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Simulated Household Travel Survey Data: Synthetic Data in Australia

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ABSTRACT:

A method has been developed to synthesize household travel survey data from a combination of Census and national transport survey data sources. The procedure, described in other papers, involves creating distributions of pertinent variables (numbers of trips by purpose, mode of travel, time of day of travel, and trip length) that can be used to estimate travel-demand models. A sample of local residents is then drawn from disaggregate census data, providing detailed information on the socioeconomic characteristics of the sample. Using these socioeconomic characteristics, travel data are simulated from the transport data distributions using Monte Carlo simulation. This procedure was developed in the United States in the past four years.

The paper describes the application of this procedure to Adelaide, South Australia, for which an actual household travel survey exists from 1999. The paper describes results obtained from applying the generic data as the basis of the simulation. Results are compared between the synthetic and real data to determine the closeness of the match between the data sets. The procedure uses data derived from a nationwide travel survey in the U.S., but uses census data for Adelaide from the 1996 ABS Census, using the one percent sample. The purpose of this research was to determine the extent to which the trip characteristics distributions from the U.S. could be used in Australia. It is concluded that the procedure performs about as well as the process was shown to perform in Dallas, Salt Lake City, and Baton Rouge in the U.S.

This process holds out considerable promise as a means to increase available samples for local and corridor planning, as well as to provide data for regions that have typically not been able to undertake household travel surveys on the scale of those being conducted in the Melbourne and Sydney regions.

KEY WORDS: Synthetic Data, Simulation, Household Travel Survey, Trip Rates.

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1. Introduction

Household travel surveys (HTSs) are expensive to undertake, costing up to $300 per respondent in Australia, depending on the technique employed for data collection. Given the large sample sizes (2,000 to 3,000 households are considered a minimum prerequisite) required in order to capture representativeness of existing household types within both large and small metropolitan areas, the costs of HTSs soon become prohibitive to all but large well funded government organizations. Yet despite the absolute and relative costs, HTSs are critical to travel-demand forecasts used to estimate the impact of proposed transport policies as well as to determine regional travel characteristics. This is accomplished by the collection of household demographic and socio-economic data along with associated travel or activity data for each of the surveyed households that are in turn used to derive travel patterns for particular areas over a period of time.

Prohibitive costs are not the only barrier to carrying out HTSs. As with any survey method, public resistance to undertaking the survey task posses many problem and can result in large non-response rates and associated non-response errors. This may be confounded if an organization undertaking research uses a data collection technique that has been shown to impact upon response rates. In addition, increasing levels of personal mobility mean that it is more difficult to find individuals at their place of residence to undertake the survey at a time convenient to the interviewer.

One proposition to overcome both the cost and non-response issue has been the suggestion to use secondary data sources to generate a sample of households for which socio-demographic data are known, and then to use a national sample or other source of data as the basis of a simulation of the household travel patterns for entire metropolitan or regional areas. This research represents a continuation of work undertaken by Greaves, Stopher and Bullock (Greaves, 1998; Greaves, 2000, Greaves and Stopher, 2000, Stopher, Greaves, and Bullock, 2001) on the use of synthetic data to simulate metropolitan travel patterns in the United States of America. This research applies the methodology used by Greaves *et al.* to a large metropolitan area in Australia.

A sample of households, with socio-demographic descriptors, was generated from the 1996 Census Household Sample File (HSF), derived from the 1996 Australian Bureau of Statistics (ABS) Census Data, and travel distributions derived from the earlier work in the United States. Travel distributions, (or key variables influencing travel behaviour) were derived from US data mainly because no national household travel survey exists in Australia. The synthesized data were then compared to the 1999 Metropolitan Adelaide Household Travel Survey (AHTS) to determine the ability of simulated data to synthesize the actual travel patterns observed in the AHTS survey.

2. Data Preparation

The Metropolitan Adelaide Household Travel Survey (AHTS) conducted in 1999 by Transport South Australia of the Department for Transport, Urban Planning and the Arts sampled 5,886 households with 14,004 associated individuals out of a then total population of 1,045,854 individuals. The survey collected demographic and socio-economic data for each household as well information on travel activities undertaken over a two day period.

These data were collected using several surveys of each household which required cleaning and combining for use. Several categorical variables were created for the analysis including a lifestyle variable consisting of the number of workers and children within a household. After cleaning the data and removing households that had not completed all of the surveys, 5,615 households remained.

The 1996 Census Household Sample File (HSF) represents a 1% sample from the 1996 census household data collected by the ABS. The file consisted of three files covering private dwellings, their associated household and individual records as well as a 1% sample of persons from non-private dwellings. These were combined so that the format of the final data file was similar to that of the AHTS data file. Again significant cleaning of the data was required before analysis could be undertaken.

Table 1 shows comparative statistics for the AHTS and the HSF for the city of Adelaide. For completeness, the table also includes the comparative statistics for the data collected for an earlier study using the 1995 U.S. Nationwide Personal Transportation Survey (NPTS) as well as HTSs undertaken in Baton Rouge (Greaves, 2000) Dallas and Salt Lake (Stopher, Greaves, and Bullock, 2001).

Table 1: Summary Statistics from the Household Travel Surveys

Statistic	AHTS	HSF	NPTS	Baton Rouge	Salt Lake	Dallas
Average Age	38	35	35	33	34	35
Average Household Size	2.46	2.44	2.63	2.71	3.14	2.47
Percent in Single Family Dwellings	N/A	N/A	74%	75%	73%	78%
Percent from Non-Car-Owning Households	9.4%	13.2%	8%	8%	4%	5%
Average Vehicles per Household	1.56	1.43	1.73	1.78	1.97	1.84
Percent Females in Sample	51.9%	50.9%	51%	52%	53%	52%
Percent Home Owners	76.5%	59.5%	64%	66%	76%	68%
Average Workers per Household	1.07	1.03	1.33	1.34	1.31	1.40

In comparing the Australian data sources, it becomes evident that possible sampling problems exist between the two. In comparison to the HSF, the AHTS appears to have under sampled the number of non-car-owning households whilst over sampling the percent of home owners. For all other variables, the statistics shown appear to be similar across data sets.

It can be seen that the number of household workers in both Australian data sets is below the average represented across the American data. Further, it is evident that the proportion of non-car-owning households in the Australian data is greater than that represented in the American data, whilst the average number of household vehicles is below that in the American data. The above suggests deviations away from the trip distributions derived in America towards a greater use of public transport and a lower number of home-work trips.

3. Simulating Travel Survey Data

A synthetic sample was drawn from the HSF data replicating as closely as possible the AHTS sample using a procedure similar to that described in Stopher, Greaves and Bullock (2001). This synthetic sample was then compared to the actual trip rates in the AHTS sample. Table 2 compares the synthetic data to the AHTS data. Table 2 shows that in terms of general household characteristics, the simulated data compared favourably to the AHTS data.

