



Zenith Transport Model

Technical Note 4 The Travel Market Segmentation Model

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1 Introduction

This Technical Note is one of a series of papers that collectively describe the Zenith Transport Model. Zenith is a four step transport model, implemented in the OmniTRANS software package for a range of Australian cities and regions.

This Technical Note details the Travel Market Segmentation model, which plays an essential role in the overall Zenith Model Run process.

1.1 Objectives and Scope of This Document

The primary objective of this document is to detail the motivation and methodologies underpinning the Travel Market Segmentation model.

This scope of this document does not extend to include the definition or validation of model parameters for specific markets. Refer to Section 3 for links to this information.

The remainder of this technical note is structured as follows:

- Section 2 describes the Travel Market Segmentation model, the motivation for its development, its functional form, and the data sources and procedures used for parameter estimation,
- Section 3 lists further sources of information relating to the Travel Market Segmentation model.



2 Travel Market Segmentation

2.1 Context

The Travel Market Segmentation model is the third step in the Zenith Model Run process, and follows the Trip Generation model, as illustrated in Figure 1 below.

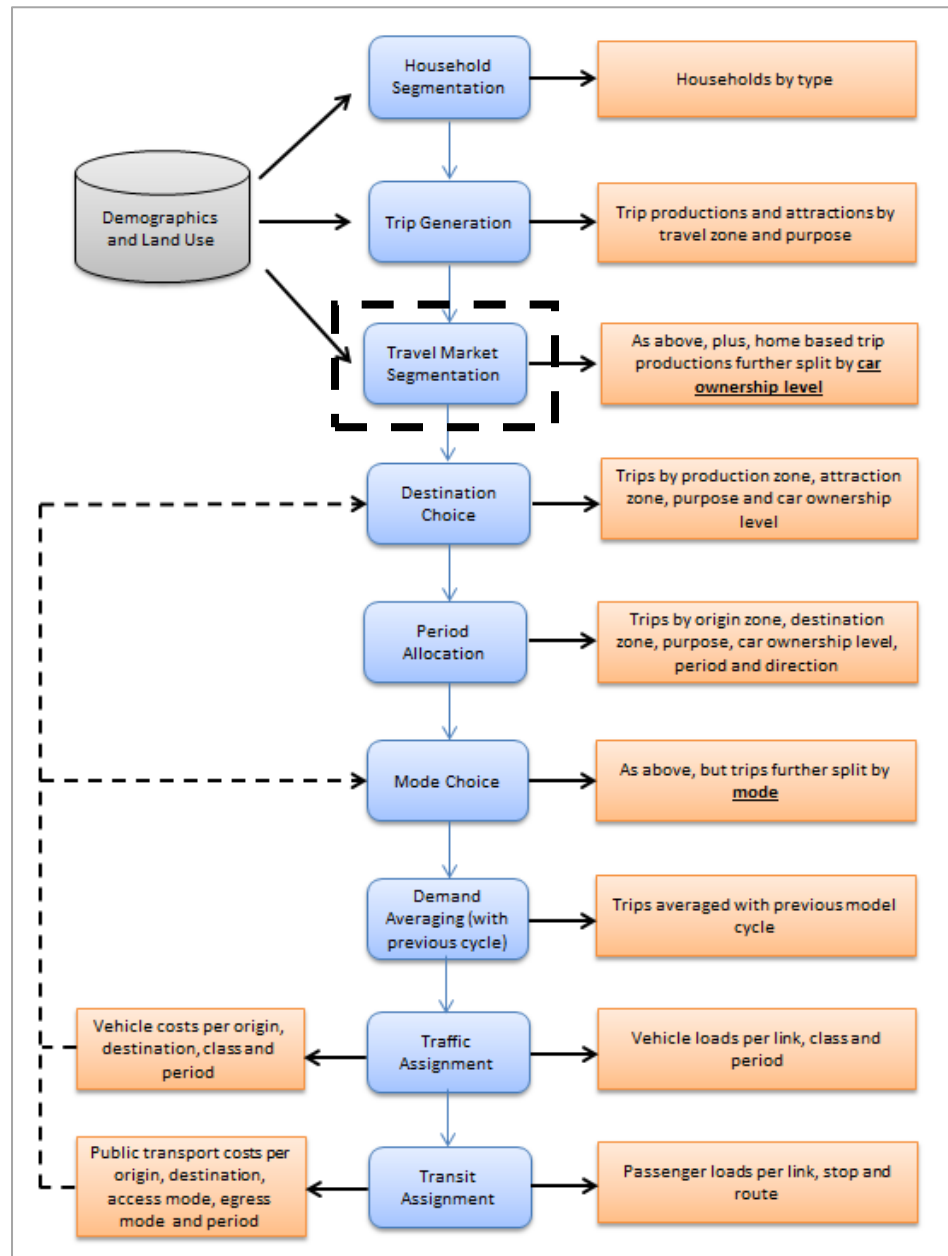


Figure 1 - Zenith Model Run Process



The Travel Market Segmentation model has two inputs:

- Home based trip productions per trip purpose, per travel zone, output from the Trip Generation model, and,
- Average zonal car ownership levels (a demographic input)

Its output of the Travel Market Segmentation model – home based trip productions segmented by the level of household car ownership – becomes input to the Destination Choice model which follows.

