An Activity-based Analysis of Singapore Household Travel Survey of 2008

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1 Introduction and Survey Description

The Land Transport Authority in Singapore (LTA) will conduct a household travel survey every four years. The latest one was conducted in 2008. The survey followed a standard trip diary approach. A trip-to-tour conversion process is required to aid modeling practitioners who are going to adopt activity-based modeling approach in Singapore. This abstract first gives a short description of the survey data. Then essential results and insights derived from tour codes are presented. The last section provides a short conclusion and future work.

The survey was conducted by face-to-face interview and was designed to capture details of household and personal characteristics and daily trip-making decisions of each person in the household. A total of 10,641 households comprised of 38,053 eligible respondents passed the quality control procedure conducted by LTA. We developed a number of scripts to run extra data checks on the original database, convert trips to tours, detect work-based sub-tours and derive useful results and insights. These results are categorized into 3 levels: trip level, tour level and person-day level. Results of trip level can be derived from original database directly. However, results of tour level and person-day level are only available

after trips are integrated into tours. Results and Insights of these two levels are briefly presented in the next section.

2 Results and Insights

Before presenting the results we need to define a number of terms. A *home-based tour* or *tour* is a sequence of trips starting and ending at home. Sample tours in Figure 1 contain 2 tours. A tour that is non-home-oriented as in the case in Figure 1 or non-home-ended is flagged as an abnormal tour. A tour may contain one or more activities (stops). A *work-based sub-tour* is a sequence of trips starting and ending at the same work location. Sample tours in Figure 1 contain 1 sub-tour. The *day pattern* of a person is the occurrence of tours (0, 1+) and intermediate stops (0, 1+) for 10 given purposes.

2.1 Tour Level

On average, 2.26 trips are made in a tour. As can be seen in Figure 2, over 83% of tours contain only 2 trips and for work tour and education tour, this percentage becomes 88 and 93 respectively. 78.8% of people make simple tours with no trip chains, which may due to the high rate of public transportation use in Singapore since private motorized vehicles tend to trigger more intermediate stops in tours. Among all purposes of tour, work-related business tour has the highest average number of trips per tour, which is 2.68.

The distribution of main mode of tour among all given modes is shown in Figure 3 and 4. For home-based tours, 3 most common modes are MRT/LRT, Public bus and Car driver. 46.8 % of tours are made by public transportation(MRT/LRT and Public bus). For work-based sub-tour, Car driver and Car passenger are the dominant modes.

2.2 Person Day Level

The person day level deals with the relationship between tours, day patterns and person types. As indicated in Table 1, number of tours made during the day shows significant heterogeneity by person type. Respondents make an average number of 0.8 tour per day. 25.7% of all respondents make no tour at all. 69.2 % of all respondents made 1 tour and 5.1% of all respondents make 2+ tours. Full time employees and students are likely to make at least 1 tour during the day. In terms of work-based sub-tour, all sub-tours are

made by employees (Employed full time, Employed part time and Self-employed). And full time employees make more than 85% of all sub-tours.

Figure 5 shows the average number of tours by person type and tour purpose, which again shows great heterogeneity among all person types. Employees and students make more tours than other people and main purpose of these tours is work and education respectively. For person types other than employees and students, tour purposes are not concentrated on one particular purpose.

By adopting the term *day pattern* defined in prior, the dominant day patterns for different person types can be determined. It is assumed that 10 activity purposes can be assigned to tours and trips as primary activity purpose of tour and purpose of trip respectively. One can make 0 or 1+ tours for each of the 10 purposes and 0 or 1+ intermediate stops for each of the 10 purposes, which theoretically results in 2^{20} alternatives for day pattern. Apparently a majority of these patterns are not feasible in reality. Only 579 day patterns are observed in the database. As can be seen in Table 2, the top 3 day patterns show great heterogeneity by person type. The No.1 pattern for a person type can be viewed as the expected stereotypical pattern, but the percentage of choosing the stereotypical pattern is significantly different from 100%. For employees and students, the "0 tour, 0 stop" day pattern is an indication of the extent of telecommuting or absenteeism from work or school on a given weekday.