Table 2: Comparison of Statistics of the HTS and Synthetic Samples

Statistic	AHTS	Simulation
Sample Size (Households)	5615	5615
Average Vehicles per Household	1.56	1.42
Average Household Size	2.46	2.44
Average Workers per Household	1.07	1.04

3.1 Trip Rates

Table 3 compares the trip rates for several trip purposes across the AHTS and synthetic data using the z test for equal population means. As can be seen from the table, home-based work, home-based school, home-based college, home-based other and other-work trips were significantly different at the 99% level between the two data sets. Total number of trips was also significantly different at the 99% level. With the exception of home-based other trips, the simulation overestimated the trip rates.

Table 3: Comparisons of HTS and Simulated Person Trip Rates per Household

Purpose	**AHTS**		**Simulation**	
	Mean	**Std. Dev.**	**Mean**	**Std. Dev.**
Home-Based Work	1.07	1.57	1.38**	1.71
Home-Based School	0.34	1.07	0.60**	1.38
Home-Based College	0.08	0.42	0.16**	0.63
Home-Based Shop	1.30	1.75	1.28	1.72
Home-Based Other	3.83	4.27	3.28**	3.53
Other-Work	0.80	2.34	1.00**	1.83
Other-Other	1.86	3.18	1.95	2.90
TOTAL TRIPS	9.28	8.02	9.66**	7.28

** Statistically significant difference in trip rates at the 95 percent confidence level*
***Statistically significant difference in trip rates at the 99 percent confidence level*

One possible explanation for the over-estimation of trip rates by the simulation is the under-estimation of the number of households not making any trips. For the AHTS survey, 492 households or 8.8% of the total sample, made no trips on the day of the survey whilst the simulation included a relatively smaller 180 households or 3.2% of the total sample. Correcting this by computing trip rates only for mobile households produces the results shown in Table 4. This creates an interesting result. Most of the trip rates that were over-estimated by the simulation are now closer, with smaller z-scores for the difference, while those that are under-estimated by the simulation are further apart, and the z-scores have increased. However, the overall trip rate is now not

significantly different and has closed in on around 10 trips per household per day. This suggests that another part of the problem may be differences in classification of trip purposes between the AHTS and the traditional procedures used in the United States. For example, the simulation produces trip rates for home-based work, home-based school, home-based college, and other-work that are higher than those observed in Adelaide. In contrast, the home-based other, and to a lesser extent the home-based shop are lower than in Adelaide data. The other-other rate is not different between the two sets of data. This might suggest that the Adelaide survey classified more trips as being home-based other, possibly because of problems in determining the real purpose. This result bears further investigation.

Table 4: Comparisons of HTS and Simulated Person Trip Rates per Mobile Household

Purpose	AHTS		Simulation	
	Mean	Std. Dev.	Mean	Std. Dev.
Home-Based Work	1.17	1.61	1.43**	1.72
Home-Based School	0.37	1.12	0.62**	1.40
Home-Based College	0.09	0.44	0.17**	0.64
Home-Based Shop	1.42	1.79	1.32**	1.73
Home-Based Other	4.20	4.31	3.39**	3.54
Other-Work	0.88	2.44	1.03**	1.85
Other-Other	2.04	3.28	2.01	2.93
TOTAL TRIPS	10.17	7.89	9.98	7.19

** Statistically significant difference in trip rates at the 95 percent confidence level*
***Statistically significant difference in trip rates at the 99 percent confidence level*

Table 5 compares the above findings to that of Stopher, Greaves and Bullock (2001). Given that the distributions of trips used in each synthetic study were derived from the NPTS, differences between the synthetic data generated for different localities demonstrates that the simulation is responsive to differences in the local population characteristic. It can be seen, from Table 5, that significant differences exist between Adelaide and Salt Lake City for all trip purposes at the 99% level. Significant differences between Adelaide and both Baton Rouge and Dallas do not exist for home-based college and other-other trips.

Table 5: Comparisons of Simulated Person Trip Rates per Household across Data Sets

Purpose	Adelaide	Baton Rouge	Dallas	Salt Lake	Adelaide		
	Simulated Mean	Simulated Mean	Simulated Mean	Simulated Mean	Diff. from Baton Rouge	Diff. from Dallas	Diff. from Salt Lake
Home-Based Work	1.38**	1.83	1.86**	1.83**	**	**	**
Home-Based School	0.6**	0.74	0.60	1.07*	**		**
Home-Based College	0.16**	0.17	0.16	0.23*			**
Home-Based Shop	1.28	1.32*	1.14**	1.38**		**	**
Home-Based Other	3.28**	3.69	3.19**	4.17**	**		**
Other-Work	1.00**	1.34	1.35**	1.33	**	**	**
Other-Other	1.95	2.02	1.86**	2.26**			**
TOTAL TRIPS	9.66**	11.11	10.17**	12.28**	**	**	**

** Statistically significant difference in trip rates at the 95 percent confidence level*
***Statistically significant difference in trip rates at the 99 percent confidence level*

Table 5 also shows the significant differences between simulation and the actual HTS data for each of Baton Rouge, Dallas, and Salt Lake. It is interesting to note here that Baton Rouge had only one significant difference, which was at 95% not 99%. Dallas and Salt Lake each had most purposes showing significant differences. One of the primary differences between these surveys is that the Baton Rouge survey was conducted using identical instruments and protocols to the NPTS survey from which the distributions have been derived, while Salt Lake and Dallas used markedly different survey procedures. This may suggest that there is also a methodological issue here in the methods used for the surveys that are being used to benchmark the simulations. It is also worth noting here that the number and magnitude of significant differences for Dallas, Salt Lake, and Adelaide between the simulated and actual HTS data for each region are about the same. On these results which are uncorrected for differences in mobility rates, Adelaide and Dallas each have two trip rates that are not significantly different, while Salt Lake has one, but also has two trip rates that are significantly different at 95% but not at 99%. All three regions show significantly different overall trip rates than their respective HTSs.

Table 6 shows a comparison of HTS trip rates with simulated trip rates according to household size. For the Adelaide data, the table shows significant differences exist for the majority of trip purposes for most household sizes. The magnitudes of the differences suggest serious shortcomings in generating the synthetic data for the city of Adelaide. For households of size 5+, the magnitude of difference between the synthetic sample and the HTS is greater than one for home-based school trips and home-based other trips (absolute difference of 1.45 and 2.12 respectively) and for households of size four for home-based other trips (1.34).