2.2 Motivation

The aim of the Travel Market Segmentation model is to segment home based trips by the number of cars owned by the household responsible for each trip (i.e. segment trips by 0 car, 1 car, 2 car and 3+ car households).

It has been found during model development in all Australian cities that segmenting travel by car ownership level, prior to destination and mode choice, significantly increases the accuracy of the resulting models – by acknowledging that households with limited private motor vehicle access are also likely to display atypical destination and mode choice decision-making behaviour.

An example of the Travel Market Segmentation process is provided in the inset below.



Travel Market Segmentation Example – Home Based Work (White Collar)

The Challenge:

Given that the households residing in a travel zone have an average household car ownership level of 1.3, what proportion of Home Based Work (white collar) trips produced in this zone are likely to be made by households owning 0, 1, 2, or 3+ cars?

The Solution:

There is no single correct answer to this question. Nonetheless, models can be developed which estimate realistic proportions given an average car ownership level.

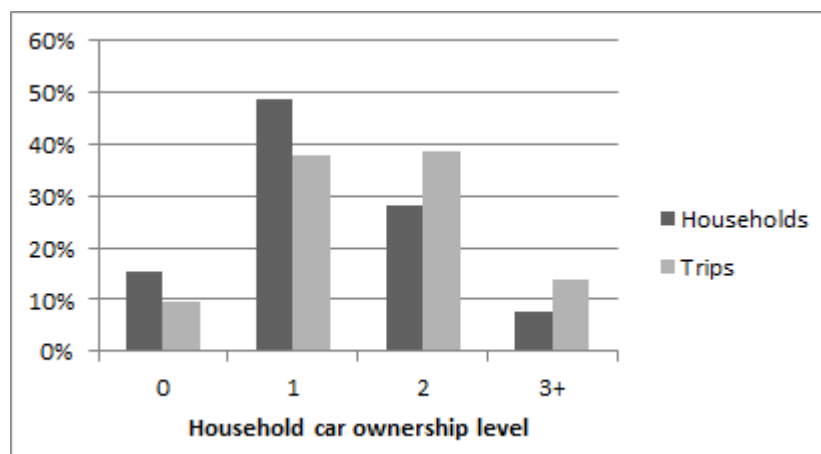
In the case of the Victorian model, the estimated proportions of trips are as follows:

- 0 car households => 9.6% of trips
- 1 car households => 37.9% of trips
- 2 car households => 38.7% of trips
- 3+ car households => 13.8% of trips

Note that the distribution of *trips* across car ownership levels is not the same as the distribution of *households* across car ownership levels, due to systematic variation in trip rates by car ownership level. Given an average car ownership level of 1.3 (as above), a realistic distribution of *households* is as follows:

- 0 car => 15.5% of households
- 1 car => 48.6% of households
- 2 car => 28.3% of households
- 3+ car => 7.7% of households

The two distributions – by households and by trips – by the level of household car ownership, is presented below:





2.3 Methodology

2.3.1 Trip Purposes which are Segmented by Car Ownership Level

Travel market segmentation by car ownership level is separately performed for each of the seven home based trip purposes:

- Home based work (white collar)
- Home based work (blue collar)
- Home based education (secondary)
- Home based education (tertiary)
- Home based shopping
- Home based recreation
- Home based other

Segmentation of home based trips by car ownership level is based on the average car ownership level of the travel zone within which the home is based.

For non-home based trips, segmentation by car ownership level is more challenging, and less relevant. A more relevant measure of car availability would be an indicator of whether the trip-maker has access to a car at their non-home location. An elegant solution to this (which has not yet been implemented) would be to model tours rather than trips.

2.3.2 Functional Form

The functional form of the Travel Market Segmentation model is presented below. Note that this functional form is identical to that of the Household Segmentation model (described in Technical Note 2).

$$T_n(x) = \frac{200 - A_n}{1 + e^{1/B_n(x - C_n)}}$$

Where: $T_n(x)$ is the percentage of trips which are made by households owning $\leq n$ cars

x is the average car ownership of the travel zone

A_n , B_n and C_n are the model parameters for level n



2.4 Data Sources and Parameter Estimation

The Travel Segmentation Model is developed using data extracted from household travel surveys.

