15:00	143	144	144	143	143	143
% Change	(+0.0%)	(+1.1%)	(+0.8%)	(+0.1%)	(+0.0%)	(+0.1%)
15:00-16:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.1%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.1%)
16:00-17:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
17:00-18:00	14	14	14	14	14	14
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
18:00-19:00	2	2	2	2	2	2
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
19:00-0:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	38	39	39	38	38	38
% Change	(+0.0%)	(+1.7%)	(+1.3%)	(+0.0%)	(+0.0%)	(+0.4%)
Alt. mode	167	165	171	167	167	161
% Change	(+0.0%)	(-1.0%)	(+2.3%)	(+0.1%)	(+0.0%)	(-3.4%)
All Choices	1524	1524	1524	1524	1524	1524
% Change	(+0.0%)	(0.0%)	(0.0%)	(0.0%)	(0.0%)	(0.0%)

ALOGIT Version

Commuting: Cost + 10% in PM peak (16:00-18:00) – Effects on PM peak, car users

User Var 1 - Scenario x Choice x umode

umode: 1 | User Var 1 | Normal Table

	P:Base	P:CCostalr	P:CCopeakr	P:CCoearlr	P:CClater	P:CCmoder
6:00-7:00	1	1	1	1	1	1
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
7:00-8:00	14	14	14	14	14	14
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
8:00-9:00	18	18	18	18	18	18
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
9:00-10:00	2	2	2	2	2	2
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
10:00-15:00	483	483	483	483	483	483
% Change	(+0.0%)	(+0.1%)	(+0.1%)	(+0.0%)	(+0.0%)	(+0.0%)
15:00-16:00	382	385	384	382	383	382
% Change	(+0.0%)	(+0.9%)	(+0.7%)	(+0.0%)	(+0.2%)	(+0.0%)
16:00-17:00	970	963	968	965	970	971
% Change	(+0.0%)	(-0.7%)	(-0.2%)	(-0.5%)	(+0.0%)	(+0.1%)
17:00-18:00	1201	1190	1193	1200	1199	1203
% Change	(+0.0%)	(-0.9%)	(-0.7%)	(-0.1%)	(-0.2%)	(+0.1%)
18:00-19:00	746	752	748	749	747	746
% Change	(+0.0%)	(+0.8%)	(+0.3%)	(+0.5%)	(+0.1%)	(+0.0%)
19:00-0:00	499	501	500	499	499	499
% Change	(+0.0%)	(+0.4%)	(+0.2%)	(+0.2%)	(+0.0%)	(+0.0%)
0:00-6:00	72	73	73	72	72	72
% Change	(+0.0%)	(+1.7%)	(+1.2%)	(+0.5%)	(+0.0%)	(+0.1%)
All. mode	237	241	241	238	238	234
% Change	(+0.0%)	(+1.8%)	(+1.5%)	(+0.4%)	(+0.2%)	(-1.2%)
All Choices	4625	4625	4625	4625	4625	4625
% Change	(+0.0%)	(0.0%)	(0.0%)	(0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

Commuting: Cost + 10% in PM peak (16:00-18:00) – Effects on PM peak, train users

User Var 1 - Scenario x Choice x umode

umode: 2 | User Var 1 | Normal Table

	P:Base	P:CCostalr	P:CCopeakr	P:CCoearlr	P:CClater	P:CCmoder
6:00-7:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
7:00-8:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
8:00-9:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
9:00-10:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
10:00-15:00	71	71	71	71	71	71
% Change	(+0.0%)	(+0.3%)	(+0.1%)	(+0.0%)	(+0.0%)	(+0.2%)
15:00-16:00	128	129	128	128	128	128
% Change	(+0.0%)	(+1.2%)	(+0.3%)	(+0.1%)	(+0.3%)	(+0.5%)
16:00-17:00	372	371	370	372	372	374
% Change	(+0.0%)	(-0.4%)	(-0.7%)	(-0.1%)	(0.0%)	(+0.5%)
17:00-18:00	497	496	495	496	496	498
% Change	(+0.0%)	(-0.2%)	(-0.3%)	(-0.1%)	(-0.1%)	(+0.2%)
18:00-19:00	174	175	174	174	174	174
% Change	(+0.0%)	(+0.7%)	(+0.4%)	(+0.1%)	(+0.0%)	(+0.2%)
19:00-0:00	114	114	114	114	114	114
% Change	(+0.0%)	(+0.3%)	(+0.2%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.2%)	(+0.0%)	(+0.2%)	(+0.0%)	(+0.0%)
All. mode	167	166	169	167	167	163
% Change	(+0.0%)	(-0.5%)	(+1.7%)	(+0.2%)	(+0.1%)	(-2.4%)
All Choices	1522	1522	1522	1522	1522	1522
% Change	(+0.0%)	(+0.0%)	(0.0%)	(0.0%)	(0.0%)	(+0.0%)

ALOGIT Version

1.2 Cross elasticities

Commuting: time +10% in AM peak, effect on PM peak, car users

User Var 1 - Scenario x Choice x umode

umode: 1 | User Var 1 | Normal Table

	P:Baser	P:CTallcro	P:CTpeakcro	P:CTearlycro	P:CTlatecro	P:ChTimecro
6:00-7:00	1	1	1	1	1	1
% Change	(+0.0%)	(+1.2%)	(+1.2%)	(+0.0%)	(+0.0%)	(+0.0%)
7:00-8:00	14	14	14	14	14	14
% Change	(+0.0%)	(+0.1%)	(+0.1%)	(+0.0%)	(+0.1%)	(+0.0%)
8:00-9:00	18	18	18	18	18	18
% Change	(+0.0%)	(-0.2%)	(-0.3%)	(0.0%)	(+0.1%)	(+0.0%)
9:00-10:00	2	2	2	2	2	2
% Change	(+0.0%)	(+0.6%)	(+2.1%)	(-0.5%)	(-0.8%)	(+0.2%)
10:00-15:00	483	483	483	482	483	484
% Change	(+0.0%)	(+0.2%)	(+0.1%)	(-0.1%)	(+0.1%)	(+0.3%)
15:00-16:00	382	387	386	381	383	382
% Change	(+0.0%)	(+1.4%)	(+1.2%)	(-0.3%)	(+0.4%)	(+0.2%)
16:00-17:00	970	972	970	966	973	975
% Change	(+0.0%)	(+0.2%)	(+0.0%)	(-0.4%)	(+0.3%)	(+0.5%)
17:00-18:00	1201	1189	1187	1200	1202	1211
% Change	(+0.0%)	(-1.0%)	(-1.2%)	(-0.1%)	(+0.0%)	(+0.8%)
18:00-19:00	746	737	735	748	744	752
% Change	(+0.0%)	(-1.2%)	(-1.5%)	(+0.3%)	(-0.2%)	(+0.9%)
19:00-0:00	499	501	500	501	497	501
% Change	(+0.0%)	(+0.5%)	(+0.3%)	(+0.4%)	(-0.3%)	(+0.5%)
0:00-6:00	72	72	76	73	68	72
% Change	(+0.0%)	(+0.6%)	(+5.2%)	(+1.1%)	(-6.1%)	(+0.5%)
Alt_mode	237	247	252	239	239	211
% Change	(+0.0%)	(+4.2%)	(+6.4%)	(+0.7%)	(+0.8%)	(-10.8%)
All Choices	4625	4625	4625	4625	4625	4625
% Change	(+0.0%)	(0.0%)	(0.0%)	(+0.0%)	(0.0%)	(0.0%)

ALOGIT Version

Commuting: time +10% in AM peak, effect on PM peak, train users

User Var 1 - Scenario x Choice x umode

umode: 2 | User Var 1 | Normal Table

	P:Baser	P:CTallcro	P:CTpeakcro	P:CTearlycro	P:CTlatecro	P:ChTimecro
6:00-7:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
7:00-8:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
8:00-9:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
9:00-10:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
10:00-15:00	71	68	69	71	71	73
% Change	(+0.0%)	(-4.1%)	(-3.6%)	(-0.6%)	(+0.0%)	(+2.0%)
15:00-16:00	128	125	125	127	128	130
% Change	(+0.0%)	(-2.4%)	(-2.1%)	(-0.5%)	(+0.2%)	(+1.6%)
16:00-17:00	372	363	363	372	372	376
% Change	(+0.0%)	(-2.3%)	(-2.4%)	(-0.1%)	(+0.1%)	(+1.1%)
17:00-18:00	497	489	489	497	496	501
% Change	(+0.0%)	(-1.6%)	(-1.6%)	(0.0%)	(-0.1%)	(+0.9%)
18:00-19:00	174	173	173	174	173	175
% Change	(+0.0%)	(-0.3%)	(-0.5%)	(+0.3%)	(-0.2%)	(+0.9%)
19:00-0:00	114	115	115	114	114	115
% Change	(+0.0%)	(+0.9%)	(+0.9%)	(-0.1%)	(0.0%)	(+1.0%)
0:00-6:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+1.9%)
Alt_mode	167	189	188	168	167	152
% Change	(+0.0%)	(+13.3%)	(+13.1%)	(+0.6%)	(+0.1%)	(-8.9%)
All Choices	1522	1522	1522	1522	1522	1522
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(0.0%)	(0.0%)	(+0.0%)

ALOGIT Version

Commuting: time +10% in PM peak, effect on AM peak, car users

User Var 1 - Scenario x Choice x umode

umode: 1 | User Var 1 | Normal Table

	P:Base	P:CTtimlrcro	P:CTpeakrcro	P:CTearlrcro	P:CTlatercro	P:ChTimercro
6:00-7:00	784	779	784	772	790	787
% Change	(+0.0%)	(-0.6%)	(+0.0%)	(-1.6%)	(+0.7%)	(+0.3%)
7:00-8:00	1229	1222	1210	1235	1231	1235
% Change	(+0.0%)	(-0.6%)	(-1.6%)	(+0.5%)	(+0.1%)	(+0.5%)
8:00-9:00	1067	1064	1053	1076	1064	1073
% Change	(+0.0%)	(-0.3%)	(-1.3%)	(+0.9%)	(-0.3%)	(+0.6%)
9:00-10:00	503	507	505	508	499	505
% Change	(+0.0%)	(+0.8%)	(+0.3%)	(+1.0%)	(-0.8%)	(+0.4%)
10:00-15:00	383	388	389	385	379	384
% Change	(+0.0%)	(+1.3%)	(+1.7%)	(+0.5%)	(-1.1%)	(+0.2%)
15:00-16:00	9	9	9	9	9	9
% Change	(+0.0%)	(+0.1%)	(+0.0%)	(+0.1%)	(+0.0%)	(+0.0%)
16:00-17:00	8	8	8	8	8	8
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
17:00-18:00	20	20	20	20	20	20
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
18:00-19:00	4	4	4	4	4	4
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
19:00-0:00	31	31	31	31	31	31
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	357	360	371	344	359	358
% Change	(+0.0%)	(+0.9%)	(+3.9%)	(-3.6%)	(+0.7%)	(+0.2%)
Alt. mode	237	240	248	240	239	219
% Change	(+0.0%)	(+1.3%)	(+4.7%)	(+1.2%)	(+0.7%)	(-7.6%)

ALOGIT Version

Commuting: time +10% in PM peak, effect on AM peak, train users

User Var 1 - Scenario x Choice x umode

umode: 2 | User Var 1 | Normal Table

	P:Base	P:CTtimlrcro	P:CTpeakrcro	P:CTearlrcro	P:CTlatercro	P:ChTimercro
6:00-7:00	149	146	150	143	149	151
% Change	(+0.0%)	(-1.7%)	(+0.9%)	(-3.7%)	(+0.4%)	(+1.6%)
7:00-8:00	487	481	472	489	489	491
% Change	(+0.0%)	(-1.2%)	(-3.0%)	(+0.5%)	(+0.4%)	(+0.9%)
8:00-9:00	417	412	404	420	418	420
% Change	(+0.0%)	(-1.0%)	(-3.0%)	(+0.8%)	(+0.3%)	(+0.7%)
9:00-10:00	108	108	108	109	107	108
% Change	(+0.0%)	(-0.1%)	(-0.3%)	(+0.6%)	(-0.6%)	(+0.2%)
10:00-15:00	143	145	148	144	139	143
% Change	(+0.0%)	(+1.4%)	(+3.4%)	(+0.6%)	(-2.6%)	(+0.2%)
15:00-16:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.1%)	(+0.0%)	(+0.1%)	(+0.0%)	(+0.0%)
16:00-17:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
17:00-18:00	14	14	14	14	14	14
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
18:00-19:00	2	2	2	2	2	2
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
19:00-0:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	36	36	42	34	36	39
% Change	(+0.0%)	(+0.6%)	(+10.0%)	(-9.6%)	(+0.6%)	(+1.1%)
Alt. mode	167	178	184	169	168	156
% Change	(+0.0%)	(+6.3%)	(+10.5%)	(+1.3%)	(+0.4%)	(-6.4%)

ALOGIT Version

Commuting: cost + 10% in PM peak, effect on AM peak, car users

User Var 1 - Scenario x Choice x umode

umode: 1 | User Var 1 | Normal Table

	P:Base	P:CCostalcro	P:CCopeakcro	P:CCoeariero	P:CColatecro	P:CComodecro
6:00-7:00	1	1	1	1	1	1
% Change	(+0.0%)	(+0.4%)	(+0.4%)	(+0.0%)	(+0.0%)	(+0.0%)
7:00-8:00	14	14	14	14	14	14
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
8:00-9:00	18	18	18	18	18	18
% Change	(+0.0%)	(0.0%)	(-0.1%)	(0.0%)	(+0.0%)	(+0.0%)
9:00-10:00	2	2	2	2	2	2
% Change	(+0.0%)	(-0.2%)	(+0.6%)	(-0.6%)	(-0.3%)	(+0.0%)
10:00-15:00	483	483	483	482	483	483
% Change	(+0.0%)	(+0.1%)	(+0.1%)	(-0.1%)	(+0.0%)	(+0.0%)
15:00-16:00	382	383	383	382	382	382
% Change	(+0.0%)	(+0.4%)	(+0.4%)	(-0.1%)	(+0.1%)	(+0.0%)
16:00-17:00	970	970	970	969	971	971
% Change	(+0.0%)	(+0.1%)	(0.0%)	(-0.1%)	(+0.1%)	(+0.1%)
17:00-18:00	1201	1198	1197	1201	1202	1203
% Change	(+0.0%)	(-0.3%)	(-0.4%)	(-0.1%)	(+0.0%)	(+0.1%)
18:00-19:00	746	744	742	746	745	747
% Change	(+0.0%)	(-0.3%)	(-0.5%)	(+0.1%)	(-0.1%)	(+0.1%)
19:00-0:00	499	500	499	499	498	499
% Change	(+0.0%)	(+0.2%)	(+0.1%)	(+0.1%)	(-0.1%)	(+0.1%)
0:00-6:00	72	72	73	72	71	72
% Change	(+0.0%)	(+0.1%)	(+1.5%)	(+0.4%)	(-1.9%)	(+0.1%)
Alt. mode	237	239	242	238	238	233
% Change	(+0.0%)	(+1.0%)	(+2.2%)	(+0.3%)	(+0.3%)	(-1.8%)
All Choices	4625	4625	4625	4625	4625	4625
% Change	(+0.0%)	(0.0%)	(0.0%)	(+0.0%)	(0.0%)	(+0.0%)

ALOGIT Version

Commuting: cost + 10% in PM peak, effect on AM peak, train users

User Var 1 - Scenario x Choice x umode

umode: 2 | User Var 1 | Normal Table

	P:Base	P:CCostalcro	P:CCopeakcro	P:CCoeariero	P:CColatecro	P:CComodecro
6:00-7:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
7:00-8:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
8:00-9:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
9:00-10:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
10:00-15:00	71	71	71	71	71	72
% Change	(+0.0%)	(+0.0%)	(-0.6%)	(-0.2%)	(+0.0%)	(+0.8%)
15:00-16:00	126	126	127	126	126	126
% Change	(+0.0%)	(-0.1%)	(+0.6%)	(-0.1%)	(+0.0%)	(+0.6%)
16:00-17:00	372	373	371	372	372	374
% Change	(+0.0%)	(+0.1%)	(-0.3%)	(0.0%)	(+0.0%)	(+0.4%)
17:00-18:00	497	497	495	497	497	498
% Change	(+0.0%)	(+0.1%)	(-0.3%)	(+0.0%)	(0.0%)	(+0.3%)
18:00-19:00	174	174	174	174	174	174
% Change	(+0.0%)	(+0.4%)	(-0.1%)	(+0.1%)	(0.0%)	(+0.4%)
19:00-0:00	114	114	114	114	114	114
% Change	(+0.0%)	(+0.2%)	(-0.1%)	(0.0%)	(0.0%)	(+0.3%)
0:00-6:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.7%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.7%)
Alt. mode	167	165	171	167	167	161
% Change	(+0.0%)	(-1.0%)	(+2.3%)	(+0.1%)	(+0.0%)	(-3.4%)
All Choices	1522	1522	1522	1522	1522	1522
% Change	(+0.0%)	(+0.0%)	(0.0%)	(0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