Table 6: Comparisons of Person Trip Rates per Household by Household Size

Purpose	Data Source	Household Size				
		1	**2**	**3**	**4**	**5+**
Home-Based Work	**AHTS**	**0.33**	**0.98**	**1.52**	**1.74**	**1.73**
	Synthetic	**0.51****	**1.29****	**1.85****	**2.22****	**2.15****
	Dallas HTS	0.95	1.78	2.22	2.23	2.34
	Simulated Data	0.96	1.97**	2.35**	2.27**	2.77**
	Salt Lake HTS	0.75	1.41	1.95	2.16	2.23
	Simulated Data	0.75	1.57**	2.01	2.39**	2.61**
Home-Based School	**AHTS**	**0**	**0.04**	**0.31**	**0.94**	**1.71**
	Synthetic	**0**	**0.07****	**0.69****	**1.55****	**3.16****
	Dallas HTS	0	0.09	0.61	1.57	2.86
	Simulated Data	0	0.09	0.6	1.66*	3.06**
	Salt Lake HTS	0	0.04	0.55	1.35	4.15
	Simulated Data	0	0.07**	0.52	1.33	3.29**
Home-Based College	**AHTS**	**0.03**	**0.05**	**0.1**	**0.14**	**0.17**
	Synthetic	**0.10****	**0.14****	**0.20****	**0.24****	**0.26****
	Dallas HTS	0.06	0.09	0.31	0.28	0.38
	Simulated Data	0.12**	0.13**	0.21**	0.20**	0.32**
	Salt Lake HTS	0.06	0.29	0.29	0.38	0.4
	Simulated Data	0.08	0.18**	0.3	0.28**	0.34*
Home-Based Shop	**AHTS**	**0.66**	**1.32**	**1.61**	**1.77**	**1.83**
	Synthetic	**0.65**	**1.37**	**1.38****	**1.66****	**2.06****
	Dallas HTS	0.35	0.73	0.73	0.69	0.85
	Simulated Data	0.59**	1.11**	1.28**	1.69**	1.88**
	Salt Lake HTS	0.51	1.04	1.31	1.46	2
	Simulated Data	0.60**	1.21**	1.38	1.60**	2.08
Home-Based Other	**AHTS**	**1.31**	**2.81**	**4.61**	**6.91**	**9.41**
	Synthetic	**1.37***	**2.73**	**3.63****	**5.57****	**7.29****
	Dallas HTS	1.08	2.4	3.38	5.07	6.7
	Simulated Data	1.26**	2.51	3.78**	5.48**	7.69**
	Salt Lake HTS	1.64	3.26	4.39	5.74	9.82
	Simulated Data	1.33**	2.72**	3.70**	5.40**	7.77**
Other-Work	**AHTS**	**0.27**	**0.76**	**1.14**	**1.29**	**1.17**
	Synthetic	**0.33****	**0.91****	**1.33****	**1.69****	**1.68****
	Dallas HTS	0.72	1.07	1.54	1.68	1.46
	Simulated Data	0.73	1.31**	1.85**	1.71	2.09**
	Salt Lake HTS	0.63	1.09	1.54	1.82	1.59
	Simulated Data	0.6	1.07	1.43*	1.76	1.93**
Other-Other	**AHTS**	**0.69**	**1.4**	**2.18**	**3.47**	**4.24**
	Synthetic	**0.85****	**1.83****	**2.14**	**2.85****	**4.22**
	Dallas HTS	0.62	1.18	1.46	1.95	2.64
	Simulated Data	0.81**	1.64**	2.15**	2.89**	4.15**
	Salt Lake HTS	1	2.06	2.61	3.1	4.69
	Simulated Data	0.77**	1.66**	1.99**	3.03	3.92**
TOTAL TRIPS	**AHTS**	**3.3**	**7.37**	**11.46**	**16.26**	**20.26**
	Synthetic	**3.82****	**8.34****	**11.22**	**15.79****	**20.82***
	Dallas HTS	3.78	7.34	10.26	13.46	17.24
	Simulated Data	4.47**	8.75**	12.23**	15.89**	21.97**
	Salt Lake HTS	4.6	9.19	12.63	16	24.88
	Simulated Data	4.13**	8.47**	11.3388	15.79	21.94**

**Statistically significant difference in trip rates at the 95 percent confidence level*
***Statistically significant difference in trip rates at the 99 percent confidence level*

Examination of the differences suggests that the simulation is over-estimating home-based work trips and home-based school trips, and that the magnitude of these differences increase as household size increases. There is a suggestion that the home-based work and other-work results may arise from a lower workforce participation rate in Adelaide than in the U.S. Home-based college trips are more consistent across household sizes. There is no consistent pattern of under estimation or over estimation evident for other trip rates.

For completeness, the results for both Dallas and Salt Lake City are compared to the Adelaide results. Comparisons between Adelaide and Dallas and Salt Lake City show mixed results. The Adelaide synthetic data performed better than the US simulations in some areas (for example home-based shopping trips for households of size 1 and 2) but worse in other areas (other-work trips for households of all sizes). Overall, the results are fairly similar among Adelaide, Dallas, and Salt Lake.

Table 7 compares the trip rates by the number of workers per household for the Adelaide data as well as for the US data. For the Adelaide data, more statistical differences exist than for trip rates per number of household members, although, as in Table 5, the majority of differences are only slight in absolute magnitude.

