

“Travel Early, Travel Free”: Investigating the Barriers and Incentives for Pre-Peak Travel

Problem Statement

In June 2013, the Singapore Government launched the “Travel Early, Travel Free” Campaign. An attempt to encourage pre-peak travel, the campaign offered free trips to commuters who exited from one of 16 MRT stations before 7:45 am on weekdays, and 50-cent discount on those who exited within the next 15 minutes. The goal was straightforward: if commuters were sufficiently motivated to leave their homes early, peak traffic will be reduced, thereby improving overall commuter experience. The question is: how do incentives and barriers influence the adoption of pre-peak travel? As consultants for the Land Transport Authority (LTA), we will first evaluate if the campaign encouraged pre-peak travel, before proceeding to uncover the reasons behind these patterns: that is, the incentives and barriers that drive commuter decisions. We trust that the research will enable LTA to evaluate and, if necessary, refine the campaign accordingly.

Research Methodology

While the programme offers cost savings that incentivise pre-peak travel, its degree of attractiveness rests on the perceptions and income brackets of commuters, some of whom may value sleep, for example, over a 50-cent rebate. Further, barriers exist on several levels: personal (e.g. income); social networks (e.g. sending children to school); and structural (e.g. flexible work arrangements). To understand how these barriers and incentives affect the adoption of pre-peak travel, we will be merging two datasets: Survey Responses and Trip-Level Records. As each contains the unique Subject IDs of participants, merging both would allow us to analyse their travel data before, during, and after the promotion period; and understand how lifestyles influence adoption rates.

Firstly, we matched the datasets by Subject ID and noted if participants were in the treatment or control group (see Assumption 1). Within each group, we defined peak travel and pre-peak travel adoption rates as the percentage of rides within a particular time period relative to total rides in the same group, within the same phase. There are four time periods: two within pre-peak timings (exits before 7:45am, for whom consumers will receive a full refund; and between 7:45am to 8am, which qualifies for a 50cent rebate); and two within peak timings (exits between 8:00am to 8:30am; and between 8:30am to 9:00am). Results were then analysed across three phases: Before Promotion (before 22/09/2014), During Promotion (22/09/2014 to 14/11/2014) and After Promotion (after 14/11/2014). Accordingly, differences in adoption rate across groups and time periods allows us to evaluate the effectiveness of the campaign in easing peak travel.

Next, we examine the Survey Responses to understand the incentives and barriers that drive adoption rate across four consumer segments, each defined by their stated willingness to “take advantage of the promotion (see Assumption 3). These four segments are “Never”, “Occasionally”, “Majority of the Time”, and “All the Time”. By cross-tabulating these segments with their income brackets, we examine if the campaign is income-sensitive. Recognising the role of non-monetary factors in driving adoption decisions, we also analyse the differences across segments tabulating their answers to specific questions in the survey: those who are “very likely” or “somewhat likely” to leave early for guaranteed seats; those who escort their children to school; and those whose employers impose a strict attendance system. Finally, we identify the needs that drive commuting patterns, and make recommendations on key segments.

Assumptions

1. **Treatment Group and Control Group:** When analysing the ride data of commuters, their inclusion (or exclusion) from the treatment group depends on the presence (or lack thereof) of a response on Q4 in the pre-survey, which was pre-determined randomly by the researchers. After merging the two datasets by unique Subject ID, commuters whose IDs are not present in the survey will be considered as part of the control group. Further, we assume that no other differences exist between the two groups.
2. **Confounding Variables:** Commuters who participate in other travel programmes (Progs 1, 2, or 3) and/or are moving houses or workplaces are disqualified from further analyses because they introduce confounding variables (i.e. incentives or barriers) that cannot be isolated from the present campaign.
3. **Consideration of Barriers and Incentives:** Commuters’ responses to survey questions are based on a comprehensive evaluation of the relevant barriers and incentives, which hold true for their actual trip data. That is, we assume the responses to Q4 (i.e. On a scale of 1-4, rate how often you plan to take advantage of the above offer by changing your travel time in the next two months.) are representative of their actual travel behaviours.

58 **Data Validation**

59 In cleaning the Survey Dataset, we removed incomplete records (N=1), and participants who presented confounding
60 variables, such as persons who participated in Programmes 1, 2, or 3, and who were moving home or workplaces
61 (N=140). After cleaning (including procedures described below), there are 232 Survey respondents, 161 of whom
62 were allocated to the treatment group, and 71 in the control group. Of the 93 commuters in Ride_Data, providing
63 40654 records, 62 were matched successfully with their survey responses: 60 were from the treatment group and
64 2 in the control group. The 31 Subject IDs who cannot be matched with survey responses were included as part of
65 the control group.