Commuting: cost + 10% in AM peak, effect on PAM peak, car users

User Var 1 - Scenario x Choice x umode

umode: 1 | User Var 1 | Normal Table

	P:Base	P:CCostrcro	P:CCopearcro	P:CCoearrcro	P:CColatrcro	P:CComodrcro
6:00-7:00	784	782	784	780	786	785
% Change	(+0.0%)	(-0.3%)	(0.0%)	(-0.5%)	(+0.2%)	(+0.1%)
7:00-8:00	1229	1226	1223	1231	1230	1230
% Change	(+0.0%)	(-0.3%)	(-0.5%)	(+0.1%)	(+0.0%)	(+0.1%)
8:00-9:00	1067	1065	1062	1070	1066	1068
% Change	(+0.0%)	(-0.2%)	(-0.4%)	(+0.3%)	(-0.1%)	(+0.1%)
9:00-10:00	503	504	504	505	502	504
% Change	(+0.0%)	(+0.2%)	(+0.1%)	(+0.3%)	(-0.3%)	(+0.1%)
10:00-15:00	383	384	385	384	382	383
% Change	(+0.0%)	(+0.3%)	(+0.5%)	(+0.2%)	(-0.3%)	(+0.0%)
15:00-16:00	9	9	9	9	9	9
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
16:00-17:00	8	8	8	8	8	8
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
17:00-18:00	20	20	20	20	20	20
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
18:00-19:00	4	4	4	4	4	4
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
19:00-0:00	31	31	31	31	31	31
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	357	358	361	353	358	357
% Change	(+0.0%)	(+0.3%)	(+1.2%)	(-1.2%)	(+0.2%)	(+0.0%)
Alt. mode	237	242	241	238	238	234
% Change	(+0.0%)	(+1.8%)	(+1.5%)	(+0.4%)	(+0.2%)	(-1.2%)
All Choices	4632	4632	4632	4632	4632	4632
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

Commuting: cost + 10% in AM peak, effect on PM peak, train users

User Var 1 - Scenario x Choice x umode

umode: 2 | User Var 1 | Normal Table

	P:Base	P:CCostrcro	P:CCopearcro	P:CCoearrcro	P:CColatrcro	P:CComodrcro
6:00-7:00	149	149	148	148	149	150
% Change	(+0.0%)	(-0.1%)	(-0.2%)	(-0.5%)	(+0.0%)	(+0.6%)
7:00-8:00	487	487	485	487	487	489
% Change	(+0.0%)	(+0.0%)	(-0.4%)	(+0.0%)	(+0.0%)	(+0.3%)
8:00-9:00	417	417	415	417	417	418
% Change	(+0.0%)	(+0.0%)	(-0.5%)	(+0.1%)	(+0.1%)	(+0.3%)
9:00-10:00	108	108	108	108	108	108
% Change	(+0.0%)	(+0.2%)	(-0.2%)	(+0.2%)	(+0.0%)	(+0.1%)
10:00-15:00	143	143	144	143	142	143
% Change	(+0.0%)	(+0.4%)	(+0.6%)	(+0.2%)	(-0.5%)	(+0.1%)
15:00-16:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
16:00-17:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
17:00-18:00	14	14	14	14	14	14
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
18:00-19:00	2	2	2	2	2	2
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
19:00-0:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	38	38	39	37	38	38
% Change	(+0.0%)	(+0.2%)	(+1.8%)	(-1.9%)	(+0.1%)	(+0.4%)
Alt. mode	167	166	170	167	167	163
% Change	(+0.0%)	(-0.5%)	(+1.7%)	(+0.2%)	(+0.1%)	(-2.4%)
All Choices	1524	1524	1524	1524	1524	1524
% Change	(+0.0%)	(+0.0%)	(0.0%)	(0.0%)	(+0.0%)	(0.0%)

ALOGIT Version

2. Business

2.1 Direct elasticities

Business: Time +10% AM peak – Effects on AM peak - Car users

User Var 1 - Scenario x Choice x umode

umode: 1 | User Var 1 | Normal Table

	P:Base	P:ChTimeall	P:CTpeak	P:CTearly	P:ChTiste	P:ChTeltm
6:00-7:00	137	146	142	137	140	137
% Change	(+0.0%)	(+6.6%)	(+4.0%)	(+0.0%)	(+2.1%)	(+0.3%)
7:00-8:00	277	264	268	271	279	279
% Change	(+0.0%)	(-4.9%)	(-3.5%)	(-2.3%)	(+0.5%)	(+0.6%)
8:00-9:00	452	433	434	452	447	455
% Change	(+0.0%)	(-4.2%)	(-3.9%)	(0.0%)	(-1.1%)	(+0.8%)
9:00-10:00	297	308	301	301	297	298
% Change	(+0.0%)	(+3.8%)	(+1.7%)	(+1.7%)	(+0.0%)	(+0.3%)
10:00-15:00	449	453	452	449	449	449
% Change	(+0.0%)	(+1.1%)	(+0.8%)	(+0.2%)	(+0.0%)	(+0.1%)
15:00-16:00	26	26	26	26	26	26
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
16:00-17:00	17	17	17	17	17	17
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
17:00-18:00	41	41	41	41	41	41
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
18:00-19:00	4	4	4	4	4	4
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
19:00-0:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	413	423	422	413	413	413
% Change	(+0.0%)	(+2.6%)	(+2.3%)	(+0.0%)	(+0.1%)	(+0.2%)
Alt. mode	92	89	96	93	93	84
% Change	(+0.0%)	(-3.4%)	(+4.3%)	(+0.6%)	(+0.6%)	(-8.4%)
All Choices	2204	2204	2204	2204	2204	2204
% Change	(+0.0%)	(0.0%)	(+0.0%)	(0.0%)	(+0.0%)	(0.0%)

ALOGIT Version

Business: Time +10% AM peak – Effects on AM peak - Train users

User Var 1 - Scenario x Choice x umode

umode: 2 | User Var 1 | Normal Table

	P:Base	P:ChTimeall	P:CTpeak	P:CTearly	P:ChTiste	P:ChTeltm
6:00-7:00	78	89	88	78	78	79
% Change	(+0.0%)	(+13.2%)	(+12.1%)	(+0.0%)	(+0.0%)	(+0.7%)
7:00-8:00	300	281	288	291	300	305
% Change	(+0.0%)	(-6.5%)	(-4.2%)	(-3.1%)	(0.0%)	(+1.5%)
8:00-9:00	427	397	386	429	427	435
% Change	(+0.0%)	(-7.0%)	(-9.6%)	(+0.5%)	(0.0%)	(+1.9%)
9:00-10:00	211	220	215	215	211	213
% Change	(+0.0%)	(+4.3%)	(+1.6%)	(+1.9%)	(+0.0%)	(+0.7%)
10:00-15:00	297	316	312	298	297	298
% Change	(+0.0%)	(+6.6%)	(+5.3%)	(+0.5%)	(+0.0%)	(+0.4%)
15:00-16:00	32	32	32	32	32	32
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
16:00-17:00	20	20	20	20	20	20
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
17:00-18:00	1	1	1	1	1	1
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
18:00-19:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
19:00-0:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	32	38	37	32	32	32
% Change	(+0.0%)	(+18.0%)	(+15.9%)	(+0.0%)	(+0.2%)	(+1.2%)
Alt. mode	210	214	230	211	210	194
% Change	(+0.0%)	(+2.2%)	(+9.5%)	(+0.7%)	(+0.1%)	(-7.7%)
All Choices	1608	1608	1608	1608	1608	1608
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

Business: Time +10% PM peak – Effects on PM peak - Car users

User Var 1 - Scenario x Choice x umode

umode: 1 | User Var 1 | Normal Table

	P:Baser	P:ChTimeallr	P:CTpeakrcro	P:CTearlyr	P:ChTlater	P:ChTaltmr
6:00-7:00	0	0	110	0	0	0
% Change	(+0.0%)	(+0.0%)	(+54607.9%)	(+0.0%)	(+0.0%)	(+0.0%)
7:00-8:00	3	3	215	3	3	3
% Change	(+0.0%)	(+0.1%)	(+6480.4%)	(+0.0%)	(+0.0%)	(+0.0%)
8:00-9:00	21	21	352	21	21	21
% Change	(+0.0%)	(+0.0%)	(+1595.6%)	(+0.0%)	(+0.0%)	(+0.0%)
9:00-10:00	4	4	224	4	4	4
% Change	(+0.0%)	(+0.4%)	(+5526.7%)	(+0.0%)	(+0.1%)	(+0.0%)
10:00-15:00	384	385	295	384	385	384
% Change	(+0.0%)	(+0.4%)	(-23.2%)	(+0.0%)	(+0.1%)	(+0.0%)
15:00-16:00	121	125	13	121	122	121
% Change	(+0.0%)	(+3.5%)	(-89.3%)	(+0.1%)	(+1.4%)	(+0.2%)
16:00-17:00	142	137	8	138	141	144
% Change	(+0.0%)	(-3.7%)	(-94.7%)	(-2.8%)	(-0.8%)	(+0.9%)
17:00-18:00	266	257	33	265	264	268
% Change	(+0.0%)	(-3.3%)	(-87.6%)	(-0.3%)	(-0.7%)	(+0.8%)
18:00-19:00	213	220	4	216	214	214
% Change	(+0.0%)	(+3.2%)	(-97.9%)	(+1.4%)	(+0.2%)	(+0.4%)
19:00-0:00	125	128	0	126	125	126
% Change	(+0.0%)	(+1.7%)	(-99.9%)	(+0.5%)	(+0.0%)	(+0.2%)
0:00-6:00	26	27	49	26	26	26
% Change	(+0.0%)	(+4.4%)	(+93.0%)	(+1.5%)	(+0.0%)	(+0.3%)
Alt. mode	62	61	65	63	63	57
% Change	(+0.0%)	(-2.6%)	(+4.1%)	(+1.1%)	(+0.9%)	(-8.3%)
All Choices	1368	1368	1368	1368	1368	1368
% Change	(+0.0%)	(0.0%)	(+0.0%)	(0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

Business: Time +10% PM peak – Effects on PM peak - Train users

User Var 1 - Scenario x Choice x umode

umode: 2 | User Var 1 | Normal Table

	P:Baser	P:ChTimeallr	P:CTpeakrcro	P:CTearlyr	P:ChTlater	P:ChTaltmr
6:00-7:00	0	0	83	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
7:00-8:00	0	0	293	0	0	0
% Change	(+0.0%)	(+0.0%)	(+712392.4%)	(+0.0%)	(+0.0%)	(+0.0%)
8:00-9:00	0	0	411	0	0	0
% Change	(+0.0%)	(+1.4%)	(+187672.0%)	(+0.0%)	(+0.0%)	(+0.0%)
9:00-10:00	1	1	207	1	1	1
% Change	(+0.0%)	(+2.1%)	(+32570.3%)	(+0.0%)	(+0.4%)	(+0.3%)
10:00-15:00	272	275	304	272	274	272
% Change	(+0.0%)	(+0.9%)	(+11.6%)	(+0.0%)	(+0.5%)	(+0.0%)
15:00-16:00	170	178	32	171	174	172
% Change	(+0.0%)	(+4.5%)	(-81.5%)	(+0.5%)	(+1.9%)	(+0.7%)
16:00-17:00	290	276	21	288	289	294
% Change	(+0.0%)	(-4.8%)	(-92.9%)	(-0.7%)	(-0.6%)	(+1.2%)
17:00-18:00	330	315	1	329	326	334
% Change	(+0.0%)	(-4.6%)	(-99.8%)	(-0.6%)	(-1.4%)	(+1.1%)
18:00-19:00	148	155	0	149	148	148
% Change	(+0.0%)	(+4.7%)	(-100.0%)	(+0.8%)	(+0.1%)	(+0.4%)
19:00-0:00	182	188	0	183	182	183
% Change	(+0.0%)	(+3.1%)	(-100.0%)	(+0.3%)	(+0.0%)	(+0.2%)
0:00-6:00	4	4	35	4	4	4
% Change	(+0.0%)	(+0.2%)	(+887.2%)	(+0.2%)	(+0.0%)	(+0.0%)
Alt. mode	210	217	223	211	212	201
% Change	(+0.0%)	(+3.2%)	(+6.1%)	(+0.6%)	(+0.8%)	(-4.4%)
All Choices	1608	1608	1608	1608	1608	1608
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

Business: Cost +10% AM peak – Effects on AM peak - Car users

User Var 1 - Scenario x Choice x umode

umode: 1 | User Var 1 | Normal Table

	P:Base	P:CCostall	P:Ccopeak	P:Ccoearly	P:Ccolate	P:Ccoaltm
6:00-7:00	137	140	139	137	135	134
% Change	(+0.0%)	(+2.6%)	(+1.7%)	(+0.0%)	(-1.1%)	(-1.7%)
7:00-8:00	277	271	273	275	279	333
% Change	(+0.0%)	(-2.2%)	(-1.5%)	(-1.0%)	(+0.7%)	(+19.9%)
8:00-9:00	452	443	443	452	458	473
% Change	(+0.0%)	(-2.0%)	(-1.8%)	(+0.0%)	(+1.4%)	(+4.7%)
9:00-10:00	297	301	299	299	296	344
% Change	(+0.0%)	(+1.5%)	(+0.7%)	(+0.7%)	(-0.1%)	(+16.1%)
10:00-15:00	449	450	450	449	444	508
% Change	(+0.0%)	(+0.3%)	(+0.2%)	(+0.1%)	(-0.9%)	(+13.1%)
15:00-16:00	26	26	26	26	26	39
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+48.8%)
16:00-17:00	17	17	17	17	17	21
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+20.3%)
17:00-18:00	41	41	41	41	41	49
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+18.9%)
18:00-19:00	4	4	4	4	4	5
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+6.0%)
19:00-0:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(-96.8%)
0:00-6:00	413	418	418	413	412	231
% Change	(+0.0%)	(+1.3%)	(+1.2%)	(+0.0%)	(-0.3%)	(-44.0%)
Alt. mode	92	92	94	92	91	69
% Change	(+0.0%)	(+0.5%)	(+1.8%)	(+0.3%)	(-1.1%)	(-25.2%)
All Choices	2204	2204	2204	2204	2204	2204
% Change	(+0.0%)	(0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

Business: Cost +10% AM peak – Effects on AM peak - Train users

User Var 1 - Scenario x Choice x umode

umode: 2 | User Var 1 | Normal Table

	P:Base	P:CCostall	P:Ccopeak	P:Ccoearly	P:Ccolate	P:Ccoaltm
6:00-7:00	78	80	80	78	78	78
% Change	(+0.0%)	(+2.0%)	(+1.7%)	(+0.0%)	(+0.0%)	(+0.3%)
7:00-8:00	300	298	298	299	300	302
% Change	(+0.0%)	(-0.6%)	(-0.6%)	(-0.5%)	(0.0%)	(+0.5%)
8:00-9:00	427	425	422	428	427	430
% Change	(+0.0%)	(-0.6%)	(-1.3%)	(+0.1%)	(0.0%)	(+0.6%)
9:00-10:00	211	213	212	212	211	212
% Change	(+0.0%)	(+0.9%)	(+0.3%)	(+0.3%)	(+0.0%)	(+0.2%)
10:00-15:00	297	299	299	297	297	297
% Change	(+0.0%)	(+0.9%)	(+0.7%)	(+0.1%)	(+0.0%)	(+0.1%)
15:00-16:00	32	32	32	32	32	32
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
16:00-17:00	20	20	20	20	20	20
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
17:00-18:00	1	1	1	1	1	1
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
18:00-19:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
19:00-0:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	32	33	33	32	32	32
% Change	(+0.0%)	(+2.3%)	(+1.9%)	(+0.0%)	(+0.0%)	(+0.4%)
Alt. mode	210	207	212	210	210	205
% Change	(+0.0%)	(-1.3%)	(+1.2%)	(+0.1%)	(+0.0%)	(-2.6%)
All Choices	1608	1608	1608	1608	1608	1608
% Change	(+0.0%)	(0.0%)	(0.0%)	(+0.0%)	(+0.0%)	(0.0%)