Table 7: Comparison of Trip Rates per Household by Workers per Household

Purpose	Data source	Workers							
		0		1		2		3+	
		HTS	Sim.	HTS	Sim.	HTS	Sim.	HTS	Sim.
Home-Based Work	**Adelaide**	**0.01**	**0.00****	**1.05**	**1.37****	**1.9**	**2.60****	**3.45**	**4.30****
	Dallas	0.14	0.00**	1.4	1.35*	2.43	2.64**	3.4	4.24**
	Salt Lake	0.12	0.00**	1.39	1.42	2.35	2.56**	3.95	4.24**
Home-Based School	**Adelaide**	**0.13**	**0.28****	**0.38**	**0.67****	**0.51**	**0.88****	**0.57**	**0.94****
	Dallas	0.14	0.12	0.47	0.54*	0.77	0.78	1.01	0.94
	Salt Lake	0.17	0.23*	1.21	1.10*	1.54	1.26**	2.29	1.98**
Home-Based College	**Adelaide**	**0.04**	**0.09****	**0.07**	**0.15****	**0.08**	**0.20****	**0.28**	**0.55****
	Dallas	0.08	0.08	0.13	0.13	0.16	0.16	0.63	0.53**
	Salt Lake	0.11	0.1	0.22	0.12**	0.35	0.24**	0.82	0.82
Home-Based Shop	**Adelaide**	**1.16**	**1.26****	**1.23**	**1.11****	**1.43**	**1.36**	**1.87**	**1.80**
	Dallas	0.85	1.09**	0.55	0.94**	0.61	1.27**	0.71	1.72**
	Salt Lake	1.03	1.29**	1.17	1.24	1.32	1.38	2.07	2.06
Home-Based Other	**Adelaide**	**2.51**	**2.70****	**3.92**	**3.14****	**4.9**	**3.85****	**6.14**	**4.91****
	Dallas	2.51	2.41	2.45	2.67**	3.34	3.67**	4.08	5.23**
	Salt Lake	3.23	2.94**	4.54	3.85	5.57	4.52	8.72	6.46
Other-Work	**Adelaide**	**0.01**	**0.00****	**0.73**	**0.98****	**1.65**	**1.99****	**1.98**	**2.71****
	Dallas	0.09	0.00**	0.93	1.04**	1.74	1.97**	1.87	2.52**
	Salt Lake	0.07	0.00**	1.04	1.03	1.95	1.99	2.64	2.61
Other-Other	**Adelaide**	**1.24**	**1.73****	**1.99**	**1.80****	**2.32**	**2.25**	**2.85**	**2.73**
	Dallas	1.18	1.65**	1.16	1.64**	1.42	2.03**	1.58	2.74**
	Salt Lake	1.89	1.60**	2.39	2.04**	3.03	2.57**	4.71	3.22**
TOTAL TRIPS	**Adelaide**	**5.11**	**6.06****	**9.37**	**9.23**	**12.79**	**13.13***	**17.14**	**17.93****
	Dallas	4.98	5.35**	7.09	8.30**	10.47	12.51**	13.29	17.93**
	Salt Lake	6.61	6.16**	11.96	10.80**	16.1	14.52**	25.18	21.40**

**Statistically significant difference in trip rates at the 95 percent confidence level*
*** Statistically significant difference in trip rates at the 99 percent confidence level*

For households of 2 or 3+ workers, the absolute magnitude of difference between the synthetic and HTS data exceeds one for home-based other trips (1.05 and 1.23 respectively) and is 0.95 for total trips for households with no workers. As the number of workers per household increases, the magnitude of over-estimation of trips for home-based work, home-based school, home-based college and other-work trips increases. No other pattern exists for under or over-estimation for other trips. In comparison to the US data the Adelaide synthetic data appears to have performed significantly worse than that of the US data with more significant differences in evidence.

Table 8 shows a comparison of the trip rates by the numbers of school-aged children per household. For the Adelaide data, significant differences exist for all cells with the exception of home-based other trips for households with 1 child. The absolute values for the differences between the synthetic data and the HTS for home-based school trips (2 children: 1.21, 3+ children: 1.87), home-based other trips (1 child: 2.16, 3 children: 1.24) and total trips (1 child: 1.67, 3+ children: 2.94) are greater than one. For 2 children households, the absolute magnitude of the difference is close to 1 for home-based other trips and total trips (0.91 and 0.97). Many of the other differences are greater than 0.5 but less than 1 in absolute magnitude. For home-based shopping trips, the simulation again over-estimates the number of trips undertaken by households by an increasing rate as the number of school age children increases. The simulation also over-estimates the number of home-based work trips and home based other trips. In comparison to the US data, the number of significant differences is similar when compared to the Dallas simulation, but more compared with Salt Lake City.

Table 8: Comparison of Trip Rates per Household by School Age Children per Household

Purpose	Source	School Age Children							
		0		1		2		3+	
		HTS	Sim.	HTS	Sim.	HTS	Sim.	HTS	Sim.
Home-Based Work	**Adelaide**	**0.96**	**1.21****	**1.5**	**1.79****	**1.38**	**1.99****	**1.24**	**1.83****
	Dallas	1.61	1.75**	2.08	2.17*	1.98	2.10**	2	2.26**
	Salt Lake	1.42	1.58**	2.03	2.24**	2.17	2.36**	2.22	2.25
Home-Based School	**Adelaide**	**0.01**	**0.00****	**0.78**	**1.31****	**1.47**	**2.68****	**2.76**	**4.63****
	Dallas	0	0	1.12	1.31**	2.47	2.85**	4.3	4.63**
	Salt Lake	0.03	0.00**	1.58	1.31**	3.01	2.78**	5.97	4.68**
Home-Based College	**Adelaide**	**0.07**	**0.16****	**0.11**	**0.21****	**0.07**	**0.12****	**0.06**	**0.13****
	Dallas	0.15	0.17	0.27	0.19**	0.17	0.12**	0.19	0.15**
	Salt Lake	0.28	0.24	0.22	0.25	0.26	0.20**	0.37	0.16**
Home-Based Shop	**Adelaide**	**1.2**	**1.12****	**1.52**	**1.49**	**1.62**	**1.77****	**1.86**	**2.39****
	Dallas	0.59	0.96**	0.65	1.48**	0.74	1.92**	0.91	1.66**
	Salt Lake	0.97	1.08**	1.51	1.76**	1.8	1.9	2.18	2.05*
Home-Based Other	**Adelaide**	**2.71**	**2.42****	**6.44**	**4.28****	**7.6**	**6.69****	**9.08**	**7.84****
	Dallas	2	2.21**	3.95	4.66**	6.11	6.68**	7.59	8.94**
	Salt Lake	3.12	2.53**	5.81	4.98**	7.94	7.23**	11.84	8.90**
Other-Work	**Adelaide**	**0.69**	**0.86****	**1.27**	**1.37***	**1.05**	**1.43****	**1.01**	**1.53****
	Dallas	1.02	1.22**	1.6	1.69	1.63	1.73*	1.18	1.89**
	Salt Lake	1.08	1.1	1.83	1.50**	1.74	2.08**	1.61	1.64
Other-Other	**Adelaide**	**1.31**	**1.52****	**2.9**	**2.38****	**4.09**	**3.58****	**4.2**	**4.80****
	Dallas	0.96	1.39**	1.69	2.49**	2.63	3.81**	2.41	4.30**
	Salt Lake	1.91	1.50**	3.24	2.53**	3.97	3.78	5.41	4.46**
TOTAL TRIPS	**Adelaide**	**6.96**	**7.29****	**14.51**	**12.84****	**17.29**	**18.26****	**20.21**	**23.15****
	Dallas	6.34	7.70**	11.36	13.98**	15.74	19.22**	18.57	23.82**
	Salt Lake	8.8	8.04**	16.23	14.56**	20.89	20.33**	29.61	24.14**

** Statistically significant difference in trip rates at the 95 percent confidence level*
*** Statistically significant difference in trip rates at the 99 percent confidence level*

Table 9 shows a comparison of trip rates per household by vehicles per household. Once more, for the Adelaide data the majority of cells demonstrate significant differences between the HTS and synthetic data.