3 Conclusion and Future Work

After the trip-to-tour conversion, the survey data presents a reasonable picture of travel behavior that can not be depicted by traditional trip-based statistics. By processing the trip-based survey data, reasonable tour codes are derived and can be used to support the development of tour-based models. For many metropolitan planning organizations, travel surveys are still conducted in a trip-based manner, this study shows that for these organizations, they already possess the data that are needed to develop tour-based models.

The future work may include the following 2 aspects. The first aspect is to apply the tour codes to develop an tour-based demand model in Singapore. The second aspect is to develop programs that can be applied to future surveys that are GPS-based and with a period of more than one day.

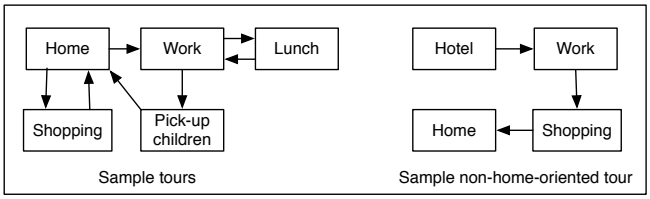

Figure 1: Tour pattern illustration

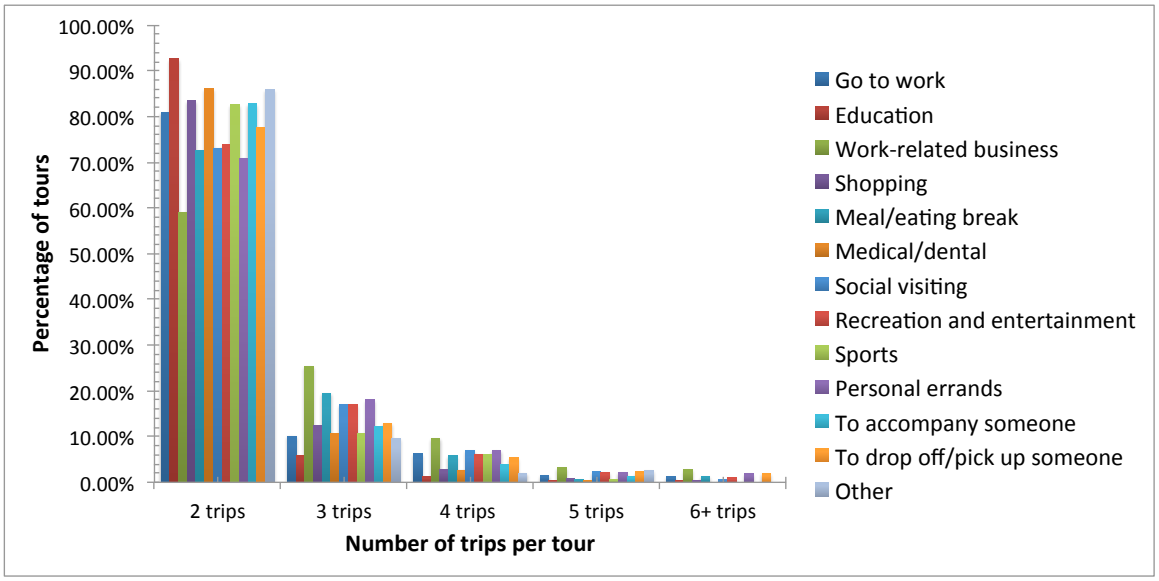

Figure 2: Number of trips per tour by purpose of tour

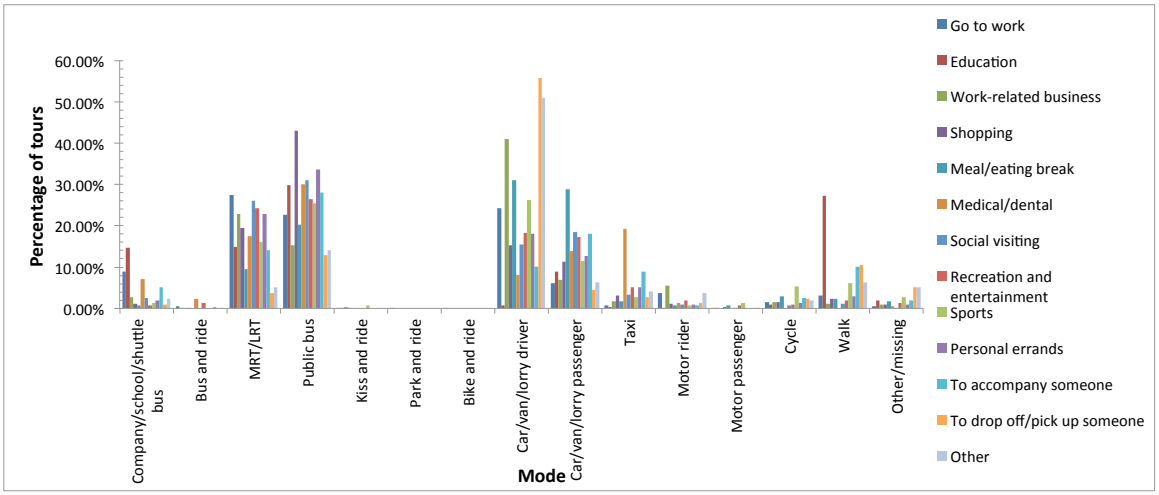

Figure 3: Home-based tour main mode by activity purpose

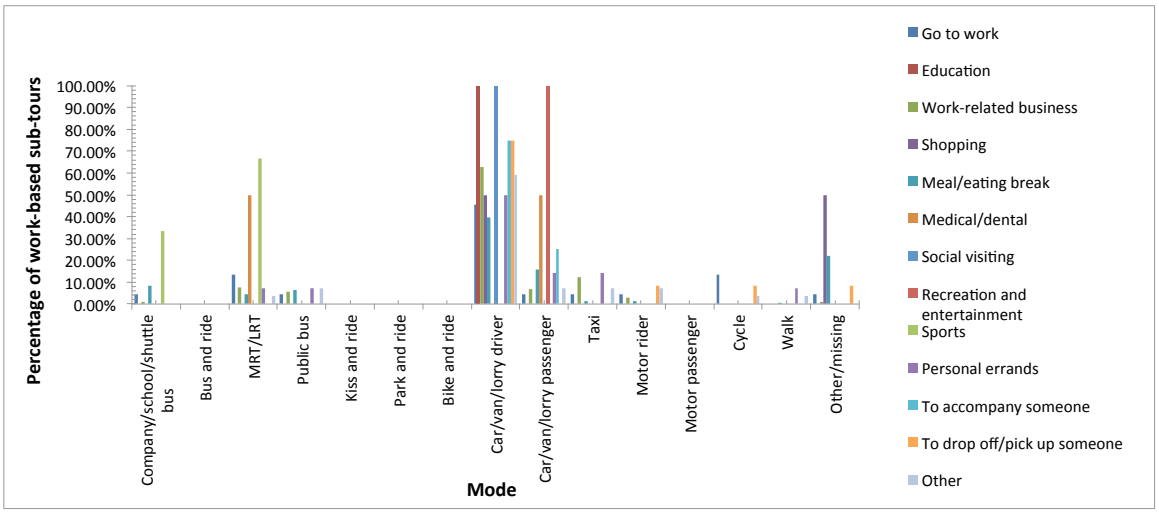

Figure 4: Work-based sub-tour main mode by activity purpose

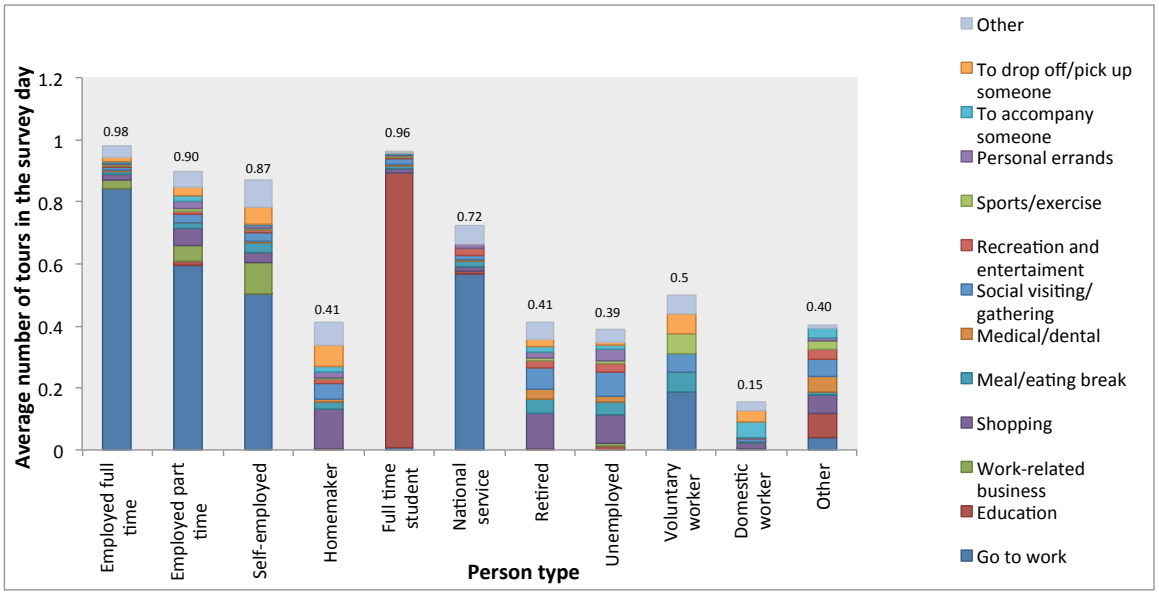

Figure 5: Average number of tours by person type and tour purpose

Table 1: Number of home-based tours by person type

Person type	Number of tours			
	0	1	2	3+
Employed full time	7.03	87.84	4.60	0.53
Employed part time	18.83	73.34	6.34	1.49
Self-employed	26.85	61.31	9.76	2.08
Homemaker	68.36	24.84	4.87	1.93
Full time student	6.64	90.09	3.15	0.12
National service	21.52	76.58	1.90	0
Retired	64.02	31.48	3.74	0.76
Unemployed	64.18	32.58	3.00	0.24
Voluntary worker	50.00	43.75	6.25	0
Domestic worker	87.86	8.93	3.07	0.14

Table 2: Top 3 day patterns by person type

Person type	Top 3 day patterns					
	No. 1	%	No. 2	%	No. 3	%