ALOGIT Version

Business: Cost +10% PM peak – Effects on PM peak - Car users

User Var 1 - Scenario x Choice x umode

umode: 1 | User Var 1 | Normal Table

	P:Baser	P:CCostallr	P:Ccopeakr	P:Ccoearlyr	P:Ccolater	P:Ccoaltmr
6:00-7:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.4%)	(+0.2%)	(+0.0%)	(+0.2%)	(-95.6%)
7:00-8:00	3	3	3	3	3	0
% Change	(+0.0%)	(+0.1%)	(+0.1%)	(+0.0%)	(0.0%)	(-90.0%)
8:00-9:00	21	21	21	21	21	24
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.1%)	(+15.4%)
9:00-10:00	4	4	4	4	4	1
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(-2.0%)	(-64.1%)
10:00-15:00	384	384	384	384	384	389
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+1.3%)
15:00-16:00	121	121	121	121	120	125
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(-0.1%)	(+3.9%)
16:00-17:00	142	142	142	142	142	142
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(0.0%)	(-0.2%)
17:00-18:00	266	266	266	266	267	268
% Change	(+0.0%)	(0.0%)	(0.0%)	(0.0%)	(+0.4%)	(+0.8%)
18:00-19:00	213	213	213	213	217	229
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+1.5%)	(+7.4%)
19:00-0:00	125	125	125	125	122	127
% Change	(+0.0%)	(+0.0%)	(0.0%)	(0.0%)	(-2.5%)	(+1.2%)
0:00-6:00	26	26	26	26	26	16
% Change	(+0.0%)	(-0.1%)	(+0.1%)	(+0.1%)	(+0.2%)	(-36.7%)
Alt. mode	62	62	62	62	61	46
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(-1.9%)	(-26.8%)
All Choices	1368	1368	1368	1368	1368	1368
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

Business: Cost +10% PM peak – Effects on PM peak - Train users

User Var 1 - Scenario x Choice x umode

umode: 2 | User Var 1 | Normal Table

	P:Baser	P:CCostallr	P:Ccopeakr	P:Ccoearlyr	P:Ccolater	P:Ccoaltmr
6:00-7:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
7:00-8:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
8:00-9:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
9:00-10:00	1	1	1	1	1	1
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
10:00-15:00	272	272	272	272	272	272
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
15:00-16:00	170	170	170	170	170	170
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
16:00-17:00	290	290	290	290	290	290
% Change	(+0.0%)	(+0.0%)	(0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
17:00-18:00	330	330	330	330	330	330
% Change	(+0.0%)	(+0.0%)	(0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
18:00-19:00	148	148	148	148	148	148
% Change	(+0.0%)	(0.0%)	(+0.0%)	(+0.0%)	(0.0%)	(+0.0%)
19:00-0:00	182	182	182	182	182	182
% Change	(+0.0%)	(+0.0%)	(0.0%)	(+0.0%)	(0.0%)	(+0.1%)
0:00-6:00	4	4	4	4	4	4
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
Alt. mode	210	210	210	210	210	210
% Change	(+0.0%)	(0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(-0.1%)
All Choices	1608	1608	1608	1608	1608	1608
% Change	(+0.0%)	(+0.0%)	(0.0%)	(+0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

2.2 Cross elasticities

Business: Time +10% AM peak, effects on PM peak – Car users

User Var 1 - Scenario x Choice x umode

umode - 1 | User Var 1 | Normal Table

	P:Base	P:ChTiallcro	P:CTpeakcro	P:CTearlycro	P:ChTlatecro	P:ChTaltmcro
6:00-7:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
7:00-8:00	3	3	3	3	3	3
% Change	(+0.0%)	(+1.1%)	(+0.7%)	(-0.1%)	(+0.5%)	(+0.0%)
8:00-9:00	21	21	21	21	21	21
% Change	(+0.0%)	(+0.1%)	(-0.3%)	(-0.1%)	(+0.4%)	(+0.0%)
9:00-10:00	4	4	4	4	4	4
% Change	(+0.0%)	(-2.1%)	(+3.2%)	(-3.4%)	(-2.0%)	(+0.2%)
10:00-15:00	384	385	384	383	385	385
% Change	(+0.0%)	(+0.3%)	(+0.1%)	(-0.2%)	(+0.2%)	(+0.2%)
15:00-16:00	121	121	120	121	121	121
% Change	(+0.0%)	(+0.3%)	(-0.8%)	(+0.2%)	(+0.4%)	(+0.5%)
16:00-17:00	142	144	144	141	143	143
% Change	(+0.0%)	(+0.8%)	(+0.9%)	(-0.9%)	(+0.1%)	(+0.6%)
17:00-18:00	266	264	262	266	266	269
% Change	(+0.0%)	(-0.8%)	(-1.5%)	(-0.2%)	(0.0%)	(+0.9%)
18:00-19:00	213	213	210	214	213	215
% Change	(+0.0%)	(-0.3%)	(-1.4%)	(+0.5%)	(0.0%)	(+0.6%)
19:00-0:00	125	128	127	126	125	126
% Change	(+0.0%)	(+1.7%)	(+1.3%)	(+0.4%)	(-0.3%)	(+0.3%)
0:00-6:00	26	26	27	26	24	26
% Change	(+0.0%)	(+2.3%)	(+4.4%)	(+1.9%)	(-4.7%)	(+0.4%)
Alt. mode	62	60	66	63	63	56
% Change	(+0.0%)	(-4.1%)	(+6.6%)	(+0.9%)	(+0.9%)	(-10.8%)
All Choices	1368	1368	1368	1368	1368	1368
% Change	(+0.0%)	(0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

Business: Time +10% AM peak, effects on PM peak – Train users

User Var 1 - Scenario x Choice x umode

umode - 2 | User Var 1 | Normal Table

	P:Base	P:ChTiallcro	P:CTpeakcro	P:CTearlycro	P:ChTlatecro	P:ChTaltmcro
6:00-7:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
7:00-8:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
8:00-9:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
9:00-10:00	1	1	1	1	1	1
% Change	(+0.0%)	(+2.2%)	(+5.6%)	(-3.5%)	(+0.0%)	(+0.2%)
10:00-15:00	272	269	267	271	272	276
% Change	(+0.0%)	(-1.1%)	(-2.0%)	(-0.3%)	(+0.0%)	(+1.2%)
15:00-16:00	170	169	169	170	170	172
% Change	(+0.0%)	(-0.7%)	(-1.0%)	(-0.4%)	(0.0%)	(+0.9%)
16:00-17:00	290	287	284	290	291	293
% Change	(+0.0%)	(-1.3%)	(-2.4%)	(-0.1%)	(+0.1%)	(+1.1%)
17:00-18:00	330	329	325	330	330	335
% Change	(+0.0%)	(-0.5%)	(-1.8%)	(+0.0%)	(0.0%)	(+1.3%)
18:00-19:00	148	148	146	148	148	150
% Change	(+0.0%)	(-0.1%)	(-1.3%)	(+0.1%)	(-0.2%)	(+1.1%)
19:00-0:00	182	187	184	182	182	185
% Change	(+0.0%)	(+2.4%)	(+0.8%)	(+0.1%)	(-0.1%)	(+1.4%)
0:00-6:00	4	4	4	4	4	4
% Change	(+0.0%)	(+21.0%)	(+16.1%)	(+2.0%)	(+0.0%)	(+1.3%)
Alt. mode	210	214	230	211	210	194
% Change	(+0.0%)	(+2.2%)	(+9.5%)	(+0.7%)	(+0.1%)	(-7.7%)
All Choices	1608	1608	1608	1608	1608	1608
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

Business: Time +10% PM peak, effects on AM peak – Car users

User Var 1 - Scenario x Choice x umode

umode: 1 | User Var 1 | Normal Table

	P:Baseb	P:ChTaltrcro	P:CTpeakrcro	P:CTeartrcro	P:ChTlatrcro	P:ChTaltrcro
6:00-7:00	109	109	110	107	111	110
% Change	(+0.0%)	(-0.2%)	(+0.3%)	(-1.9%)	(+1.0%)	(+0.4%)
7:00-8:00	217	216	215	215	218	218
% Change	(+0.0%)	(-0.6%)	(-0.7%)	(-0.8%)	(+0.5%)	(+0.4%)
8:00-9:00	359	358	352	362	359	361
% Change	(+0.0%)	(-0.2%)	(-1.9%)	(+0.9%)	(+0.1%)	(+0.6%)
9:00-10:00	223	225	224	226	221	224
% Change	(+0.0%)	(+0.9%)	(+0.3%)	(+1.0%)	(-0.8%)	(+0.4%)
10:00-15:00	294	294	295	294	292	294
% Change	(+0.0%)	(+0.3%)	(+0.5%)	(+0.2%)	(-0.5%)	(+0.2%)
15:00-16:00	13	13	13	13	13	13
% Change	(+0.0%)	(+0.4%)	(+0.6%)	(+0.1%)	(-0.3%)	(+0.1%)
16:00-17:00	7	7	8	7	7	7
% Change	(+0.0%)	(-0.9%)	(+0.6%)	(-1.4%)	(+0.0%)	(+0.0%)
17:00-18:00	33	33	33	33	33	33
% Change	(+0.0%)	(+0.1%)	(-0.2%)	(+0.3%)	(0.0%)	(+0.0%)
18:00-19:00	4	4	4	4	4	4
% Change	(+0.0%)	(+1.0%)	(+0.6%)	(+0.4%)	(+0.0%)	(+0.0%)
19:00-0:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	46	47	49	43	46	46
% Change	(+0.0%)	(+2.8%)	(+7.5%)	(-5.9%)	(+0.8%)	(+0.6%)
Alt. mode	62	61	65	63	63	57
% Change	(+0.0%)	(-2.6%)	(+4.1%)	(+1.1%)	(+0.9%)	(-8.3%)
All Choices	1368	1368	1368	1368	1368	1368
% Change	(+0.0%)	(0.0%)	(+0.0%)	(0.0%)	(0.0%)	(0.0%)

ALOGIT Version

Business: Time +10% PM peak, effects on AM peak – Train users

User Var 1 - Scenario x Choice x umode

umode: 2 | User Var 1 | Normal Table

	P:Baseb	P:ChTaltrcro	P:CTpeakrcro	P:CTeartrcro	P:ChTlatrcro	P:ChTaltrcro
6:00-7:00	78	79	83	74	79	79
% Change	(+0.0%)	(+0.7%)	(+5.9%)	(-5.2%)	(+0.6%)	(+0.4%)
7:00-8:00	300	297	293	300	302	302
% Change	(+0.0%)	(-1.0%)	(-2.3%)	(-0.2%)	(+0.6%)	(+0.7%)
8:00-9:00	427	422	411	430	431	431
% Change	(+0.0%)	(-1.2%)	(-3.9%)	(+0.7%)	(+0.9%)	(+0.8%)
9:00-10:00	211	211	207	213	212	213
% Change	(+0.0%)	(-0.1%)	(-1.9%)	(+0.8%)	(+0.3%)	(+0.7%)
10:00-16:00	297	297	304	298	288	298
% Change	(+0.0%)	(+0.1%)	(+2.5%)	(+0.3%)	(-3.0%)	(+0.5%)
15:00-16:00	32	32	32	32	32	32
% Change	(+0.0%)	(+0.1%)	(-0.6%)	(+0.7%)	(-0.1%)	(+0.0%)
16:00-17:00	20	21	21	21	20	20
% Change	(+0.0%)	(+0.3%)	(+0.6%)	(+0.1%)	(-0.4%)	(+0.0%)
17:00-18:00	1	1	1	1	1	1
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
18:00-19:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
19:00-0:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	32	32	35	30	32	32
% Change	(+0.0%)	(+1.4%)	(+8.5%)	(-7.6%)	(+0.7%)	(+0.7%)
Alt. mode	210	217	223	211	212	201
% Change	(+0.0%)	(+3.2%)	(+6.1%)	(+0.6%)	(+0.8%)	(-4.4%)
All Choices	1608	1608	1608	1608	1608	1608
% Change	(+0.0%)	(0.0%)	(0.0%)	(+0.0%)	(+0.0%)	(0.0%)

ALOGIT Version

Business: Cost +10% AM peak, effects on PM peak – Car users

User Var 1 - Scenario x Choice x umode

umode: 1 | User Var 1 | Normal Table

	P:Base	P:CCoallcro	P:Ccopeakcro	P:Ccoaricro	P:Ccolatecro	P:Ccoaltmcro
6:00-7:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(-95.6%)
7:00-8:00	3	3	3	3	3	0
% Change	(+0.0%)	(+0.8%)	(+0.7%)	(-0.1%)	(+1.4%)	(-90.0%)
8:00-9:00	21	21	21	21	21	24
% Change	(+0.0%)	(0.0%)	(-0.3%)	(-0.1%)	(-0.4%)	(+15.5%)
9:00-10:00	4	4	4	4	4	1
% Change	(+0.0%)	(-1.6%)	(+2.2%)	(-2.5%)	(-0.9%)	(-63.0%)
10:00-15:00	384	384	384	384	384	389
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(-0.1%)	(+0.0%)	(+1.3%)
15:00-16:00	121	121	120	121	120	125
% Change	(+0.0%)	(0.0%)	(-0.2%)	(0.0%)	(-0.3%)	(+3.9%)
16:00-17:00	142	143	143	142	143	142
% Change	(+0.0%)	(+0.2%)	(+0.2%)	(-0.3%)	(+0.1%)	(-0.2%)
17:00-18:00	266	265	265	266	267	267
% Change	(+0.0%)	(-0.4%)	(-0.5%)	(-0.1%)	(+0.3%)	(+0.4%)
18:00-19:00	213	213	212	214	216	228
% Change	(+0.0%)	(-0.3%)	(-0.6%)	(+0.2%)	(+1.4%)	(+6.9%)
19:00-0:00	125	126	126	126	122	127
% Change	(+0.0%)	(+0.6%)	(+0.5%)	(+0.2%)	(-2.4%)	(+1.7%)
0:00-6:00	26	26	26	26	26	16
% Change	(+0.0%)	(+0.5%)	(+1.6%)	(+0.7%)	(+1.3%)	(-35.8%)
Alt. mode	62	63	64	63	61	47
% Change	(+0.0%)	(+0.8%)	(+2.2%)	(+0.4%)	(-1.7%)	(-25.0%)
All Choices	1368	1368	1368	1368	1368	1368
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(0.0%)

ALOGIT Version

Business: Cost +10% AM peak, effects on PM peak – Train users

User Var 1 - Scenario x Choice x umode

umode: 2 | User Var 1 | Normal Table

	P:Base	P:CCoallcro	P:Ccopeakcro	P:Ccoaricro	P:Ccolatecro	P:Ccoaltmcro
6:00-7:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
7:00-8:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
8:00-9:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
9:00-10:00	1	1	1	1	1	1
% Change	(+0.0%)	(+0.4%)	(+1.5%)	(-1.2%)	(+0.0%)	(+0.1%)
10:00-15:00	272	272	272	272	272	273
% Change	(+0.0%)	(+0.1%)	(-0.2%)	(-0.1%)	(+0.0%)	(+0.3%)
15:00-16:00	170	171	170	170	170	171
% Change	(+0.0%)	(+0.1%)	(-0.1%)	(0.0%)	(0.0%)	(+0.3%)
16:00-17:00	290	291	289	290	290	292
% Change	(+0.0%)	(+0.1%)	(-0.3%)	(0.0%)	(+0.0%)	(+0.4%)
17:00-18:00	330	331	330	330	330	332
% Change	(+0.0%)	(+0.2%)	(-0.3%)	(+0.0%)	(0.0%)	(+0.5%)
18:00-19:00	148	148	148	148	148	148
% Change	(+0.0%)	(+0.2%)	(-0.1%)	(+0.0%)	(0.0%)	(+0.4%)
19:00-0:00	182	183	183	182	182	183
% Change	(+0.0%)	(+0.6%)	(+0.2%)	(+0.0%)	(0.0%)	(+0.4%)
0:00-6:00	4	4	4	4	4	4
% Change	(+0.0%)	(+2.0%)	(+1.5%)	(+0.2%)	(+0.0%)	(+0.3%)
Alt. mode	210	207	212	210	210	205
% Change	(+0.0%)	(-1.3%)	(+1.2%)	(+0.1%)	(+0.0%)	(-2.6%)
All Choices	1608	1608	1608	1608	1608	1608
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