Table 9: Comparison of Trip Rates per Household by Vehicles per Household

Purpose	Source	Vehicles							
		0		1		2		3+	
		HTS	Sim.	HTS	Sim.	HTS	Sim.	HTS	Sim.
Home-Based Work	**Adelaide**	**0.12**	**0.31****	**0.56**	**0.91****	**1.47**	**1.92****	**2.52**	**1.83****
	Dallas	1.01	1.11**	1.16	1.22*	1.94	2.13**	2.47	2.71**
	Salt Lake	0.73	0.52**	1.12	1.11	1.7	1.88**	2.4	2.75**
Home-Based School	**Adelaide**	**0.09**	**0.20****	**0.23**	**0.49****	**0.49**	**0.88****	**0.48**	**4.63****
	Dallas	0.57	0.34**	0.34	0.37	0.65	0.7	0.78	0.90**
	Salt Lake	0.16	0.30**	0.59	0.59	1.4	1.18**	1.75	1.57**
Home-Based College	**Adelaide**	**0.02**	**0.10****	**0.05**	**0.11****	**0.07**	**0.19****	**0.2**	**0.13****
	Dallas	0.15	0.19*	0.09	0.15**	0.14	0.15	0.38	0.22**
	Salt Lake	0.15	0.14	0.28	0.14**	0.26	0.16**	0.38	0.44*
Home-Based Shop	**Adelaide**	**0.73**	**0.85****	**1.18**	**1.24**	**1.5**	**1.40****	**1.71**	**2.39****
	Dallas	0.32	1.00**	0.52	0.84**	0.71	1.25**	0.73	1.51**
	Salt Lake	0.68	0.74	0.94	1.14**	1.3	1.39	1.64	1.74
Home-Based Other	**Adelaide**	**1.33**	**1.60****	**3.05**	**3.02**	**5.01**	**3.92****	**5.29**	**7.84****
	Dallas	0.98	2.13**	1.89	2.25**	3.47	3.64	3.93	4.33**
	Salt Lake	1.92	1.73**	3.45	2.95**	5.33	4.54**	6.51	5.34**
Other-Work	**Adelaide**	**0.05**	**0.21****	**0.42**	**0.61****	**1.17**	**1.51****	**1.73**	**1.53****
	Dallas	0.19	0.68**	0.8	0.94**	1.41	1.54**	1.54	1.93**
	Salt Lake	0.4	0.29**	0.85	0.87	1.43	1.44	1.71	1.81
Other-Other	**Adelaide**	**0.56**	**0.85****	**1.58**	**1.90****	**2.38**	**2.33**	**2.52**	**4.80****
	Dallas	0.31	1.48**	0.96	1.39**	1.5	2.09**	1.66	2.39**
	Salt Lake	1.2	0.80**	1.98	1.50**	2.85	2.51**	3.45	2.95**
TOTAL TRIPS	**Adelaide**	**2.9**	**4.11****	**7.09**	**8.29****	**12.1**	**12.15**	**14.44**	**23.15****
	Dallas	3.55	6.93**	5.76	7.17**	9.82	11.50**	11.49	13.99**
	Salt Lake	5.24	4.52**	9.2	8.30**	14.28	13.09**	17.84	16.61**

** Statistically significant difference in trip rates at the 95 percent confidence level*
***Statistically significant difference in trip rates at the 99 percent confidence level*

For households with 3+ vehicles, the absolute magnitude of the difference exceeds one for home-based school, home-based other, other-other and total trips (4.15, 2.55, 2.28 and 8.71 respectively). For households with two vehicles, the absolute magnitude of difference exceeds one for home-based other trips only (1.09) and for households with no vehicles for total trips only (1.21). All other magnitude differences are relatively small. In comparison to the US data compares similarly to all but home-based school trips for which the Dallas simulation performs markedly better.

Table 10 shows the categories created for the household life cycle variable and Table 11 compares the trip rates per household by the categorical variable household lifecycle. This variable was created for each data set taking into account the number of household members, the number of household workers and the children.

Table 10: Household Lifecycle Category

Lifecycle Category	Household lifecycle
1	**1 person, 1 worker**
2	**Single working parent**
3	**Multiple adults, 1+ workers, 0 children**
4	**Multiple adults, 1+ workers, 1+ children aged 0-4**
5	**Multiple adults, 1+ workers, 1+ school aged children**
6	**1+ adults, no workers, no children**
7	**1+ adults, no workers, 1+ children**
8	**No adults, 1 worker**
9	No adults, no workers