Employed full time	1+ work tour 0 stop	64.68	0 tour 0 stop	7.03	1+ work tour 1+ escort stop	5.85
Employed part time	1+ work tour 0 stop	48.37	0 tour 0 stop	18.83	1+ shopping tour 0 stop	3.36
Self-employed	1+ work tour 0 stop	31.81	0 tour 0 stop	26.85	1+ work-related business tour 0 stop	4.62
Homemaker	0 tour 0 stop	68.36	1+ shopping tour 0 stop	9.79	1+ social/recreation tour 0 stop	4.81
Full time student	1+ education tour 0 stop	78.77	0 tour 0 stop	6.64	1+ education tour 1+ escort stop	1.73
National service	1+ work tour 0 stop	53.16	0 tour 0 stop	21.52	1+ other tour 1 stop	8.23
Retired	0 tour 0 stop	64.01	1+ shopping tour 0 stop	9.01	1+ social/recreation tour 0 stop	7.44
Unemployed	0 tour 0 stop	64.18	1+ social/recreation tour 0 stop	8.29	1+ shopping tour 0 stop	6.25
Voluntary worker	0 tour 0 stop	50.00	1+work tour 0 stop	12.50	N/A	N/A
Domestic worker	0 tour 0 stop	87.87	1+ escort tour 0 stop	5.23	1+ shopping tour 0 stop	1.19