Business: Cost +10% PM peak, effects on AM peak – Car users

User Var 1 - Scenario x Choice x umode

umode: 1 | User Var 1 | Normal Table

	P:Baseb	P:CCallrcro	P:Ccopsarcro	P:Ccpsarrcro	P:Ccolarcro	P:Ccoaltrcro
6:00-7:00	109	109	109	109	108	100
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(-1.5%)	(-9.1%)
7:00-8:00	217	217	217	217	220	249
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+1.4%)	(+15.0%)
8:00-9:00	359	359	359	359	364	360
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+1.6%)	(+0.3%)
9:00-10:00	223	223	223	223	223	252
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(-0.2%)	(+12.8%)
10:00-15:00	294	294	294	294	289	276
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(-1.4%)	(-5.8%)
15:00-16:00	13	13	13	13	13	13
% Change	(+0.0%)	(+1.1%)	(+0.0%)	(+0.0%)	(-1.2%)	(-0.4%)
16:00-17:00	7	7	8	7	8	4
% Change	(+0.0%)	(-2.5%)	(+0.7%)	(-2.8%)	(+0.8%)	(-42.8%)
17:00-18:00	33	33	33	33	33	37
% Change	(+0.0%)	(-0.6%)	(-0.6%)	(+0.3%)	(+0.0%)	(+11.0%)
18:00-19:00	4	5	4	4	4	5
% Change	(+0.0%)	(+4.4%)	(+2.3%)	(+2.1%)	(+0.0%)	(+6.7%)
19:00-0:00	0	0	0	0	0	0
% Change	(+0.0%)	(+6.0%)	(+0.0%)	(+6.0%)	(+0.0%)	(-98.8%)
0:00-6:00	46	46	46	46	45	27
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(-2.9%)	(-41.2%)
All mode	62	62	62	62	61	46
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(-1.9%)	(-26.8%)
All Choices	1368	1368	1368	1368	1368	1368
% Change	(+0.0%)	(0.0%)	(0.0%)	(0.0%)	(0.0%)	(0.0%)

ALOGIT Version

Business: Cost +10% PM peak, effects on AM peak – Train users

User Var 1 - Scenario x Choice x umode

umode: 2 | User Var 1 | Normal Table

	P:Baseb	P:CCallrcro	P:Ccopsarcro	P:Ccpsarrcro	P:Ccolarcro	P:Ccoaltrcro
6:00-7:00	78	78	78	78	78	78
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
7:00-8:00	300	300	300	300	300	300
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
8:00-9:00	427	427	427	427	427	427
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
9:00-10:00	211	211	211	211	211	211
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
10:00-15:00	297	297	297	297	297	297
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
15:00-16:00	32	32	32	32	32	32
% Change	(+0.0%)	(+0.5%)	(+0.1%)	(+0.0%)	(+0.3%)	(+0.1%)
16:00-17:00	20	20	20	20	20	21
% Change	(+0.0%)	(-0.5%)	(-0.7%)	(+0.0%)	(-0.5%)	(+0.7%)
17:00-18:00	1	1	1	1	0	1
% Change	(+0.0%)	(+0.3%)	(+3.9%)	(+0.0%)	(-4.4%)	(+0.9%)
18:00-19:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
19:00-0:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	32	32	32	32	32	32
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
All mode	210	210	210	210	210	210
% Change	(+0.0%)	(0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(-0.1%)
All Choices	1608	1608	1608	1608	1608	1608
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

3. Education

3.1 Direct elasticities

Education: Time +10% AM peak – Effects on AM peak - Car users

User Var 1 - Scenario x Choice x umode

umode: 1 | User Var 1 | Normal Table

	P:Base	P:CTimeall	P:CTpeak	P:CTearly	P:CTlate	P:Chtime
6:00-7:00	2	2	2	2	2	2
% Change	(+0.0%)	(+11.6%)	(+2.9%)	(+0.0%)	(+0.2%)	(+7.5%)
7:00-8:00	6	6	6	6	6	7
% Change	(+0.0%)	(+10.5%)	(-5.2%)	(-1.2%)	(+0.3%)	(+16.0%)
8:00-9:00	10	11	10	10	10	11
% Change	(+0.0%)	(+8.5%)	(-4.0%)	(+0.3%)	(-0.4%)	(+12.6%)
9:00-10:00	3	3	3	3	3	3
% Change	(+0.0%)	(+8.4%)	(+1.9%)	(+0.2%)	(+0.0%)	(+5.6%)
10:00-16:00	5	5	5	5	5	5
% Change	(+0.0%)	(+2.3%)	(+0.6%)	(+0.0%)	(+0.0%)	(+1.5%)
16:00-16:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
16:00-17:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
17:00-18:00	1	1	1	1	1	1
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
18:00-19:00	3	3	3	3	3	3
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
19:00-0:00	1	1	1	1	1	1
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	1	1	1	1	1	1
% Change	(+0.0%)	(+7.1%)	(+2.1%)	(+0.0%)	(+0.0%)	(+4.3%)
Alt. mode	27	25	27	27	27	24
% Change	(+0.0%)	(-7.7%)	(+2.1%)	(+0.1%)	(+0.1%)	(-9.7%)
All Choices	57	57	57	57	57	57
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

Education: Time +10% AM peak – Effects on AM peak - Train users

User Var 1 - Scenario x Choice x umode

umode: 2 | User Var 1 | Normal Table

	P:Base	P:CTimeall	P:CTpeak	P:CTearly	P:CTlate	P:Chtime
6:00-7:00	44	67	66	44	44	44
% Change	(+0.0%)	(+52.6%)	(+51.7%)	(+0.0%)	(+0.2%)	(+0.3%)
7:00-8:00	336	290	303	328	336	337
% Change	(+0.0%)	(-13.7%)	(-9.9%)	(-2.6%)	(0.0%)	(+0.3%)
8:00-9:00	258	221	215	260	258	259
% Change	(+0.0%)	(-14.3%)	(-16.6%)	(+0.8%)	(0.0%)	(+0.6%)
9:00-10:00	145	157	151	149	145	145
% Change	(+0.0%)	(+8.4%)	(+4.6%)	(+3.1%)	(+0.0%)	(+0.1%)
10:00-16:00	267	300	296	269	267	267
% Change	(+0.0%)	(+12.5%)	(+11.0%)	(+0.7%)	(+0.0%)	(+0.1%)
15:00-16:00	15	15	15	15	15	15
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
16:00-17:00	27	27	27	27	27	27
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
17:00-18:00	2	2	2	2	2	2
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
18:00-19:00	1	1	1	1	1	1
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
19:00-0:00	16	16	16	16	16	16
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	14	23	22	14	14	14
% Change	(+0.0%)	(+65.6%)	(+63.8%)	(+0.0%)	(+0.4%)	(+0.3%)
Alt. mode	69	74	77	69	69	66
% Change	(+0.0%)	(+8.4%)	(+12.3%)	(+0.8%)	(+0.1%)	(-4.5%)
All Choices	1193	1193	1193	1193	1193	1193
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

Education: Time +10% PM peak – Effects on PM peak - Car users

User Var 1 - Scenario x Choice x umode

umode: 1 | User Var 1 | Normal Table

	P:Baser	P:CTimealtr	P:CTpeakr	P:CTearlyr	P:CTlater	P:CHaltr
6:00-7:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.9%)
7:00-8:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.7%)
8:00-9:00	4	4	4	4	4	4
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(-1.5%)
9:00-10:00	1	1	1	1	1	1
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(-2.4%)
10:00-15:00	16	16	16	16	16	16
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(-1.1%)
15:00-16:00	1	1	1	1	1	1
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+49.6%)
16:00-17:00	0	0	0	0	0	0
% Change	(+0.0%)	(+2.7%)	(+6.9%)	(-14.1%)	(+0.0%)	(+4.8%)
17:00-18:00	3	3	2	3	2	3
% Change	(+0.0%)	(+8.0%)	(-7.8%)	(+0.1%)	(-0.3%)	(+1.0%)
18:00-19:00	0	0	0	0	0	0
% Change	(+0.0%)	(+37.6%)	(+16.6%)	(+2.4%)	(+0.0%)	(-77.0%)
19:00-0:00	4	4	4	4	4	4
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(-1.4%)
0:00-6:00	1	1	1	1	1	1
% Change	(+0.0%)	(+3.7%)	(+0.9%)	(+0.1%)	(+0.0%)	(+24.4%)
Alt. mode	27	26	27	27	27	26
% Change	(+0.0%)	(-1.0%)	(+0.6%)	(+0.1%)	(+0.0%)	(-0.8%)
All Choices	57	57	57	57	57	57
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

Education: Time +10% PM peak – Effects on PM peak - Train users

User Var 1 - Scenario x Choice x umode

umode: 2 | User Var 1 | Normal Table

	P:Baser	P:CTimealtr	P:CTpeakr	P:CTearlyr	P:CTlater	P:CHaltr
6:00-7:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
7:00-8:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
8:00-9:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
9:00-10:00	6	6	6	6	6	6
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
10:00-15:00	281	283	282	281	282	281
% Change	(+0.0%)	(+0.7%)	(+0.3%)	(+0.0%)	(+0.3%)	(+0.0%)
15:00-16:00	237	246	240	239	241	238
% Change	(+0.0%)	(+3.8%)	(+1.1%)	(+0.7%)	(+1.7%)	(+0.2%)
16:00-17:00	187	173	170	186	189	188
% Change	(+0.0%)	(-7.8%)	(-9.1%)	(-1.0%)	(+0.6%)	(+0.5%)
17:00-18:00	205	192	204	204	199	206
% Change	(+0.0%)	(-6.3%)	(-0.7%)	(-0.8%)	(-3.3%)	(+0.4%)
18:00-19:00	83	89	88	84	83	83
% Change	(+0.0%)	(+7.7%)	(+6.1%)	(+1.0%)	(+0.2%)	(+0.1%)
19:00-0:00	121	126	125	121	121	121
% Change	(+0.0%)	(+4.4%)	(+3.6%)	(+0.2%)	(+0.0%)	(+0.0%)
0:00-6:00	1	1	1	1	1	1
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
Alt. mode	68	72	73	68	68	66
% Change	(+0.0%)	(+6.7%)	(+8.4%)	(+0.6%)	(+0.7%)	(-3.3%)
All Choices	1189	1189	1189	1189	1189	1189
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

Education: Cost +10% AM peak – Effects on AM peak - Car users

User Var 1 - Scenario x Choice x umode

umode - 1 | User Var 1 | Normal Table

	P:Base	P:Ccostall	P:Ccopeak	P:Ccoearly	P:Ccolate	P:Ccoaltm
6:00-7:00	2	2	2	2	2	2
% Change	(+0.0%)	(+9.6%)	(+7.2%)	(+0.0%)	(+0.4%)	(+1.1%)
7:00-8:00	6	5	5	6	6	6
% Change	(+0.0%)	(-12.0%)	(-12.8%)	(-2.3%)	(+0.8%)	(+2.6%)
8:00-9:00	10	9	9	10	10	10
% Change	(+0.0%)	(-6.8%)	(-8.1%)	(+0.6%)	(-0.9%)	(+1.8%)
9:00-10:00	3	3	3	3	3	3
% Change	(+0.0%)	(+5.6%)	(+4.0%)	(+0.4%)	(+0.0%)	(+0.8%)
10:00-15:00	5	5	5	5	5	5
% Change	(+0.0%)	(+1.9%)	(+1.6%)	(+0.0%)	(+0.0%)	(+0.2%)
15:00-16:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
16:00-17:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
17:00-18:00	1	1	1	1	1	1
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
18:00-19:00	3	3	3	3	3	3
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
19:00-0:00	1	1	1	1	1	1
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	1	1	1	1	1	1
% Change	(+0.0%)	(+6.5%)	(+5.6%)	(+0.0%)	(+0.0%)	(+0.7%)
Alt. mode	27	28	28	27	27	26
% Change	(+0.0%)	(+3.6%)	(+4.6%)	(+0.3%)	(+0.2%)	(-1.5%)
All Choices	57	57	57	57	57	57
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

Education: Cost +10% AM peak – Effects on AM peak - Train users

User Var 1 - Scenario x Choice x umode

umode - 2 | User Var 1 | Normal Table

	P:Base	P:Ccostall	P:Ccopeak	P:Ccoearly	P:Ccolate	P:Ccoaltm
6:00-7:00	44	44	44	44	44	44
% Change	(+0.0%)	(+0.4%)	(+1.4%)	(+0.0%)	(+0.0%)	(+0.7%)
7:00-8:00	336	338	336	336	336	339
% Change	(+0.0%)	(+0.4%)	(-0.3%)	(-0.3%)	(0.0%)	(+0.6%)
8:00-9:00	258	259	253	258	258	261
% Change	(+0.0%)	(+0.4%)	(-1.8%)	(+0.1%)	(0.0%)	(+1.4%)
9:00-10:00	145	145	145	145	145	145
% Change	(+0.0%)	(+0.1%)	(+0.2%)	(+0.1%)	(+0.0%)	(+0.2%)
10:00-15:00	267	268	269	267	267	268
% Change	(+0.0%)	(+0.3%)	(+0.6%)	(+0.0%)	(+0.0%)	(+0.3%)
15:00-16:00	15	15	15	15	15	15
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
16:00-17:00	27	27	27	27	27	27
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
17:00-18:00	2	2	2	2	2	2
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
18:00-19:00	1	1	1	1	1	1
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
19:00-0:00	16	16	16	16	16	16
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	14	14	14	14	14	14
% Change	(+0.0%)	(+0.4%)	(+1.8%)	(+0.0%)	(+0.1%)	(+0.7%)
Alt. mode	69	65	71	69	69	61
% Change	(+0.0%)	(-4.9%)	(+3.7%)	(+0.4%)	(+0.1%)	(-10.8%)
All Choices	1193	1193	1193	1193	1193	1193
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

Education: Cost +10% PM peak – Effects on PM peak - Car users

User Var 1 - Scenario x Choice x umode

umode: 1 | User Var 1 | Normal Table

	P:Baser	P:CCostallr	P:CCopeakr	P:CCosarlyr	P:Ccolater	P:Ccoaltmr
6:00-7:00	0	0	0	0	0	0
% Change	(+0.0%)	(+2.1%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
7:00-8:00	0	0	0	0	0	0
% Change	(+0.0%)	(+1.7%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
8:00-9:00	4	4	4	4	4	4
% Change	(+0.0%)	(+1.6%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
9:00-10:00	1	2	1	1	1	1
% Change	(+0.0%)	(+1.7%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
10:00-15:00	16	16	16	16	16	16
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
15:00-16:00	1	1	1	1	1	1
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
16:00-17:00	0	0	0	0	0	0
% Change	(+0.0%)	(-20.3%)	(+24.0%)	(-34.7%)	(+0.0%)	(+1.7%)
17:00-18:00	3	2	2	3	2	3
% Change	(+0.0%)	(-20.9%)	(-19.4%)	(+0.3%)	(-0.9%)	(+2.7%)
18:00-19:00	0	0	0	0	0	0
% Change	(+0.0%)	(+53.8%)	(+37.9%)	(+5.8%)	(+0.0%)	(+2.0%)
19:00-0:00	4	4	4	4	4	4
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	1	1	1	1	1	1
% Change	(+0.0%)	(+2.6%)	(+2.1%)	(+0.2%)	(+0.0%)	(+0.4%)
All_mode	27	27	27	27	27	27
% Change	(+0.0%)	(+1.5%)	(+1.5%)	(+0.1%)	(+0.1%)	(-0.3%)
All Choices	57	57	57	57	57	57
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

Education: Cost +10% PM peak – Effects on PM peak - Train users

User Var 1 - Scenario x Choice x umode

umode: 2 | User Var 1 | Normal Table

	P:Baser	P:CCostallr	P:CCopeakr	P:CCosarlyr	P:Ccolater	P:Ccoaltmr
6:00-7:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
7:00-8:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
8:00-9:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
9:00-10:00	6	6	6	6	6	6
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
10:00-15:00	281	281	281	281	281	281
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
15:00-16:00	237	237	237	237	237	238
% Change	(+0.0%)	(+0.0%)	(+0.1%)	(+0.1%)	(+0.0%)	(+0.3%)
16:00-17:00	187	189	186	187	188	189
% Change	(+0.0%)	(+0.6%)	(-0.7%)	(0.0%)	(+0.1%)	(+0.9%)
17:00-18:00	205	206	205	205	205	207
% Change	(+0.0%)	(+0.5%)	(-0.1%)	(-0.1%)	(-0.2%)	(+0.6%)
18:00-19:00	83	83	83	83	83	83
% Change	(+0.0%)	(+0.1%)	(+0.2%)	(+0.0%)	(+0.0%)	(+0.1%)
19:00-0:00	121	121	122	121	121	121
% Change	(+0.0%)	(+0.1%)	(+0.9%)	(+0.0%)	(+0.0%)	(+0.1%)
0:00-6:00	1	1	1	1	1	1
% Change	(+0.0%)	(+0.0%)	(+13.1%)	(+0.0%)	(+0.0%)	(+0.0%)
All_mode	68	65	70	68	68	64
% Change	(+0.0%)	(-3.5%)	(+2.7%)	(+0.1%)	(+0.1%)	(-5.7%)
All Choices	1189	1189	1191	1189	1189	1189
% Change	(+0.0%)	(+0.0%)	(+0.2%)	(+0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