Table 11: Comparison of Trip Rates per Household by Household Lifecycle

Purpose	Source	Lifecycle						
		1	2	3	4	5	6	7
Home-Based Work	**AHTS**	**0.95**	**0.83**	**2.06**	**1.44**	**1.74**	**0.02**	**0.05**
	Synthetic	**1.33****	**1.72****	**2.49****	**1.79****	**2.39****	**0.00****	**0.03****
	Dallas HTS	1.31	1.09	2.45	2.01	2.25	0.13	0.24
	Simulated Data	1.31	1.29**	2.60**	2.12**	2.38**	0.00**	0.00**
	Salt Lake HTS	1.27	1.02	2.21	1.89	2.26	0.12	0.04
	Simulated Data	1.34**	1.44**	2.64**	2.01**	2.48**	0.00**	0.03**
Home-Based School	**AHTS**	**0**	**0.86**	**0**	**0.12**	**1.36**	**0**	**1.22**
	Synthetic	**0**	**2.16****	**0**	**0.00****	**2.35****	**0**	**1.81****
	Dallas HTS	0	1.62	0	0	2.02	0	2.1
	Simulated Data	0	1.74**	0	0	2.38**	0	1.54**
	Salt Lake HTS	0	1.88	0.07	0.01	3.68	0	2.02
	Simulated Data	0	2.10**	0.00**	0.00**	3.01**	0	1.81**
Home-Based College	**AHTS**	**0.02**	**0.03**	**0.15**	**0.04**	**0.1**	**0.03**	**0.06**
	Synthetic	**0.14****	**0.04***	**0.28****	**0.08****	**0.20****	**0.09****	**0.08**
	Dallas HTS	0.06	0.07	0.23	0.18	0.25	0.06	0.37
	Simulated Data	0.13**	0.10**	0.22	0.18	0.17**	0.08*	0.12**
	Salt Lake HTS	0.05	0.12	0.51	0.28	0.3	0.08	0.42
	Simulated Data	0.07*	0.09**	0.45	0.14**	0.22**	0.1	0.08**
Home-Based Shop	**AHTS**	**0.64**	**1.13**	**1.46**	**1.45**	**1.68**	**1.12**	**1.49**
	Synthetic	**0.51****	**1.44****	**1.26****	**1.10****	**1.77***	**1.19***	**1.91****
	Dallas HTS	0.29	0.51	0.68	0.58	0.74	0.86	0.76
	Simulated Data	0.55**	1.22**	1.13**	1.07**	1.74**	1.09**	1.10**
	Salt Lake HTS	0.41	0.8	1.15	1.06	1.9	0.99	1.46
	Simulated Data	0.50**	1.33**	1.2	1.15*	1.95	1.20**	1.91**
Home-Based Other	**AHTS**	**1.22**	**5.24**	**3.13**	**5.96**	**7.84**	**2.15**	**5.65**
	Synthetic	**1.10****	**4.41****	**2.84****	**2.98****	**6.14****	**2.35****	**5.46***
	Dallas HTS	0.92	2.86	2.42	2.5	5.59	2.48	3.15
	Simulated Data	1.16**	4.00**	2.60**	3.25**	6.31**	2.31**	3.61**
	Salt Lake HTS	1.47	3.67	3.61	3.8	8.95	3.04	5.34
	Simulated Data	1.12**	4.59**	2.92**	2.89**	7.27**	2.57**	5.46
Other-Work	**AHTS**	**0.77**	**0.7**	**1.45**	**1.04**	**1.42**	**0.01**	**0.03**
	Synthetic	**0.86****	**0.99****	**1.68****	**1.87****	**1.84****	**0**	**0**
	Dallas HTS	0.99	1.1	1.4	1.48	1.68	0.1	0.05
	Simulated Data	0.98	1.00**	1.69**	1.86	1.91**	0	0
	Salt Lake HTS	1.13	1.38	1.61	1.38	1.8	0.07	0.04
	Simulated Data	1.08	1.18**	1.68	1.69**	1.87**	0	0
Other-Other	**AHTS**	**0.79**	**3.01**	**1.52**	**2.51**	**3.73**	**1.03**	**2.99**
	Synthetic	**0.70****	**2.75****	**1.76****	**1.81****	**3.28****	**1.51****	**2.46****
	Dallas HTS	0.55	1.69	1.16	1	2.15	1.13	2.02
	Simulated Data	0.74**	2.34**	1.58**	2.07**	3.33**	1.58**	2.46**
	Salt Lake HTS	0.95	2.26	2.27	2.23	4.37	1.75	3.32
	Simulated Data	0.67**	1.93**	1.79**	1.77**	3.75**	1.47**	2.46**
TOTAL TRIPS	**AHTS**	**4.39**	**11.8**	**9.76**	**12.57**	**17.88**	**4.37**	**11.48**
	Synthetic	**4.63****	**13.52****	**10.31****	**9.64****	**17.97**	**5.14****	**11.73**
	Dallas HTS	4.13	8.93	8.33	7.75	14.69	4.74	8.68
	Simulated Data	4.87**	11.70**	9.81**	10.55**	18.22**	5.06**	8.83
	Salt Lake HTS	5.29	11.12	11.42	10.64	23.26	6.06	12.64
	Simulated Data	4.79**	12.66**	10.67**	9.65**	20.56**	5.34**	11.73**

** Statistically significant difference in trip rates at the 95 percent confidence level*
***Statistically significant difference in trip rates at the 99 percent confidence level*

Despite the significant differences, the absolute magnitude of the differences for the Adelaide data is relatively small. Only for home-based college trips for household life cycle category 2 (1.3), home-based other trips for household life cycle category 4 (2.98) and for total trips for life cycle categories 2 and 4 (1.72 and 2.93) is the absolute magnitude of the difference greater than 1. Although several other differences are greater than 0.5, the majority are less than 0.5. In comparison to the US data in terms of number of absolute differences, the Adelaide data compares fairly similarly.

3.2 Mode share comparisons

Table 12 shows a comparison of the mode shares for the Adelaide HTS and synthetic data as well as comparing the Adelaide synthetic mode shares with those of the synthetic data from Dallas and Salt Lake City. Significant differences are also shown. Baton Rouge was not compared due to the non-availability of data. As can be seen for the Adelaide study, significant differences exist for nearly every mode share, the exceptions being for home-school drivers, home-college bike/walk, home other transit, other-work driver and other-other transit.

Table 12: Comparisons of Simulated Data by Mode and Purpose

Trip Purpose	Mode	Adelaide		Dallas	Salt Lake	Adelaide Synthetic	
		HTS	Synthetic	Synthetic	Synthetic	Diff From Dallas	Diff From Salt Lake
Home-Work	**Driver**	82.56%	86.53%**	88.76%	89.92%	**	**
	Passenger	7.51%	9.33%**	7.44%	7.42%	**	**
	Transit	6.43%	2.21%**	2.16%	1.22%		**
	Bike/Walk	3.49%	1.92%**	1.63%	1.43%		*
Home-School	**Driver**	1.61%	2.28%	3.75%	5.43%	**	**
	Passenger	58.86%	37.3%**	38.99%	36.40%		
	Transit	13.67%	51.11%**	49.16%	49.68%		
	Bike/Walk	25.84%	9.3%**	8.09%	8.48%		
Home-College	**Driver**	47.97%	73.34%**	71.51%	68.90%		
	Passenger	11.48%	10.66%	11.02%	8.27%		
	Transit	31.98%	6.85%**	7.81%	7.85%		
	Bike/Walk	8.55%	9.14%	9.64%	14.98%		**
Home-Shop	**Driver**	64.79%	67.75%**	73.04%	72.33%	**	**
	Passenger	17.20%	24.41%**	21.66%	22.65%	**	*
	Transit	3.51%	2.16%**	1.38%	1.22%	**	**
	Bike/Walk	14.47%	5.66%**	3.90%	3.80%	**	**
Home-Other	**Driver**	49.52%	60.47%**	62.38%	59.40%	**	
	Passenger	36.05%	31.74%**	30.66%	33.62%	*	**
	Transit	1.90%	2.11%	1.87%	1.45%		**
	Bike/Walk	12.51%	5.66%**	5.07%	5.54%	*	
Other-Work	**Driver**	82.54%	82.79%	85.09%	85.12%	**	**
	Passenger	4.94%	10.4%**	8.91%	9.72%	**	
	Transit	1.22%	1.86%**	1.50%	1.13%		**
	Bike/Walk	11.28%	4.93%**	4.48%	4.04%		*
Other-Other	**Driver**	48.23%	61.88%**	63.22%	60.26%		*
	Passenger	35.50%	30.57%**	29.76%	32.99%		**
	Transit	1.96%	1.97%	1.74%	1.46%		**
	Bike/Walk	14.28%	5.56%**	5.26%	5.28%		
All Purposes	**Driver**	56.35%	64.36%**	68.24%	63.80%	**	
	Passenger	27.92%	25.1%**	22.53%	25.55%	**	
	Transit	3.27%	5.21%**	4.69%	5.70%	**	**
	Bike/Walk	12.44%	5.31%**	4.52%	4.95%	**	*

** Statistically significant difference in trip rates at the 95 percent confidence level*
***Statistically significant difference in trip rates at the 99 percent confidence level*

Examination of the differences between both US synthetic data and the Adelaide synthetic data show that home-school, other-other and home-college trip rates (Dallas only) and mode shares are statistically similar. Various other mode shares are also statistically similar across the synthetic data.