A dataset is typically constructed by repeatedly drawing sub-samples of households from the household travel survey, and for each sub-sample, calculating the average car ownership, as well as the proportion of trips made by 0, 1, 2 and 3+ car households for each trip purpose. Sub-samples of 200 households are typically drawn with replacement.

The sub-samples of 200 households are not drawn using simple random sampling. The drawback of simple random sampling is that most samples of 200 households will tend to have roughly the same average car ownership level, leading to a dataset with minimal variation along the x-axis.

Instead, a stratified random sampling technique is employed, with households stratified according to their level of car ownership (0,1,2,3+). In creating a sub-sample, first, a target average car ownership level is nominated. Then, households are sampled from each of the strata to achieve the target average. This involves over and under-sampling certain car ownership levels to achieve the required target average.

The Household Segmentation model for car ownership is typically used to define the number of households to be drawn from each strata to achieve a given target average.

For example, to produce a data point with an average car ownership level of 1.3, we would randomly select:

- 31 households with no car (15.5%)
- 97 households with 1 car (48.5%)
- 57 households with 2 cars (28.3%)
- 15 households with 3+ cars (7.7%)

These proportions are drawn from the example in Technical Note 2.

By employing a non-proportional sampling technique, we can deliberately construct a dataset which spans a wide range of car ownership levels, which increases the accuracy of the resulting model.

An example dataset, and the estimated curves which are fitted to the data, are plotted in Figure 2 below.



For each data point (which represents a sub-sample of 200 households from the Household Travel Survey), we have an average household car ownership level, which places it on the x-axis. We then have the breakdown of trips by 0, 1, 2 and 3+ car households for the sub-sample, which results in three dots (blue, red and green), which mark the boundaries between the segments.

The segmentation curves themselves are plotted as grey lines which pass through the survey data, and divide the market into our four segments; the grey, blue, red and green regions representing trips made households owning 0, 1, 2, and 3+ cars respectively.

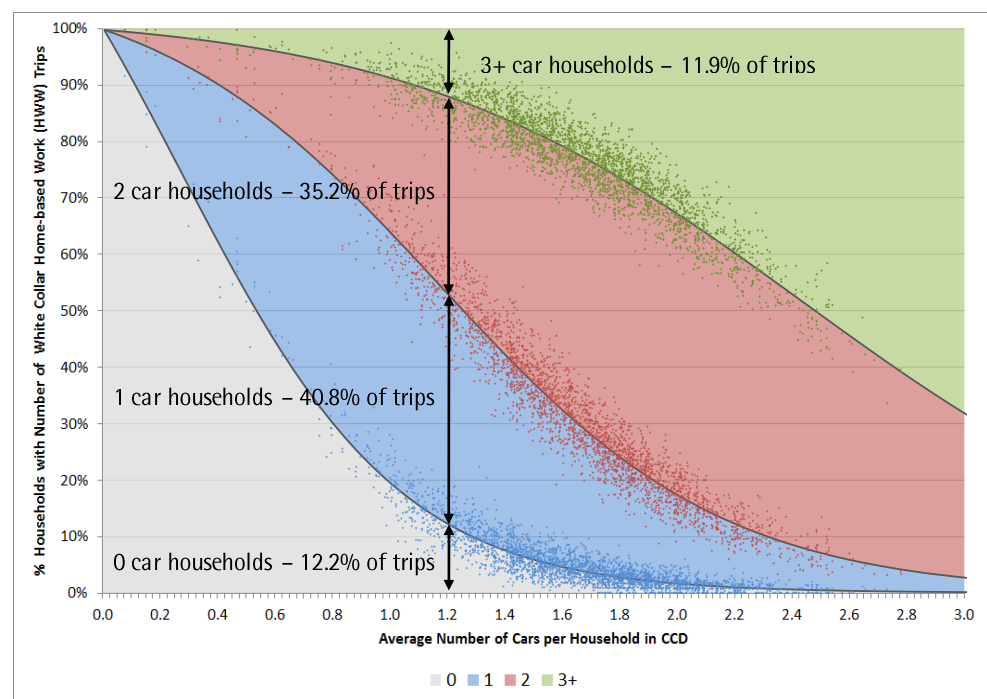


Figure 2 - Segmentation of Home Based Work (white collar) trips by car ownership level

An example is marked on the Figure, showing the segmentation of trips by car ownership level for a zone with average car household ownership of 1.2. The model (for this data set) estimates that 12.2% of trips would be made by 0 car households, 40.8% by 1 car households, 35.2% by 2 car households and 11.9% by 3+ car households.



3 Sources of Further Information

This technical note has described the objectives and methodology underpinning the Zenith Travel Market Segmentation model.

The note has not, however, listed the actual parameters estimated and applied for each modelled region. These can be found in the *model specific* technical notes relating to travel market segmentation. Simply go to: <http://zenith.veitchlister.com.au>, and go the tab which reflects your region of interest.

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