3.2 *Cross elasticities*

Education: Time +10% AM peak, effects on PM peak – Car users

User Var 1 - Scenario x Choice x umode

umode: 1 | User Var 1 | Normal Table

	P:Base	P:CTimalicro	P:CTpeakcro	P:CTearlycro	P:CTlatecro	P:Chtimecro
6:00-7:00	0	0	0	0	0	0
% Change	(+0.0%)	(+1.2%)	(+1.2%)	(+0.0%)	(+0.0%)	(+13.7%)
7:00-8:00	0	0	0	0	0	0
% Change	(+0.0%)	(+5.0%)	(+1.5%)	(-3.0%)	(+0.1%)	(+12.6%)
8:00-9:00	4	4	4	4	4	4
% Change	(+0.0%)	(+2.7%)	(-3.3%)	(-0.2%)	(+0.0%)	(+11.6%)
9:00-10:00	1	1	1	2	1	2
% Change	(+0.0%)	(-1.8%)	(-2.6%)	(+0.2%)	(-0.5%)	(+12.8%)
10:00-15:00	16	16	16	16	16	17
% Change	(+0.0%)	(-0.8%)	(-1.6%)	(-0.1%)	(+0.0%)	(+8.1%)
15:00-16:00	1	1	1	1	1	1
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
16:00-17:00	0	0	0	0	0	0
% Change	(+0.0%)	(+30.7%)	(+13.8%)	(+0.0%)	(+1.7%)	(+10.0%)
17:00-18:00	3	3	2	2	3	3
% Change	(+0.0%)	(+3.1%)	(-7.8%)	(-0.2%)	(+0.3%)	(+22.0%)
18:00-19:00	0	0	0	0	0	0
% Change	(+0.0%)	(+8.0%)	(+16.6%)	(+0.0%)	(-19.6%)	(+12.1%)
19:00-0:00	4	4	4	4	4	4
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	1	1	1	1	1	1
% Change	(+0.0%)	(+2.6%)	(+1.6%)	(+0.2%)	(-0.8%)	(+4.3%)
Alt. mode	27	27	27	27	27	24
% Change	(+0.0%)	(-0.4%)	(+2.1%)	(+0.1%)	(+0.1%)	(-9.7%)
All Choices	57	57	57	57	57	57
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

Education: Time +10% AM peak, effects on PM peak – Train users

User Var 1 - Scenario x Choice x umode

umode: 2 | User Var 1 | Normal Table

	P:Base	P:CTimalicro	P:CTpeakcro	P:CTearlycro	P:CTlatecro	P:Chtimecro
6:00-7:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
7:00-8:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
8:00-9:00	0	0	0	0	0	0
% Change	(+0.0%)	(+26.5%)	(+26.5%)	(+0.0%)	(+0.0%)	(+0.0%)
9:00-10:00	6	5	5	6	6	6
% Change	(+0.0%)	(-8.7%)	(-9.7%)	(-0.8%)	(+1.5%)	(+0.0%)
10:00-15:00	281	273	275	280	281	281
% Change	(+0.0%)	(-2.7%)	(-2.2%)	(-0.3%)	(0.0%)	(+0.1%)
15:00-16:00	237	234	234	237	238	238
% Change	(+0.0%)	(-1.3%)	(-1.5%)	(0.0%)	(+0.2%)	(+0.1%)
16:00-17:00	187	181	181	188	187	188
% Change	(+0.0%)	(-3.3%)	(-3.4%)	(+0.1%)	(-0.1%)	(+0.5%)
17:00-18:00	205	206	207	205	205	206
% Change	(+0.0%)	(+0.4%)	(+0.6%)	(0.0%)	(-0.1%)	(+0.3%)
18:00-19:00	83	87	87	83	83	83
% Change	(+0.0%)	(+5.0%)	(+4.3%)	(+0.6%)	(-0.1%)	(+0.0%)
19:00-0:00	121	123	123	121	121	122
% Change	(+0.0%)	(+1.9%)	(+1.9%)	(-0.1%)	(0.0%)	(+0.7%)
0:00-6:00	1	2	2	1	1	1
% Change	(+0.0%)	(+78.1%)	(+75.7%)	(+0.7%)	(+0.0%)	(+0.0%)
Alt. mode	68	77	76	68	68	65
% Change	(+0.0%)	(+13.7%)	(+12.5%)	(+0.8%)	(+0.1%)	(-4.6%)
All Choices	1189	1189	1189	1189	1189	1189
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

Education: Time +10% PM peak, effects on AM peak – Car users

User Var 1 - Scenario x Choice x umode

umode: 1 | User Var 1 | Normal Table

	P:Base	P:CTimallcro	P:CTpeakrcro	P:CTearlrcro	P:CTlaterrcro	P:CHaltrcor
6:00-7:00	2	2	2	2	2	1
% Change	(+0.0%)	(+0.4%)	(+1.5%)	(-1.7%)	(+0.0%)	(-7.0%)
7:00-8:00	6	6	6	6	6	6
% Change	(+0.0%)	(+1.5%)	(-3.8%)	(+0.3%)	(+0.2%)	(+4.1%)
8:00-9:00	10	10	10	10	10	10
% Change	(+0.0%)	(+0.4%)	(+0.2%)	(+0.0%)	(-0.1%)	(+0.8%)
9:00-10:00	3	3	3	3	3	2
% Change	(+0.0%)	(+0.2%)	(+0.2%)	(+0.0%)	(+0.0%)	(-17.4%)
10:00-15:00	5	5	5	5	5	5
% Change	(+0.0%)	(0.0%)	(0.0%)	(+0.0%)	(-0.2%)	(+8.0%)
15:00-16:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
16:00-17:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
17:00-18:00	1	1	1	1	1	1
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(-21.2%)
18:00-19:00	3	3	3	3	3	3
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+1.1%)
19:00-0:00	1	1	1	1	1	1
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+43.0%)
0:00-6:00	1	1	1	1	1	1
% Change	(+0.0%)	(+0.8%)	(+0.9%)	(-1.2%)	(+0.1%)	(-0.6%)
Alt. mode	27	26	27	27	27	26
% Change	(+0.0%)	(-0.6%)	(+0.6%)	(+0.1%)	(+0.0%)	(-0.8%)
All Choices	57	57	57	57	57	57
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

Education: Time +10% PM peak, effects on AM peak – Train users

User Var 1 - Scenario x Choice x umode

umode: 2 | User Var 1 | Normal Table

	P:Base	P:CTimallcro	P:CTpeakrcro	P:CTearlrcro	P:CTlaterrcro	P:CHaltrcor
6:00-7:00	44	44	53	37	44	44
% Change	(+0.0%)	(+1.5%)	(+21.9%)	(-15.6%)	(+1.2%)	(+0.1%)
7:00-8:00	336	334	325	339	340	337
% Change	(+0.0%)	(-0.9%)	(-3.4%)	(+0.7%)	(+1.0%)	(+0.2%)
8:00-9:00	258	253	241	262	262	259
% Change	(+0.0%)	(-1.9%)	(-6.4%)	(+1.5%)	(+1.5%)	(+0.4%)
9:00-10:00	145	143	142	145	145	145
% Change	(+0.0%)	(-0.8%)	(-1.7%)	(+0.5%)	(+0.1%)	(+0.1%)
10:00-15:00	267	270	279	269	258	267
% Change	(+0.0%)	(+1.1%)	(+4.4%)	(+0.8%)	(-3.2%)	(+0.1%)
15:00-16:00	15	15	15	16	15	16
% Change	(+0.0%)	(-2.7%)	(-2.6%)	(+0.3%)	(-0.4%)	(+0.4%)
16:00-17:00	27	27	27	27	27	27
% Change	(+0.0%)	(+0.3%)	(+0.3%)	(+0.0%)	(+0.0%)	(+0.0%)
17:00-18:00	2	2	2	2	2	2
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
18:00-19:00	1	1	1	1	1	1
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
19:00-0:00	16	16	16	16	16	16
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	14	14	17	11	14	14
% Change	(+0.0%)	(+2.6%)	(+27.4%)	(-18.3%)	(+1.7%)	(+0.2%)
Alt. mode	69	74	74	69	69	66
% Change	(+0.0%)	(+7.8%)	(+8.3%)	(+0.6%)	(+0.7%)	(-3.3%)
All Choices	1193	1193	1193	1193	1193	1193
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

Education: Cost +10% AM peak, effects on PM peak – Car users

User Var 1 - Scenario x Choice x umode

umode = 1 | User Var 1 | Normal Table

	P:Baser	P:Ccoallcro	P:Ccopeakcro	P:Ccoaltcro	P:Ccoaltmcro	P:Ccoaltmcro
6:00-7:00	0	0	0	0	0	0
% Change	(+0.0%)	(+5.0%)	(+2.7%)	(+0.0%)	(+2.1%)	(+2.1%)
7:00-8:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.2%)	(+2.6%)	(-4.2%)	(+1.7%)	(+1.7%)
8:00-9:00	4	4	4	4	4	4
% Change	(+0.0%)	(-4.4%)	(-5.7%)	(-0.3%)	(+1.6%)	(+1.6%)
9:00-10:00	1	1	1	2	2	2
% Change	(+0.0%)	(-3.0%)	(-4.2%)	(+0.2%)	(+1.8%)	(+1.8%)
10:00-15:00	16	16	16	16	16	16
% Change	(+0.0%)	(-2.5%)	(-3.5%)	(-0.2%)	(+1.2%)	(+1.2%)
15:00-16:00	1	1	1	1	1	1
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
16:00-17:00	0	0	0	0	0	0
% Change	(+0.0%)	(+42.1%)	(+31.4%)	(+0.0%)	(+1.7%)	(+1.7%)
17:00-18:00	3	2	2	2	3	3
% Change	(+0.0%)	(-15.8%)	(-19.4%)	(-0.5%)	(+4.0%)	(+4.0%)
18:00-19:00	0	0	0	0	0	0
% Change	(+0.0%)	(-17.2%)	(+37.9%)	(+0.0%)	(+2.0%)	(+2.0%)
19:00-0:00	4	4	4	4	4	4
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	1	1	1	1	1	1
% Change	(+0.0%)	(+3.0%)	(+3.4%)	(+0.4%)	(+0.7%)	(+0.7%)
Alt. mode	27	28	28	27	26	26
% Change	(+0.0%)	(+3.6%)	(+4.6%)	(+0.3%)	(-1.5%)	(-1.5%)
All Choices	57	57	57	57	57	57
% Change	(+0.0%)	(0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

Education: Cost +10% AM peak, effects on PM peak – Train users

User Var 1 - Scenario x Choice x umode

umode = 2 | User Var 1 | Normal Table

	P:Baser	P:Ccoallcro	P:Ccopeakcro	P:Ccoaltcro	P:Ccoaltmcro	P:Ccoaltmcro
6:00-7:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
7:00-8:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
8:00-9:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
9:00-10:00	6	6	6	6	6	6
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
10:00-15:00	281	282	281	281	282	282
% Change	(+0.0%)	(+0.3%)	(0.0%)	(+0.0%)	(+0.3%)	(+0.3%)
15:00-16:00	237	238	237	237	238	238
% Change	(+0.0%)	(+0.1%)	(-0.1%)	(0.0%)	(+0.2%)	(+0.2%)
16:00-17:00	187	188	186	188	189	189
% Change	(+0.0%)	(+0.4%)	(-0.5%)	(+0.0%)	(+0.8%)	(+0.8%)
17:00-18:00	205	206	205	205	206	206
% Change	(+0.0%)	(+0.4%)	(-0.1%)	(0.0%)	(+0.5%)	(+0.5%)
18:00-19:00	83	83	83	83	83	83
% Change	(+0.0%)	(+0.1%)	(+0.2%)	(+0.0%)	(+0.1%)	(+0.1%)
19:00-0:00	121	121	119	121	124	124
% Change	(+0.0%)	(+0.4%)	(-1.1%)	(-0.2%)	(+2.7%)	(+2.7%)
0:00-6:00	1	1	1	1	1	1
% Change	(+0.0%)	(+6.6%)	(+12.8%)	(+0.2%)	(+0.0%)	(+0.0%)
Alt. mode	68	64	70	68	60	60
% Change	(+0.0%)	(-5.0%)	(+3.7%)	(+0.4%)	(-10.9%)	(-10.9%)
All Choices	1189	1189	1189	1189	1189	1189
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

Education: Cost +10% PM peak, effects on AM peak – Car users

User Var 1 - Scenario x Choice x umode

umode: 1 | User Var 1 | Normal Table

	P:Base	P:CCoaltrcro	P:CCopeatrcro	P:CCoeatrcro	P:Ccoltrcro	P:Ccoaltrcro
6:00-7:00	2	2	2	2	2	2
% Change	(+0.0%)	(-1.5%)	(+3.5%)	(-4.2%)	(+0.1%)	(+0.2%)
7:00-8:00	6	5	5	6	6	6
% Change	(+0.0%)	(-7.6%)	(-9.6%)	(+0.8%)	(+0.6%)	(+1.1%)
8:00-9:00	10	10	10	10	10	10
% Change	(+0.0%)	(+0.9%)	(+0.5%)	(+0.1%)	(-0.3%)	(+0.0%)
9:00-10:00	3	3	3	3	3	3
% Change	(+0.0%)	(+0.8%)	(+0.5%)	(+0.1%)	(+0.0%)	(+0.1%)
10:00-15:00	5	5	5	5	5	5
% Change	(+0.0%)	(-0.4%)	(+0.3%)	(+0.0%)	(-0.5%)	(+0.0%)
15:00-16:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
16:00-17:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
17:00-18:00	1	1	1	1	1	1
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
18:00-19:00	3	3	3	3	3	3
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
19:00-0:00	1	1	1	1	1	1
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	1	1	1	1	1	1
% Change	(+0.0%)	(-0.9%)	(+2.5%)	(-2.7%)	(+0.2%)	(+0.2%)
Alt. mode	27	27	27	27	27	27
% Change	(+0.0%)	(+1.5%)	(+1.5%)	(+0.1%)	(+0.1%)	(-0.3%)
All Choices	57	57	57	57	57	57
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

Education: Cost +10% PM peak, effects on AM peak – Train users

User Var 1 - Scenario x Choice x umode

umode: 2 | User Var 1 | Normal Table

	P:Base	P:CCoaltrcro	P:CCopeatrcro	P:CCoeatrcro	P:Ccoltrcro	P:Ccoaltrcro
6:00-7:00	44	44	44	43	44	44
% Change	(+0.0%)	(+0.1%)	(+0.6%)	(-0.5%)	(+0.1%)	(+0.2%)
7:00-8:00	336	337	336	336	337	338
% Change	(+0.0%)	(+0.2%)	(-0.1%)	(-0.1%)	(+0.0%)	(+0.3%)
8:00-9:00	258	259	256	258	258	259
% Change	(+0.0%)	(+0.3%)	(-0.6%)	(+0.1%)	(+0.1%)	(+0.6%)
9:00-10:00	145	145	144	145	144	145
% Change	(+0.0%)	(+0.1%)	(0.0%)	(+0.0%)	(-0.1%)	(+0.1%)
10:00-15:00	267	268	268	267	267	268
% Change	(+0.0%)	(+0.3%)	(+0.3%)	(+0.0%)	(-0.1%)	(+0.3%)
15:00-16:00	15	16	15	15	15	16
% Change	(+0.0%)	(+0.5%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.5%)
16:00-17:00	27	27	27	27	27	27
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
17:00-18:00	2	2	2	2	2	2
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
18:00-19:00	1	1	1	1	1	1
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
19:00-0:00	16	16	16	16	16	16
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	14	14	14	14	14	14
% Change	(+0.0%)	(+0.1%)	(+0.7%)	(-0.7%)	(+0.1%)	(+0.4%)
Alt. mode	69	66	70	69	69	65
% Change	(+0.0%)	(-3.5%)	(+1.2%)	(+0.1%)	(+0.1%)	(-5.7%)
All Choices	1193	1193	1193	1193	1193	1193
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