As discussed in Greaves, Stopher and Bullock (7), disaggregation of mode shares into segments allows for analysis of simulation performance in estimation. Table 13 shows mode shares for the major trip purposes for households with different numbers of vehicles. Of significance, the simulation consistently over-estimates privately owned vehicle (POV) shares for all three-trip purposes across all households independent of number of vehicles and significantly under-estimates the volume of bike/walk trips. Transit and other trips are also poorly simulated. This is possibly the result of US trip distributions not being representative of travel patterns in Australia. Table 13 suggests that in Adelaide, there is a lower level of reliance on POV based travel than is probably the case in the US.

Table 13: Mode Share Comparisons by Number of Household Vehicles

Trip Purpose	Vehicles	Data Source	Mode of Travel			
			POV	Transit	Bike/Walk	Other
Home-work trips	**0**	**Adelaide**	23.33%	30.00%	31.67%	15.00%
		Synthetic	47.66%**	31.49%	20.85%**	0%**
	1	**Adelaide**	78.18%	14.11%	7.25%	0.47%
		Synthetic	93.99%**	2.84%**	3.17%**	0%**
	2	**Adelaide**	93.45%	4.39%	1.82%	0.34%
		Synthetic	99.09%**	0.52%**	0.39%**	0%**
	3+	**Adelaide**	94.65%	2.79%	2.32%	0.24%
		Synthetic	97.81%**	1.1%**	1.1%**	0%**
Home-non work trips	**0**	**Adelaide**	31.74%	19.86%	41.93%	6.47%
		Synthetic	59.61%**	19.13%*	21.26%**	0%**
	1	**Adelaide**	79.94%	3.36%	16.11%	0.59%
		Synthetic	86.93%**	6.78%**	6.28%**	0.02%**
	2	**Adelaide**	86.86%	1.88%	10.97%	0.28%
		Synthetic	88.16%**	7.73%**	4.09%**	0.02%**
	3+	**Adelaide**	87.84%	2.78%	8.91%	0.47%
		Synthetic	90.78%**	4.75%**	4.44%**	0.03%**
Non-home trips	**0**	**Adelaide**	38.63%	13.08%	47.98%	0.31%
		Synthetic	63.33%**	17.48%**	19.19%**	0%**
	1	**Adelaide**	81.97%	2.13%	15.61%	0.28%
		Synthetic	93.02%**	1.64%**	5.28%**	0.05%**
	2	**Adelaide**	87.67%	1.13%	10.82%	0.38%
		Synthetic	95.01%**	0.84%**	4.12%**	0.04%**
	3+	**Adelaide**	87.26%	1.16%	10.91%	0.67%
		Synthetic	94.51%**	0.77%**	4.68%**	0.05%**

** Statistically significant difference in trip rates at the 95 percent confidence level*
***Statistically significant difference in trip rates at the 99 percent confidence level*

The life cycle variable represents the primary categorization variable for the simulation and hence it is worthwhile examining this variable against mode shares. Such an examination, as shown in Table 14, reveals disappointing results with significant differences in every cell save transit for life cycle category 6. The simulation over-estimates the driver share and transit shares and underestimates each of the passenger and bike/walk mode shares. The results for the US studies in Dallas and Salt Lake are included for reference. It is interesting to note that for the two US studies there are fewer statistical differences and the magnitude of differences is far less than for the Adelaide data. As discussed earlier, this is suggestive of different modal distributions

between the US and Adelaide, with far greater reliance on privately-owned vehicles in the US than in the city of Adelaide.

3.3 Departure time Comparisons

Table 15 shows the departure time comparisons for all trip purposes. The Kolmogorov-Smirnov D-value provides a test to determine if the distribution of trips over the day is significantly different between the HTS and simulated data. This shows that for all but home-based school trips and other-work trips significant differences are observed between the two over the day. However the z test between the individual fractions in each time period demonstrate slightly better results with 14 out of the 32 fractions showing statistically different results. Interestingly, the differences largely occur in the home-based shopping, home-based other and other-other trips suggesting that for all other categories Australians and Americans share similar travel time patterns. Clearly examination of the percentages suggest that residents of Adelaide prefer to, or are forced by necessity to shop between business hours whereas in America, a greater percentage of shopping activity probably occurs outside this period.

Table 14: Mode-Share Comparisons by Household Lifecycle

Life Cycle Grouping	Data source	Mode shares (Percent)			
		Driver	**Passenger**	**Transit**	**Bike/Walk**
1 1 person, 1 worker	**AHTS**	76.89	4.86	3.57	14.67
	Synthetic	89.9**	3.6*	6.3**	0.0**
	Dallas HTS	92.5	3	4.4	0.2
	Simulated Data	93.7*	2.0*	4.2	0
	Salt Lake HTS	89.7	2.8	6.9	0.6
	Simulated Data	94.1**	1.9	3.9**	0.0**
2 Single working parent	**AHTS**	44.68	41.55	3.26	10.51
	Synthetic	81.8**	11.0**	7.1**	0**
	Dallas HTS	79.3	11.1	9.5	0.1
	Simulated Data	84.4**	8.9*	6.8**	0
	Salt Lake HTS	82	4.3	12.7	1
	Simulated Data	81	11.7**	7.2**	0.0**
3 Multiple adults, 1+ workers, 0 children	**AHTS**	71.27	15.87	2.72	10.14
	Synthetic	95.1**	1.5**	3.2**	0.0**
	Dallas HTS	96	1.1	2.7	0.2
	Simulated Data	96	1.1	2.8	0.1**
	Salt Lake HTS	94.3	0.9	4.2	0.6
	Simulated Data	94.9	1.2*	3.8	0.1**
4 Multiple adults, 1+ workers, 1+ children aged 0-4	**AHTS**	52.27	38.43	1.30	7.99
	Synthetic	95.3**	0.9**	3.6**	0**
	Dallas HTS	94.8	1.2	3.9	0.1
	Simulated Data	92.2**	3.3**	4.4	0.1
	Salt Lake HTS	97.6	2.4	0	0
	Simulated Data	94.8	1.6	3.6**	0.1
5 Multiple adults, 1+ workers, 1+ school aged children	**AHTS**	49.28	36.99	3.05	10.67
	Synthetic	86.1**	8.1**	5.7**	0.0**
	Dallas HTS	89.1	4.7	6.1	0.1
	Simulated Data	86.1**	8.3**	5.6	0.0**
	Salt Lake HTS	81.2	5.2	12.7	1
	Simulated Data	86.3**	8.3**	5.4**	0.0**
6 1+ adults, no workers, no children	**AHTS**	51.55	22.03	5.54	20.89
	Synthetic	90.4**	3.3**	0.06	0.0**
	Dallas HTS	94.8	1.1	3.9	0.3
	Simulated Data	92.7**	2.0**	5.2*	0.0*
	Salt Lake HTS	92.3	2.5	5	0.1
	Simulated Data	93.8*	1.6**	4.6	0
7 1+ adults, no workers, 1+ children	**AHTS**	34.81	42.81	3.09	19.29
	Synthetic	79.8**	11.04**	9.0**	0.0**
	Dallas HTS	69.7	10.4	19.9	0
	Simulated Data	75.4	15.2	9.4**	0
	Salt Lake HTS	76	10.6	11.8	1.6
	Simulated Data	78.7	11.7	9.6	0.0**