4. 'Other' purposes

4.1 Direct elasticities

Other: Time +10% AM peak – Effects on AM peak - Car users

User Var 1 - Scenario x Choice x umode

umode: 1 | User Var 1 | Normal Table

	P:Base	P:CTimeall	P:Ctpeak	P:CTearly	P:CTlate	P:ChTime
6:00-7:00	48	50	50	48	48	48
% Change	(+0.0%)	(+4.3%)	(+3.8%)	(+0.0%)	(+0.4%)	(+0.2%)
7:00-8:00	97	94	96	95	97	97
% Change	(+0.0%)	(-2.6%)	(-0.9%)	(-2.2%)	(+0.5%)	(+0.3%)
8:00-9:00	165	159	161	164	165	166
% Change	(+0.0%)	(-3.9%)	(-2.5%)	(-1.0%)	(-0.4%)	(+0.3%)
9:00-10:00	321	325	322	323	321	321
% Change	(+0.0%)	(+1.3%)	(+0.5%)	(+0.8%)	(+0.0%)	(+0.1%)
10:00-15:00	1033	1034	1033	1034	1033	1033
% Change	(+0.0%)	(+0.1%)	(+0.0%)	(+0.1%)	(+0.0%)	(+0.0%)
15:00-16:00	181	181	181	181	181	181
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
16:00-17:00	76	76	76	76	76	76
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
17:00-18:00	83	83	83	83	83	83
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
18:00-19:00	69	69	69	69	69	69
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
19:00-0:00	106	106	106	106	106	106
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	16	17	17	16	16	16
% Change	(+0.0%)	(+2.9%)	(+2.8%)	(+0.0%)	(+0.1%)	(+0.1%)
Alt. mode	79	80	80	79	79	78
% Change	(+0.0%)	(+0.8%)	(+0.8%)	(+0.2%)	(+0.0%)	(-1.5%)
All Choices	2274	2274	2274	2274	2274	2274
% Change	(+0.0%)	(0.0%)	(+0.0%)	(0.0%)	(0.0%)	(+0.0%)

ALOGIT Version

Other: Time +10% AM peak – Effects on AM peak - Train users

User Var 1 - Scenario x Choice x umode

umode: 2 | User Var 1 | Normal Table

	P:Base	P:CTimeall	P:Ctpeak	P:CTearly	P:CTlate	P:ChTime
6:00-7:00	31	32	32	31	31	31
% Change	(+0.0%)	(+3.5%)	(+3.5%)	(+0.0%)	(+0.0%)	(+0.5%)
7:00-8:00	30	30	30	28	30	31
% Change	(+0.0%)	(-2.2%)	(-2.2%)	(-7.9%)	(-0.1%)	(+2.0%)
8:00-9:00	61	54	54	57	61	62
% Change	(+0.0%)	(-11.1%)	(-11.1%)	(-7.1%)	(+0.0%)	(+1.4%)
9:00-10:00	168	168	168	172	168	169
% Change	(+0.0%)	(+0.2%)	(+0.2%)	(+2.1%)	(+0.0%)	(+0.6%)
10:00-15:00	414	417	417	416	414	415
% Change	(+0.0%)	(+0.7%)	(+0.7%)	(+0.5%)	(+0.0%)	(+0.2%)
15:00-16:00	39	39	39	39	39	39
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
16:00-17:00	16	16	16	16	16	16
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
17:00-18:00	25	25	25	25	25	25
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
18:00-19:00	8	8	8	8	8	8
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
19:00-0:00	4	4	4	4	4	4
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	22	22	22	22	22	22
% Change	(+0.0%)	(+3.3%)	(+3.3%)	(+0.0%)	(+0.0%)	(+0.4%)
Alt. mode	131	134	134	132	131	128
% Change	(+0.0%)	(+1.8%)	(+1.9%)	(+0.9%)	(+0.0%)	(-2.6%)
All Choices	950	950	950	950	950	950
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

Other: Time +10% PM peak – Effects on PM peak - Car users

User Var 1 - Scenario x Choice x umode

umode: 1 | User Var 1 | Normal Table

	P:Baser	P:CTimealir	P:Ctpeakr	P:CTearlyr	P:CTlater	P:ChTimer
6:00-7:00	1	1	1	1	1	1
% Change	(+0.0%)	(+0.4%)	(+0.3%)	(+0.0%)	(+0.1%)	(+0.0%)
7:00-8:00	7	7	7	7	7	7
% Change	(+0.0%)	(+0.3%)	(+0.1%)	(+0.0%)	(+0.1%)	(+0.0%)
8:00-9:00	44	44	44	44	44	44
% Change	(+0.0%)	(+0.1%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
9:00-10:00	22	22	22	22	22	22
% Change	(+0.0%)	(+0.2%)	(+0.1%)	(+0.0%)	(+0.0%)	(+0.0%)
10:00-15:00	590	591	591	590	590	590
% Change	(+0.0%)	(+0.2%)	(+0.1%)	(+0.0%)	(+0.1%)	(+0.0%)
15:00-16:00	191	195	193	191	192	191
% Change	(+0.0%)	(+2.0%)	(+1.1%)	(+0.0%)	(+0.7%)	(+0.1%)
16:00-17:00	380	375	377	376	380	381
% Change	(+0.0%)	(-1.4%)	(-0.8%)	(-0.9%)	(-0.1%)	(+0.4%)
17:00-18:00	272	267	267	273	269	273
% Change	(+0.0%)	(-1.9%)	(-1.8%)	(+0.4%)	(-1.0%)	(+0.4%)
18:00-19:00	154	157	155	155	154	154
% Change	(+0.0%)	(+2.4%)	(+1.3%)	(+0.8%)	(+0.2%)	(+0.2%)
19:00-0:00	486	487	487	487	486	486
% Change	(+0.0%)	(+0.2%)	(+0.1%)	(+0.1%)	(+0.0%)	(+0.0%)
0:00-6:00	35	36	36	35	35	35
% Change	(+0.0%)	(+3.2%)	(+2.4%)	(+0.6%)	(+0.0%)	(+0.1%)
Alt. mode	79	78	80	79	79	76
% Change	(+0.0%)	(-0.4%)	(+2.3%)	(+0.4%)	(+0.9%)	(-3.9%)
All Choices	2259	2259	2259	2259	2259	2259
% Change	(+0.0%)	(+0.0%)	(0.0%)	(+0.0%)	(+0.0%)	(0.0%)

ALOGIT Version

Other: Time +10% PM peak – Effects on PM peak - Train users

User Var 1 - Scenario x Choice x umode

umode: 2 | User Var 1 | Normal Table

	P:Baser	P:CTimealir	P:Ctpeakr	P:CTearlyr	P:CTlater	P:ChTimer
6:00-7:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
7:00-8:00	1	1	1	1	1	1
% Change	(+0.0%)	(+4.6%)	(+2.1%)	(+0.0%)	(+1.6%)	(+0.0%)
8:00-9:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
9:00-10:00	2	2	2	2	2	2
% Change	(+0.0%)	(+1.1%)	(+0.7%)	(+0.0%)	(+0.2%)	(+0.3%)
10:00-15:00	96	99	96	96	97	97
% Change	(+0.0%)	(+2.6%)	(+0.3%)	(+0.1%)	(+1.2%)	(+0.7%)
15:00-16:00	102	108	103	102	105	103
% Change	(+0.0%)	(+6.7%)	(+1.4%)	(+0.5%)	(+3.8%)	(+1.4%)
16:00-17:00	200	191	192	198	196	202
% Change	(+0.0%)	(-4.3%)	(-3.8%)	(-1.0%)	(-2.0%)	(+1.0%)
17:00-18:00	145	139	141	143	141	147
% Change	(+0.0%)	(-4.1%)	(-2.4%)	(-1.3%)	(-3.0%)	(+1.5%)
18:00-19:00	76	79	79	77	76	76
% Change	(+0.0%)	(+4.7%)	(+4.3%)	(+1.6%)	(+0.3%)	(+0.9%)
19:00-0:00	195	196	196	195	195	195
% Change	(+0.0%)	(+0.8%)	(+0.8%)	(+0.2%)	(+0.0%)	(+0.1%)
0:00-6:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+2.0%)	(+0.0%)	(+0.0%)
Alt. mode	131	131	136	132	134	124
% Change	(+0.0%)	(+0.2%)	(+3.6%)	(+1.1%)	(+2.5%)	(-5.5%)
All Choices	947	947	947	947	947	947
% Change	(+0.0%)	(0.0%)	(0.0%)	(+0.0%)	(0.0%)	(+0.0%)

ALOGIT Version

Other: Cost +10% AM peak – Effects on AM peak - Car users

User Var 1 - Scenario x Choice x umode

umode: 1 | User Var 1 | Normal Table

	P:Base	P:Ccostall	P:Ccopeak	P:Ccoearly	P:Ccolate	P:Ccomode
6:00-7:00	48	49	49	48	48	48
% Change	(+0.0%)	(+1.1%)	(+1.0%)	(+0.0%)	(+0.1%)	(+0.0%)
7:00-8:00	97	96	97	96	97	97
% Change	(+0.0%)	(-0.6%)	(-0.1%)	(-0.6%)	(+0.1%)	(+0.0%)
8:00-9:00	165	164	164	165	165	165
% Change	(+0.0%)	(-1.1%)	(-0.7%)	(-0.3%)	(-0.1%)	(+0.0%)
9:00-10:00	321	322	321	322	321	321
% Change	(+0.0%)	(+0.3%)	(+0.1%)	(+0.2%)	(+0.0%)	(+0.0%)
10:00-15:00	1033	1033	1033	1033	1033	1033
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
15:00-16:00	181	181	181	181	181	181
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
16:00-17:00	76	76	76	76	76	76
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
17:00-18:00	83	83	83	83	83	83
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
18:00-19:00	69	69	69	69	69	69
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
19:00-0:00	106	106	106	106	106	106
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	16	16	16	16	16	16
% Change	(+0.0%)	(+0.8%)	(+0.7%)	(+0.0%)	(+0.0%)	(+0.0%)
Alt. mode	79	79	79	79	79	79
% Change	(+0.0%)	(+0.1%)	(+0.2%)	(+0.0%)	(+0.0%)	(+0.0%)
All Choices	2274	2274	2274	2274	2274	2274
% Change	(+0.0%)	(0.0%)	(0.0%)	(0.0%)	(0.0%)	(+0.0%)

ALOGIT Version

Other: Cost +10% AM peak – Effects on AM peak - Train users

User Var 1 - Scenario x Choice x umode

umode: 2 | User Var 1 | Normal Table

	P:Base	P:Ccostall	P:Ccopeak	P:Ccoearly	P:Ccolate	P:Ccomode
6:00-7:00	31	31	31	31	31	31
% Change	(+0.0%)	(+0.7%)	(+0.6%)	(+0.0%)	(+0.0%)	(+0.0%)
7:00-8:00	30	30	30	30	30	30
% Change	(+0.0%)	(-1.7%)	(-0.9%)	(-1.2%)	(0.0%)	(+0.0%)
8:00-9:00	61	60	60	61	61	61
% Change	(+0.0%)	(-2.0%)	(-1.7%)	(-0.8%)	(+0.0%)	(+0.0%)
9:00-10:00	168	169	168	169	168	168
% Change	(+0.0%)	(+0.5%)	(+0.0%)	(+0.2%)	(+0.0%)	(+0.0%)
10:00-15:00	414	415	415	415	414	414
% Change	(+0.0%)	(+0.2%)	(+0.1%)	(+0.1%)	(+0.0%)	(+0.0%)
15:00-16:00	39	39	39	39	39	39
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
16:00-17:00	16	16	16	16	16	16
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
17:00-18:00	25	25	25	25	25	25
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
18:00-19:00	8	8	8	8	8	8
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
19:00-0:00	4	4	4	4	4	4
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	22	22	22	22	22	22
% Change	(+0.0%)	(+0.6%)	(+0.4%)	(+0.0%)	(+0.0%)	(+0.0%)
Alt. mode	131	131	132	131	131	131
% Change	(+0.0%)	(-0.4%)	(+0.4%)	(+0.2%)	(+0.0%)	(+0.0%)
All Choices	950	950	950	950	950	950
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

Other: Cost +10% PM peak – Effects on PM peak - Car users

User Var 1 - Scenario x Choice x umode

umode: 1 | User Var 1 | Normal Table

	P:Baser	P:Ccostallr	P:Ccopeakr	P:Cceaarlyr	P:Ccolater	P:Ccomoder
6:00-7:00	1	1	1	1	1	1
% Change	(+0.0%)	(+0.2%)	(+0.1%)	(-1.2%)	(+0.0%)	(+0.0%)
7:00-8:00	7	7	7	7	7	7
% Change	(+0.0%)	(+0.1%)	(+0.0%)	(-1.7%)	(+0.0%)	(+0.0%)
8:00-9:00	44	44	44	44	44	44
% Change	(+0.0%)	(+0.1%)	(+0.0%)	(-0.1%)	(+0.0%)	(+0.0%)
9:00-10:00	22	22	22	22	22	22
% Change	(+0.0%)	(+0.1%)	(+0.0%)	(-0.2%)	(+0.0%)	(+0.0%)
10:00-15:00	590	590	590	590	590	590
% Change	(+0.0%)	(+0.1%)	(+0.0%)	(-0.1%)	(+0.0%)	(+0.0%)
15:00-16:00	191	192	191	190	191	191
% Change	(+0.0%)	(+0.5%)	(+0.3%)	(-0.3%)	(+0.2%)	(+0.0%)
16:00-17:00	380	378	379	380	380	380
% Change	(+0.0%)	(-0.4%)	(-0.2%)	(-0.1%)	(0.0%)	(+0.0%)
17:00-18:00	272	270	271	273	271	272
% Change	(+0.0%)	(-0.6%)	(-0.5%)	(+0.4%)	(-0.3%)	(+0.1%)
18:00-19:00	154	155	154	154	154	154
% Change	(+0.0%)	(+0.7%)	(+0.4%)	(+0.1%)	(+0.1%)	(+0.0%)
19:00-0:00	486	487	486	486	486	486
% Change	(+0.0%)	(+0.1%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	35	35	35	35	35	35
% Change	(+0.0%)	(+0.8%)	(+0.6%)	(+0.3%)	(+0.0%)	(+0.0%)
Alt. mode	79	79	79	79	79	78
% Change	(+0.0%)	(+0.6%)	(+0.5%)	(+0.2%)	(+0.2%)	(-0.5%)
All Choices	2259	2259	2259	2259	2259	2259
% Change	(+0.0%)	(0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(0.0%)

ALOGIT Version

Other: Cost +10% PM peak – Effects on PM peak - Train users

User Var 1 - Scenario x Choice x umode

umode: 2 | User Var 1 | Normal Table

	P:Baser	P:Ccostallr	P:Ccopeakr	P:Cceaarlyr	P:Ccolater	P:Ccomoder
6:00-7:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
7:00-8:00	1	1	1	1	1	1
% Change	(+0.0%)	(+0.3%)	(+0.2%)	(+4.5%)	(+0.1%)	(+0.0%)
8:00-9:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+7.2%)	(+0.0%)	(+0.0%)
9:00-10:00	2	2	2	2	2	2
% Change	(+0.0%)	(+0.3%)	(+0.1%)	(+8.9%)	(+0.1%)	(+0.1%)
10:00-15:00	96	97	96	97	96	97
% Change	(+0.0%)	(+0.5%)	(+0.0%)	(+0.6%)	(+0.2%)	(+0.3%)
15:00-16:00	102	103	102	102	102	102
% Change	(+0.0%)	(+1.1%)	(+0.1%)	(-0.1%)	(+0.4%)	(+0.5%)
16:00-17:00	200	199	199	199	199	200
% Change	(+0.0%)	(-0.4%)	(-0.4%)	(-0.2%)	(-0.2%)	(+0.4%)
17:00-18:00	146	144	144	145	144	146
% Change	(+0.0%)	(-0.4%)	(-0.4%)	(+0.0%)	(-0.3%)	(+0.5%)
18:00-19:00	76	76	76	76	76	76
% Change	(+0.0%)	(+0.9%)	(+0.4%)	(0.0%)	(+0.0%)	(+0.3%)
19:00-0:00	195	195	195	195	195	195
% Change	(+0.0%)	(+0.1%)	(+0.1%)	(-0.1%)	(+0.0%)	(+0.0%)
0:00-6:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.3%)	(+0.0%)	(+0.1%)	(+0.0%)	(+0.0%)
Alt. mode	131	130	132	131	131	128
% Change	(+0.0%)	(-0.9%)	(+0.6%)	(-0.1%)	(+0.3%)	(-2.0%)
All Choices	947	947	947	947	947	947
% Change	(+0.0%)	(0.0%)	(0.0%)	(0.0%)	(+0.0%)	(0.0%)

ALOGIT Version

4.2 Cross elasticities

Other: Time +10% AM peak, effects on PM peak – Car users

User Var 1 - Scenario x Choice x umode

umode: 1 | User Var 1 | Normal Table

	P:Baser	P:CTallcro	P:Ctpeakcro	P:CTearlycro	P:CTlatecro	P:ChTimecro
6:00-7:00	1	1	1	1	1	1
% Change	(+0.0%)	(+1.2%)	(+1.2%)	(+0.0%)	(+0.0%)	(+0.2%)
7:00-8:00	7	7	7	7	7	7
% Change	(+0.0%)	(+0.8%)	(+2.3%)	(-1.8%)	(+0.2%)	(+0.3%)
8:00-9:00	44	44	44	44	44	44
% Change	(+0.0%)	(-0.8%)	(-0.9%)	(-0.2%)	(+0.2%)	(+0.4%)
9:00-10:00	22	22	22	22	22	22
% Change	(+0.0%)	(-0.3%)	(+0.7%)	(-0.6%)	(-0.5%)	(+0.4%)
10:00-15:00	590	590	590	590	590	590
% Change	(+0.0%)	(0.0%)	(0.0%)	(0.0%)	(+0.0%)	(+0.0%)
15:00-16:00	191	191	191	190	191	191
% Change	(+0.0%)	(+0.2%)	(+0.3%)	(-0.1%)	(+0.0%)	(+0.0%)
16:00-17:00	380	380	380	380	380	380
% Change	(+0.0%)	(+0.1%)	(+0.1%)	(-0.1%)	(+0.1%)	(+0.0%)
17:00-18:00	272	271	270	272	272	272
% Change	(+0.0%)	(-0.4%)	(-0.5%)	(+0.1%)	(0.0%)	(+0.1%)
18:00-19:00	154	153	153	154	153	154
% Change	(+0.0%)	(-0.2%)	(-0.2%)	(0.0%)	(0.0%)	(+0.1%)
19:00-0:00	486	487	487	487	486	486
% Change	(+0.0%)	(+0.1%)	(+0.1%)	(+0.1%)	(0.0%)	(+0.0%)
0:00-6:00	35	35	35	35	35	35
% Change	(+0.0%)	(+0.9%)	(+0.6%)	(+0.6%)	(-0.3%)	(+0.0%)
Alt. mode	79	79	79	79	79	78
% Change	(+0.0%)	(+0.8%)	(+0.8%)	(+0.2%)	(+0.0%)	(-1.5%)
All Choices	2259	2259	2259	2259	2259	2259
% Change	(+0.0%)	(0.0%)	(0.0%)	(+0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

Other: Time +10% AM peak, effects on PM peak – Train users

User Var 1 - Scenario x Choice x umode

umode: 2 | User Var 1 | Normal Table

	P:Baser	P:CTallcro	P:Ctpeakcro	P:CTearlycro	P:CTlatecro	P:ChTimecro
6:00-7:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
7:00-8:00	1	1	1	1	1	1
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
8:00-9:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
9:00-10:00	2	2	2	2	2	2
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
10:00-15:00	96	95	95	96	96	96
% Change	(+0.0%)	(-1.3%)	(-1.3%)	(-0.4%)	(+0.0%)	(+0.3%)
15:00-16:00	102	102	102	101	102	102
% Change	(+0.0%)	(-0.1%)	(-0.1%)	(-0.2%)	(+0.0%)	(+0.6%)
16:00-17:00	200	198	198	199	200	201
% Change	(+0.0%)	(-0.7%)	(-0.7%)	(-0.1%)	(0.0%)	(+0.5%)
17:00-18:00	145	145	145	144	145	146
% Change	(+0.0%)	(-0.2%)	(-0.3%)	(-0.8%)	(0.0%)	(+0.7%)
18:00-19:00	76	76	76	76	76	76
% Change	(+0.0%)	(+0.4%)	(+0.4%)	(+0.7%)	(+0.0%)	(+0.6%)
19:00-0:00	195	195	195	195	195	195
% Change	(+0.0%)	(+0.2%)	(+0.2%)	(+0.1%)	(+0.0%)	(+0.1%)
0:00-6:00	0	0	0	0	0	0
% Change	(+0.0%)	(+13.5%)	(+13.5%)	(+3.7%)	(+0.0%)	(+0.0%)
Alt. mode	131	133	133	132	131	128
% Change	(+0.0%)	(+1.8%)	(+1.9%)	(+0.9%)	(+0.0%)	(-2.6%)
All Choices	947	947	947	947	947	947
% Change	(+0.0%)	(0.0%)	(0.0%)	(+0.0%)	(+0.0%)	(0.0%)

ALOGIT Version

Other: Time +10% PM peak, effects on AM peak – Car users

User Var 1 - Scenario x Choice x umode

umode: 1 | User Var 1 | Normal Table

	P:Base	P:Ccostallr	P:Ctpeakrcro	P:CTaarlrcro	P:CTlatercro	P:ChTimercro
6:00-7:00	48	48	50	47	49	48
% Change	(+0.0%)	(+0.5%)	(+3.8%)	(-3.0%)	(+0.8%)	(+0.2%)
7:00-8:00	97	97	95	97	97	97
% Change	(+0.0%)	(-0.1%)	(-1.3%)	(+0.4%)	(+0.4%)	(+0.2%)
8:00-9:00	165	165	164	165	166	165
% Change	(+0.0%)	(-0.2%)	(-0.6%)	(-0.1%)	(+0.2%)	(+0.1%)
9:00-10:00	321	321	320	320	322	321
% Change	(+0.0%)	(-0.1%)	(-0.3%)	(-0.4%)	(+0.3%)	(+0.1%)
10:00-15:00	1033	1033	1032	1035	1030	1034
% Change	(+0.0%)	(+0.0%)	(-0.1%)	(+0.2%)	(-0.2%)	(+0.2%)
15:00-16:00	181	181	180	181	181	181
% Change	(+0.0%)	(-0.1%)	(-0.6%)	(+0.2%)	(0.0%)	(+0.1%)
16:00-17:00	76	76	76	76	75	76
% Change	(+0.0%)	(-0.1%)	(+0.8%)	(+0.2%)	(-0.9%)	(+0.1%)
17:00-18:00	83	84	83	84	83	84
% Change	(+0.0%)	(+0.1%)	(0.0%)	(+0.2%)	(0.0%)	(+0.1%)
18:00-19:00	69	69	69	69	69	69
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
19:00-0:00	106	106	106	106	106	106
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	16	16	17	16	16	16
% Change	(+0.0%)	(-0.1%)	(+4.8%)	(-4.2%)	(+1.1%)	(+0.1%)
Alt. mode	79	80	81	80	80	76
% Change	(+0.0%)	(+0.5%)	(+2.2%)	(+0.4%)	(+0.9%)	(-3.9%)
All Choices	2274	2274	2274	2274	2274	2274
% Change	(+0.0%)	(0.0%)	(+0.0%)	(0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

Other: Time +10% PM peak, effects on AM peak – Train users

User Var 1 - Scenario x Choice x umode

umode: 2 | User Var 1 | Normal Table

	P:Base	P:Ccostallr	P:Ctpeakrcro	P:CTaarlrcro	P:CTlatercro	P:ChTimercro
6:00-7:00	31	31	31	30	31	31
% Change	(+0.0%)	(-0.1%)	(+1.9%)	(-2.1%)	(+1.0%)	(+0.4%)
7:00-8:00	30	30	30	30	31	31
% Change	(+0.0%)	(-0.6%)	(-1.6%)	(-3.0%)	(+1.2%)	(+1.7%)
8:00-9:00	61	61	60	59	63	62
% Change	(+0.0%)	(+0.1%)	(-1.9%)	(-4.0%)	(+2.7%)	(+1.6%)
9:00-10:00	168	169	161	170	171	170
% Change	(+0.0%)	(+0.3%)	(-4.0%)	(+0.8%)	(+1.5%)	(+1.4%)
10:00-15:00	414	415	416	417	406	417
% Change	(+0.0%)	(+0.2%)	(+0.5%)	(+0.6%)	(-1.9%)	(+0.7%)
15:00-16:00	39	39	39	39	39	39
% Change	(+0.0%)	(+0.0%)	(-0.3%)	(+0.6%)	(-0.5%)	(+0.1%)
16:00-17:00	16	16	16	16	16	16
% Change	(+0.0%)	(+0.0%)	(+0.2%)	(+0.0%)	(+0.0%)	(+0.0%)
17:00-18:00	25	25	25	25	25	25
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
18:00-19:00	8	8	8	8	8	8
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
19:00-0:00	4	4	4	4	4	4
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	22	22	23	20	22	22
% Change	(+0.0%)	(+0.1%)	(+4.4%)	(-6.3%)	(+1.3%)	(+1.1%)
Alt. mode	131	130	136	133	134	124
% Change	(+0.0%)	(-0.9%)	(+3.6%)	(+1.1%)	(+2.4%)	(-5.5%)
All Choices	950	950	950	950	950	950
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

Other: Cost +10% AM peak, effects on PM peak – Car users

User Var 1 - Scenario x Choice x umode

umode: 1 | User Var 1 | Normal Table

	P:Baser	P:Ccoallcro	P:Ccopeakcro	P:Ccoearlcro	P:Ccolatecro	P:Ccomodecro
6:00-7:00	1	1	1	1	1	1
% Change	(+0.0%)	(+0.5%)	(+0.5%)	(+0.0%)	(+0.0%)	(+0.0%)
7:00-8:00	7	7	7	7	7	7
% Change	(+0.0%)	(+0.3%)	(+0.6%)	(-0.4%)	(+0.1%)	(+0.0%)
8:00-9:00	44	44	44	44	44	44
% Change	(+0.0%)	(-0.2%)	(-0.2%)	(0.0%)	(+0.0%)	(+0.0%)
9:00-10:00	22	22	22	22	22	22
% Change	(+0.0%)	(+0.0%)	(+0.2%)	(-0.1%)	(-0.1%)	(+0.0%)
10:00-15:00	590	590	590	590	590	590
% Change	(+0.0%)	(0.0%)	(0.0%)	(0.0%)	(+0.0%)	(+0.0%)
15:00-16:00	191	191	191	191	191	191
% Change	(+0.0%)	(+0.0%)	(+0.1%)	(0.0%)	(+0.0%)	(+0.0%)
16:00-17:00	380	380	380	380	380	380
% Change	(+0.0%)	(0.0%)	(+0.0%)	(0.0%)	(+0.0%)	(+0.0%)
17:00-18:00	272	272	271	272	272	272
% Change	(+0.0%)	(-0.1%)	(-0.2%)	(+0.1%)	(0.0%)	(+0.0%)
18:00-19:00	154	153	154	153	154	154
% Change	(+0.0%)	(-0.1%)	(0.0%)	(0.0%)	(0.0%)	(+0.0%)
19:00-0:00	486	486	486	486	486	486
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(0.0%)	(+0.0%)
0:00-6:00	35	35	35	35	35	35
% Change	(+0.0%)	(+0.2%)	(+0.2%)	(+0.1%)	(-0.1%)	(+0.0%)
Alt. mode	79	79	79	79	79	79
% Change	(+0.0%)	(+0.1%)	(+0.2%)	(+0.0%)	(+0.0%)	(+0.0%)
All Choices	2259	2259	2259	2259	2259	2259
% Change	(+0.0%)	(0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

Other: Cost +10% AM peak, effects on PM peak – Train users

User Var 1 - Scenario x Choice x umode

umode: 2 | User Var 1 | Normal Table

	P:Baser	P:Ccoallcro	P:Ccopeakcro	P:Ccoearlcro	P:Ccolatecro	P:Ccomodecro
6:00-7:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
7:00-8:00	1	1	1	1	1	1
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
8:00-9:00	0	0	0	0	0	0
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
9:00-10:00	2	2	2	2	2	2
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
10:00-15:00	96	96	96	96	96	96
% Change	(+0.0%)	(-0.1%)	(-0.2%)	(-0.1%)	(+0.0%)	(+0.0%)
15:00-16:00	102	102	102	102	102	102
% Change	(+0.0%)	(+0.1%)	(-0.1%)	(0.0%)	(+0.0%)	(+0.0%)
16:00-17:00	200	200	199	200	200	200
% Change	(+0.0%)	(+0.1%)	(-0.1%)	(0.0%)	(0.0%)	(+0.0%)
17:00-18:00	145	145	145	145	145	145
% Change	(+0.0%)	(+0.0%)	(-0.1%)	(-0.1%)	(0.0%)	(+0.0%)
18:00-19:00	76	76	76	76	76	76
% Change	(+0.0%)	(+0.2%)	(-0.1%)	(+0.0%)	(+0.0%)	(+0.0%)
19:00-0:00	195	195	195	195	195	195
% Change	(+0.0%)	(+0.1%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	0	0	0	0	0	0
% Change	(+0.0%)	(+4.1%)	(+2.9%)	(+1.0%)	(+0.0%)	(+0.0%)
Alt. mode	131	131	132	131	131	131
% Change	(+0.0%)	(-0.4%)	(+0.4%)	(+0.2%)	(+0.0%)	(+0.0%)
All Choices	947	947	947	947	947	947
% Change	(+0.0%)	(0.0%)	(0.0%)	(+0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

Other: Cost +10% PM peak, effects on AM peak – Car users

User Var 1 - Scenario x Choice x umode

umode: 1 | User Var 1 | Normal Table

	P:Base	P:Ccoallrcro	P:Ccopeakcro	P:Ccoaamcro	P:Ccolatrcro	P:Ccomodrcro
6:00-7:00	48	48	49	47	48	48
% Change	(+0.0%)	(+0.5%)	(+1.0%)	(-3.2%)	(+0.2%)	(+0.0%)
7:00-8:00	97	97	96	97	97	97
% Change	(+0.0%)	(-0.1%)	(-0.2%)	(-0.1%)	(+0.1%)	(+0.0%)
8:00-9:00	165	165	165	166	165	165
% Change	(+0.0%)	(-0.2%)	(-0.2%)	(+0.4%)	(+0.1%)	(+0.0%)
9:00-10:00	321	321	321	321	321	321
% Change	(+0.0%)	(-0.1%)	(-0.1%)	(+0.0%)	(+0.1%)	(+0.0%)
10:00-15:00	1033	1033	1033	1034	1032	1033
% Change	(+0.0%)	(+0.0%)	(0.0%)	(+0.1%)	(-0.1%)	(+0.0%)
15:00-16:00	181	181	181	181	181	181
% Change	(+0.0%)	(-0.1%)	(-0.1%)	(+0.1%)	(0.0%)	(+0.0%)
16:00-17:00	76	76	76	76	76	76
% Change	(+0.0%)	(-0.1%)	(+0.2%)	(+0.1%)	(-0.2%)	(+0.0%)
17:00-18:00	83	84	83	84	83	83
% Change	(+0.0%)	(+0.1%)	(0.0%)	(+0.0%)	(0.0%)	(+0.0%)
18:00-19:00	69	69	69	69	69	69
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
19:00-0:00	106	106	106	106	106	106
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	16	16	16	16	16	16
% Change	(+0.0%)	(-0.1%)	(+1.3%)	(-4.1%)	(+0.4%)	(+0.0%)
All_mode	79	80	80	79	79	79
% Change	(+0.0%)	(+0.5%)	(+0.5%)	(+0.2%)	(+0.2%)	(-0.5%)
All Choices	2274	2274	2274	2274	2274	2274
% Change	(+0.0%)	(0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)

ALOGIT Version

Other: Cost +10% PM peak, effects on AM peak – Train users

User Var 1 - Scenario x Choice x umode

umode: 2 | User Var 1 | Normal Table

	P:Base	P:Ccoallrcro	P:Ccopeakcro	P:Ccoearrcro	P:Ccolatrcro	P:Ccomodrcro
6:00-7:00	31	31	31	32	31	31
% Change	(+0.0%)	(-0.1%)	(+0.3%)	(+2.4%)	(+0.1%)	(+0.1%)
7:00-8:00	30	30	30	31	30	31
% Change	(+0.0%)	(-0.6%)	(-0.9%)	(+0.4%)	(+0.1%)	(+0.5%)
8:00-9:00	61	61	61	61	61	61
% Change	(+0.0%)	(+0.1%)	(-0.3%)	(+0.3%)	(+0.2%)	(+0.6%)
9:00-10:00	168	169	168	169	168	169
% Change	(+0.0%)	(+0.3%)	(-0.3%)	(+0.5%)	(+0.1%)	(+0.5%)
10:00-15:00	414	415	414	412	414	415
% Change	(+0.0%)	(+0.2%)	(+0.0%)	(-0.6%)	(-0.2%)	(+0.3%)
15:00-16:00	39	39	39	39	39	39
% Change	(+0.0%)	(+0.0%)	(0.0%)	(-0.3%)	(0.0%)	(+0.0%)
16:00-17:00	16	16	16	16	16	16
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(-0.1%)	(+0.0%)	(+0.0%)
17:00-18:00	25	25	25	25	25	25
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(-0.4%)	(+0.0%)	(+0.0%)
18:00-19:00	8	8	8	8	8	8
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(-0.1%)	(+0.0%)	(+0.0%)
19:00-0:00	4	4	4	4	4	4
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)	(+0.0%)
0:00-6:00	22	22	22	23	22	22
% Change	(+0.0%)	(+0.1%)	(+0.4%)	(+4.2%)	(+0.1%)	(+0.4%)
Alt. mode	131	130	132	131	132	129
% Change	(+0.0%)	(-0.9%)	(+0.6%)	(-0.1%)	(+0.3%)	(-2.0%)
All Choices	950	950	950	950	950	950
% Change	(+0.0%)	(+0.0%)	(+0.0%)	(0.0%)	(+0.0%)	(0.0%)