** Statistically significant difference in trip rates at the 95 percent confidence level*
***Statistically significant difference in trip rates at the 99 percent confidence level*

Table 15: Comparisons of HTS and Simulated Departure Times by Trip Purpose

Purpose	Time Period	AHTS	Synthetic	D Stat
Home-Based Work	6.01 a.m. - 9.00 a.m.	35.3%	35.7%	**
	9.01 a.m. - 4.00 p.m.	24.5%	24.2%	**
	4.01 p.m. - 7.00 p.m.	28.3%	25.3%*	**
	7.01 p.m. - 6.00 a.m.	11.9%	14.8%	**
Home-Based School	6.01 a.m. - 9.00 a.m.	52.7%	49.4%	
	9.01 a.m. - 4.00 p.m.	42.4%	45.2%	
	4.01 p.m. - 7.00 p.m.	4.6%	4.9%	
	7.01 p.m. - 6.00 a.m.	0.3%	0.5%	
Home-Based College	6.01 a.m. - 9.00 a.m.	25.4%	36.0%*	**
	9.01 a.m. - 4.00 p.m.	44.8%	40.4%	**
	4.01 p.m. - 7.00 p.m.	22.3%	13.7%	**
	7.01 p.m. - 6.00 a.m.	7.6%	9.9%	**
Home-Based Shop	6.01 a.m. - 9.00 a.m.	5.5%	5.9%	**
	9.01 a.m. - 4.00 p.m.	67.4%	53.9%**	**
	4.01 p.m. - 7.00 p.m.	21.2%	24.9%**	**
	7.01 p.m. - 6.00 a.m.	5.9%	15.2%**	**
Home-Based Other	6.01 a.m. - 9.00 a.m.	11.3%	12.0%	**
	9.01 a.m. - 4.00 p.m.	47.6%	40.8%**	**
	4.01 p.m. - 7.00 p.m.	24.6%	26.6%*	**
	7.01 p.m. - 6.00 a.m.	16.4%	20.4%**	**
Other-Work	6.01 a.m. - 9.00 a.m.	11.7%	13.0%	
	9.01 a.m. - 4.00 p.m.	65.9%	64.2%	
	4.01 p.m. - 7.00 p.m.	17.8%	18.2%	
	7.01 p.m. - 6.00 a.m.	4.6%	4.5%	
Other-Other	6.01 a.m. - 9.00 a.m.	6.1%	6.8%	**
	9.01 a.m. - 4.00 p.m.	68.1%	61.2%**	**
	4.01 p.m. - 7.00 p.m.	17.3%	18.8%	**
	7.01 p.m. - 6.00 a.m.	8.6%	13.1%**	**
TOTAL TRIPS	6.01 a.m. - 9.00 a.m.	6.1%	16.3%**	**
	9.01 a.m. - 4.00 p.m.	68.1%	47.0%**	**
	4.01 p.m. - 7.00 p.m.	17.3%	22.2%**	**
	7.01 p.m. - 6.00 a.m.	8.6%	14.3%**	**

** Statistically significant difference in trip rates at the 95 percent confidence level*
***Statistically significant difference in trip rates at the 99 percent confidence level*

3.4 Trip-Length Comparisons

Table 16 shows the comparison for the Adelaide HTS and simulation trip lengths. Statistical differences are observed for all trips purposes with the exception of home-based shopping trips. With the exception of home-based school trips, where a difference exists, the simulation overestimates the trip length. One of the critical shortcomings of the simulation is that it does not take into account physical geography.

Table 16: Comparison of HTS and Simulated Vehicle Trip Lengths (minutes)

Purpose	Adelaide		Synthetic	
	Mean	Std. Dev.	Mean	Std. Dev.
Home-Based Work	23.63	16.64	19.46**	16.44
Home-Based School	14.08	12.04	16.34**	13.76
Home-Based College	29.35	20.44	19.02**	15.32
Home-Based Shop	12.10	11.64	12.32	12.00
Home-Based Other	16.64	18.87	14.01**	15.75
Other-Work	17.26	18.93	15.11**	17.42
Other-Other	15.50	20.87	14.29**	16.49
TOTAL TRIPS	16.66	18.34	14.97**	15.77

** Statistically significant difference in trip rates at the 95 percent confidence level*
***Statistically significant difference in trip rates at the 99 percent confidence level*

4. Conclusion

While the simulation produced a considerable number of statistical differences to the HTS, that warrant further investigation as to how the simulation procedure can be improved, the overall performance of the simulation was not much different from that found in application to Dallas and Salt Lake in the U.S.. As has been stated, there do appear to be significant differences between the US and Australia in terms of reliance upon privately owned automobiles. As a result, the simulated results are less close than would be desired when applied to the Australian sphere. This suggests that in the future, perhaps a small local survey be conducted and the results used to update the distributions so as to take into account the local trip distributions. Nevertheless, when one considers that the Adelaide data showed about 30 percent fewer workers per household, an average of 50% more non-car-owning households, and about 25% lower average cars per household, it is remarkable that the simulations for Adelaide did as well as they did. This seems to indicate that the simulation procedure used here is capable of adapting to quite a wide range of differences in socio-demographics and transport supply situations.

Recent work by Kothuri (2002) on Bayesian updating of the simulations suggests that this may be a simple method by which the results can be improved. This would be the next logical step in this procedure of simulation. At the same time, it is important to note that statistical significance of differences between the simulated and original survey results is neither a sufficient nor a necessary condition for acceptance of the simulation procedure. These results are inputs to descriptions of the region, obtained through data expansion and weighting procedures, and to models that describe and forecast travel behaviour. To determine the real acceptability of the simulations, it would be necessary to undertake both of these activities with each of the simulated and actual data and compare the results.

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