ALOGIT Version

Appendix B List of variables

Variable	Description
Age40m	Respondents younger than 40 years old, car earlier and later alternatives, only
Arrearly	Reported arrival time minus presented arrival time (outward leg; only if positive)
Arrlate	Presented arrival time minus reported arrival time (outward leg; only if positive)
C_solo	Single workers travelling by car, car earlier and later alternatives
CaTswi_c	Constant - Car-time switch
CcarComp	Car cost coefficient for compensated travellers
CcarFlex	Dummy variable for car user with flexible working hours
CcarNoComp	Car cost coefficient for non-compensated travellers
Ccost_bus	Car cost – Business
Ccost_com	Car cost – Commuting
Ccost_edu	Car cost – Education
Ccost_NHB	Schedule penalty coefficient for non-home-based cartrips
Ccost_oth	Car cost – 'Other' purposes
Cearl_c	Constant – Car earlier alternative
Chmode	Change mode constant
Clate_c	Constant – Car later alternative
Costincx (x=1,2,3)	Income catergories for car users
Ctime_bus	Car time – Business
Ctime_com	Car time – Commuting
Ctime_edu	Car time – Education
Ctime_NHB	Time coefficient for non-home-based cartrips
Ctime_oth	Car time – 'Other' purposes
CtraComp	Train cost coefficient for compensated travellers
CtraNoComp	Train cost coefficient for non-compensated travellers
DepEarly	Early schedule penalty – outward leg
DepEarlyC	Preferred or reported departure time minus presented departure time, car users only (only if positive)
DepEarlyF	As DepEarly only for flexible working hours
DepEarlyN	Early penalty coefficient for non-home-based trips
DepEarlyNF	As DepEarly only for non-flexible working hours
DepEarlyT	Preferred or reported departure time minus presented departure time, train users only (only if positive)
DepLate	Late schedule penalty – outward leg
DepLateC	Presented departure time minus preferred or reported departure time, car users only (only if positive)
DepLateF	As DepLate only for flexible working hours
DepLateN	Late penalty coefficient for non-home-based trips
DepLateNF	As DepLate only for non-flexible working hours
DepLateT	Presented departure time minus preferred or reported departure time, car train only (only if positive)
Educlow	Highest education reached by respondent is low, car and train earlier and later alternatives
Educmidd	Highest education reached by respondent is average, car and train earlier and later alternatives
Frequency	Frequency of public transport
Hwife	The respondent is a housewife, car and train earlier and later alternatives
M_T1	Nest coefficient for morning/evening nests in mode choice
M_T2	Nest coefficient for period nests in mode choice
Moscale	Nest coefficient for mode nest
NH_early_c	Constant – Car non-home based trips earlier alternative
NH_late_c	Constant – Car non-home based trips later alternative
NH_Ptalt_c	Constant – Car non-home based trips 'switch mode' alternative

Partime	Respondents working parttime (less than 32 hours), car and train earlier and later alternatives
Per1_c	Period-specific constant
PTSeatav	Number of times a traveller has a seat out of ten trips in public transport
RdepEearly	Early schedule penalty – return leg
RdepLate	Late schedule penalty – return leg
Scale	Scale factor for relative scale of simplified to detailed model
Shopping	Shopping is the main purpose of the tour, mode change alternative
StLonger	Duration of stay presented on the screen minus reported duration of stay (only if positive)
StLongerC	Presented duration time minus reported duration of stay time, car users only (only if positive)
StLongerF	As StLonger only for flexible working hours
StLongerNF	As StLonger only for non-flexible working hours
StLongerT	Presented duration time minus reported duration of stay time, train users only (only if positive)
StShorter	Reported duration of stay minus duration of stay presented on the screen (only if positive)
StShorterC	Reported duration of stay minus duration of stay presented on the screen, car users only (only if positive)
StShorterF	As StShorter only for flexible working hours
StShorterNF	As StShorter only for non-flexible working hours
StShorterT	Reported duration of stay minus duration of stay presented on the screen, train users only (only if positive)
T_age25	The respondent is less than 25 year old, train earlier and later alternatives
T_caralt_c	Constant – Train 'switch mode' alternative
T_solo	Single workers travelling by train, train earlier and later alternatives
T1_M	Nest coefficient for mode nests in morning/evening choice
T2_M	Nest coefficient for mode nests in period choice
Tcost_com	Train cost– Commuting
Tcost_bus	Train cost– Business
Tcost_edu	Train cost– Education
Tcostincx (x= 1,2,3)	Income categories for train users
Tcost_NHB	Schedule penalty coefficient for non-home-based traintrips
Tcost_oth	Train cost– 'Other' purposes
Tearly_c	Constant – Train earlier alternative
Tkaartx (four purposes : x= c, b, e, o)	Train cost coefficient for 'vastrecht'
Tlate_c	Constant – Train later alternative
Totherx (four purposes : x= c, b, e, o)	Train cost coefficient for other users (no 'vastrecht')
Train_c	Constant – Car 'switch mode' alternative
TrTswi_C	Constant - Train earlier or later alternatives
Ttime_com	Train time – Commuting
Ttime_bus	Train time – Business
Ttime_edu	Train time – Education
Ttime_NHB	Time coefficient for non-home-based traintrips
Ttime_oth	Train time – 'Other' purposes
TtraFlex	Dummy variable for train user with flexible working hours
Whome	Respondent works at home, car and train earlier and later alternatives and switch mode
*	Not relevant

Appendix C List of estimated models

ID	Name	Description
1	Todmod9c.f12	Base multinomial model for commuting
2	Todmod10b.L12	Base multinomial model for business
3	Todmod9e.f12	Base multinomial model for education
4	Todmod9f.f12	Base multinomial model for other
5	Todmod12c.L12	As 1 but respondents with unchangeable behaviour excluded
6	Todmod12b.L12	As 2 but respondents with unchangeable behaviour excluded
7	Todmod12e.L12	As 3 but respondents with unchangeable behaviour excluded
8	Todmod12f.L12	As 4 but respondents with unchangeable behaviour excluded
9	Todmod10C.F12	As 1 but with a nest coefficient
10	Todmod10b.F12	As 2 but with a nest coefficient
11	Todmod10e.F12	As 3 but with a nest coefficient
12	Todmod10f.F12	As 4 but with a nest coefficient
13	Todmod17c.f12	As 9 but with 3 instead of 9 alternative specific constants
14	Todmod17b.f12	As 10 but with 3 instead of 9 alternative specific constants
15	Todmod17e.f12	As 11 but with 3 instead of 9 alternative specific constants
16	Todmod17f.f12	As 12 but with 3 instead of 9 alternative specific constants
17	Todcom01.f12	As 1 but with 3 instead of 9 alternative specific constants and with train cost variables (all commuters)
18	Todcomc1.f12	As 17 but for car users only
19	Todcomt1.f12	As 17 but for train users only
20	Todcom1b.f12	As 17 but one coefficient for train costs
21	Todbus02.f12	As 2 but with 3 instead of 9 alternative specific constants and with train cost variables (all business travellers)
22	Bus02car.f12	As 21 but for car users only
23	Bus02tra.f12	As 21 but for train users only
24	Todbus01.f12	As 21 but one coefficient for train costs
25	Toedu01.f12	As 3 but with 3 instead of 9 alternative specific constants and with train cost variables (all business travellers)
26	Todedu1c.f12	As 25 but for car users only
27	Todedu1t.f12	As 25 but for train users only
28	Todedu1b.f12	As 25 but one coefficient for train costs
29	Todoth01.f12	As 4 but with 3 instead of 9 alternative specific constants and with train cost variables (all business travellers)
30	Todoth1c.f12	As 29 but for car users only
31	Todoth1t.f12	As 29 but for train users only
32	Todoth1b.f12	As 29 but one coefficient for train costs
33	Todbus1h.f12	As 21 but only home based tours
34	Todbus1n.f12	As 21 but only non-home based tours
35	Bus1hcar.f12	As 33 but only for car users
36	Bus1htra.f12	As 33 but only for car users
37	Todcom04.f12	As 17 but with dummies for flexible workin hours
38	Todcom05.f12	As 17 but only respondents with flexible working hours
39	Todcom06.f12	As 17 but only respondents with non-flexible working hours
40	Comcomp1.f12	As 17 but with car and train cost compensated
41	Todcom02.f12	As 17 but only respondents who are compensated
42	Todcom03.f12	As 17 but only respondents who are not compensated
43	Todcom07.f12	As 17 but with coefficients for the duration of the stay
44	Todbus07.f12	As 18 but with coefficients for the duration of the stay
45	Todedu07.f12	As 19 but with coefficients for the duration of the stay
46	Todoth07.f12	As 20 but with coefficients for the duration of the stay
47	Todcom07b.f12	As 17 but with other definition of departure time coefficients
48	Todcom07c.f12	As 43 but with other definition of duration of stay coefficients
49	Todcom08.f12	As 17 but with penalty for arrival and departure time at/from work
50	Todcom08b.f12	As 47 but with penalty for arrival and departure time at/from work

51	Todcom09.f12	As 43 but with specific schedule penalty and participation penalty
52	Todcom9b.f12	As 51 but with flexible and non-flexible coefficients
53	Todcom9c.f12	As 52 but with compensated and non-compensated coefficients
54	Todcom9d.f12	As 51 but with compensated and non-compensated coefficients
55	Todcom9e.f12	As 53 but with only one coefficient for both compensated and non-compensated car users
56	Todbus7b.f12	As 44 but with penalty for arrival and departure time
57	Todbus7e.f12	As 56 but with only one train cost coefficient
58	Todbus7c.f12	As 56 but with penalty for arrival and departure time for non-home-based trips specific
59	Todbus7d.f12	As 58 but with specific time and cost coefficients for non-home-based trips
60	Todbus7i.f12	As 57 but with specific time coefficients for non-home-based trips
61	Todbus7j.f12	As 60 but with penalty for arrival and departure time for non-home-based trips specific
62	Todbus7h.f12	As 61 but with specific cost coefficients for non-home-based trips
63	Todedu02.f12	As 45 but with specific schedule penalty and participation penalty for each mode
64	Todedu2b.f12	As 63 but with car users whose purpose is education excluded
65	Todedu2d.f12	As 63 but with only one train cost coefficient
66	Todedu2f.f12	As 65 but with one coefficient for the duration of stay (longer)
67	Todoth02.f12	As 46 but with specific schedule penalty and participation penalty for each mode
68	Todoth2d.f12	As 67 but with only one train cost coefficient
69	Todoth2b.f12	As 67 but included are car users with purpose education
70	Todcom12.f12	As 55 but with log of costs
71	Todbus12.f12	As 61 but with log of costs
72	Todedu12.f12	As 66 but with log of costs
73	Todoth12.f12	As 68 but with log of costs
74	Todbus7l.f12	As 61 but only one time coefficient for non-home-based trips and home-based trips per mode
75	Todbus7m.f12	As 74 but assuming the cost for 'vastrecht' is zero
76	Todedu2j.f12	As 66 but assuming the cost for 'vastrecht' is zero
77	Todoth2h.f12	As 68 but assuming the cost for 'vastrecht' is zero
78	Todedu2i.f12	As 66 but with one coefficient for the duration of stay (shorter)
79	Todcom10.f12	As 9 but with all data instead of 90 %.
80	Todcom10b.f12	As 79 but with a car time-switch constant
81	Todcom10g.f12	As 79 but with three nest coefficients
82	Todbus08.f12	As 10 but with all data instead of 90 %.
83	Todbus8d.f12	As 82 but with a car time-switch constant
84	Todbus8f.f12	As 82 but with three nest coefficients
85	Todedu08.f12	As 11 but with all data instead of 90 %.
86	Todedu08e.f12	As 85 but with a car time-switch constant
87	Todoth08.f12	As 12 but with all data instead of 90 %.
88	Todoth8e.f12	As 87 but with a car time-switch constant
89	Todoth8g.f12	As 87 but with three nest coefficients
90	Todcom13c.f12	As 70 but with 2 income categories
91	Todcom13d.f12	As 70 but with 3 income categories
92	Todbus13c.f12	As 71 but with 2 income categories
93	Todbus13d.f12	As 71 but with 3 income categories
94	Todedu13c.f12	As 66 but with 2 income categories
95	Todedu13d.f12	As 66 but with 3 income categories
96	Todoth13b.f12	As 67 but with 2 income categories
97	Todoth13d.f12	As 67 but with 3 income categories
98	Eccom01.f12	As 55 but with error components for mode and time (2) added.
99	Eccom02.f12	As 55 but with error components for mode and cost (2) added.
100	Eccom04.f12	As 55 but with error components for time (2) added.

101	Eccom05.f12	As 55 but with error components for mode, cost (2) and time (2) added.
102	Eccom07.f12	As 55 but with error components for traveltime (2) added.
103	Ecbus01.f12	As 61 but with error components for mode and time (2) added.
104	Ecbus02.f12	As 61 but with error components for mode and cost (2) added.
105	Ecbus03.f12	As 61 but with error components for time (2) added.
106	Ecbus04.f12	As 61 but with error components for mode, cost (2) and time (2) added.
107	Ecbus05.f12	As 61 but with error components for traveltime (2) added.
108	Ecedu01.f12	As 78 but with error components for mode and time (2) added.
109	Ecedu02.f12	As 78 but with error components for mode and cost added.
110	Ecoth01.f12	As 68 but with error components for mode and time (2) added.
111	Ecoth02.f12	As 68 but with error components for mode and cost added.
112	Ecoth03.f12	As 68 but with error components for mode and cost (2) added.
113	Todcom14.f12	As 55 but with socio-economic variables
114	Todcom14b.f12	As 113 including working at home variable
115	Todbus14.f12	As 74 but with socio-economic variables
116	Todedu14.f12	As 78 but with socio-economic variables
117	Todoth14.f12	As 68 but with socio-economic variables
118	Todcom17.f12	As 114 but with seat availability and excluding single worker
119	Todbus17.f12	As 115 but with seat availability and excluding single worker
120	Todedu16.f12	As 116 but with seat availability and excluding single worker
121	Todoth17.f12	As 117 but with seat availability and excluding single worker
122	Cvecccom12.f12	As 118 but with error components for time (2) added
123	Todcom9l.f12	As 55 but with public transport frequency
124	Todbus7n.f12	As 74 but with public transport frequency
125	Todedu2k.f12	As 78 but with public transport frequency
126	Todoth2i.f12	As 68 but with public transport frequency
127	Cveccom08.f12	As 114 but with error components for time (2) excluding seat availability
128	Jcveccom08.f12	As 127 but with jack-knife
129	Cvecbus07.f12	As 115 but with error components for time (2) excluding seat availability
130	Cvecbus07.j12	As 129 but with jack-knife
131	Cvtodedu21.f12	As 116 excluding seat availability
132	Jkcvtodedu2l.j12	As 131 but with jack-knife
133	Cvecoth07.f12	As 117 but with error components for time (2) excluding seat availability
134	Jcvecoth07.j12	As 133 but with jack-knife
135	Cveccom08rp.f12	As 127 but with road pricing variables for each income category
136	Cvecbus07rp.f12	As 129 but with road pricing variable
137	Cvtodedu2lrp.f12	As 131 but with road pricing variable
138	Cvecoth07rp.f12	As 133 but with road pricing variable
139	Cvecvis07.f12	As 133 but only observations used for purpose 'visiting'
140	Cvecshp07.f12	As 133 but only observations used for purpose 'shopping'
141	Cvecrec07.f12	As 133 but only observations used for purpose 'recreation'
142	Cvecand07.f12	As 133 but only observations used for purpose 'other(2)'

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