66
67 **Data Errors (Internal Validity)**

68 We identified data errors by systematically checking for “common” data errors:

- 69 • **Data Type Check:** “DATE”, which represents the date of ride, should be converted from “character” to “date”
70 so that we may analyse the commuters' travelling patterns during different periods.
- 71 • **Range check:** As children under seven years old can travel for free on public transport, respondents should be
72 older than seven. Hence, we removed the entry of a particular respondent whose “YearOfBirth” was 2014--
73 the year in which the survey was conducted.
- 74 • **Formatting check:** “SubIdx” contains the unique Subject IDs of survey respondents and commuters, allowing
75 us to match respondents between the two datasets. However, there are 443 entries whose Subject IDs are
76 represented by a period (“.”) instead of an integer. As the latter entries are ambiguous and cannot be
77 compared against the survey dataset, we removed these entries.
- 78 • **Consistency check:** “ENTRY_TM” and “EXIT_TM” presented multiple inconsistencies. For example, a particular
79 passenger may enter the station at 17:35:11, but exit at 6:39:50, suggesting erroneously that he stayed within
80 the MRT station overnight. After inspection, we found that these inconsistencies arose from inaccurate
81 conversions between 12-hour and 24-hour clocks. In the above example, the exit time should be “18:39:50”.
82 To resolve the inconsistency, further analyses rely instead on the columns “ENTRY_HHMM” and
83 “EXIT_HHMM” which equal to 60*EXIT_HH + EXIT_MM, representing the accurate times at which subjects
84 enter or exit the MRT station.

85
86 **External Validity:** This research investigates incentives of people who live in Singapore for pre_peak travel and
87 the barrier for the authority to carry out measures to resolve the peak hour problem. Hence, while providing
88 some descriptive insight into the above problems, we are unable to generalise these results to other peak travel
89 periods of the day, nor to other countries.

90
91 **Key Findings**

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93 **1. Campaign Effectiveness**

% of adopters	Treatment Group				Control Group			
	Before 7:45am	7:45am – 8:00am	8:00am – 8:30am	8:30am – 9:00am	Before 7:45am	7:45am – 8:00am	8:00am – 8:30am	8:30am – 9:00am
Before promotion	5.81%	4.45%	21.48%	18.20%	9.21%	4.47%	19.29%	17.90%
During Promotion	7.88%	6.52%	20.88%	15.36%	8.62%	5.34%	17.76%	19.93%
After Promotion	5.88%	6.14%	21.46%	15.35%	7.52%	6.27%	16.15%	19.82%

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96 **Diversion of Peak Travel Crowds** There is strong evidence that the campaign was successful in increasing pre-peak
97 travel, and in achieving LTA’s overall goal of smoothing the surged crowd between 8:30am and 9:30am. Firstly, pre-
98 peak travel rates increased during the promotion: within the treatment group, rides before 7:45am increased by
99 2.07% from 5.81% to 7.88%, while rides between 7:45am to 8am increased by 2.07% from 4.45% to 6.52%.
100 Correspondingly, rides between 8:30am to 9:00am declined by 2.84%, suggesting that the campaign successfully
101 diverted peak crowds to non-peak travel. When contrasted against the control group, which witnessed a 2.03%

102 increase in peak travel over the same period (owing to factors outside the purview of this study) we are happy to
 103 report that the campaign achieved an overall effect of 2.84% + 2.03% = 4.87% in reducing peak travel between
 104 8:30am and 9am.

105
 106 **Cultivating the Habit of Pre-Peak Travel** Interestingly, there is evidence that the effect is sustained even *after* the
 107 promotion, with spill-over effects across the peak window between 8am to 9am. While only 10.26% of all trips were
 108 made before 8am before the promotion, this figure increased to 12.02% post-promotion. Correspondingly, peak
 109 travel between 8am–9am decreased from 39.68% to 36.81%. We can confidently say that this effect may be
 110 attributed to the promotion, as peak travel reduced by just 1.22% in the control group, versus 2.87% for the
 111 treatment group. This sustained diversion of crowds even in the absence of monetary incentives suggests that pre-
 112 peak travel may be cultivated as a habit, and that commuters who ease into a routine, or who realise non-monetary
 113 perks of pre-peak travel, can be convinced to avoid peak travel windows.

114
 115 **2. Incentives and Barriers for Pre-Peak Travel**

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 117 To induce changes in commuter routines, the campaign tested the potential of monetary incentives in encouraging
 118 pre-peak travel. Whilst attractive, the decision to adopt pre-peak travel ultimately rests on a host of monetary and
 119 non-monetary incentives and barriers. To understand our target segments and identify ways to further refine the
 120 campaign, we pose the following research questions:

- 121
 122 a) Is the promotion income-sensitive?
 123 b) How do commuter segments vary by (a) preference for guaranteed seating, (b) whether or not they escort
 124 children to school, and (c) flexible work arrangements?

125
 126 The following analysis segments commuters by their stated willingness in Screen #4 of the survey to “take
 127 advantage of the promotion”. These four segments are: “Never”, “Occasional”, “Majority”, and “All the Time”.

128
 129 **2.1. Income Brackets of Commuters**

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 131 This “Travel Early, Travel Free” promotion is explicitly monetary in nature, as commuters enjoy fee waivers and
 132 rebates for pre-peak travel. In this regard, we hypothesized that commuters of lower income-brackets would be
 133 especially drawn to this incentive, as daily travel expenses comprise a relatively high proportion of their income as
 134 compared to commuters of higher income brackets.

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Income Bracket	Consumer Segment (Within Treatment Group)				
	Never	Occasional	Majority	All the time	Total
Below S\$1000	0.62%	0.00%	0.00%	0.62%	1.24%
S\$1,000-S\$1,999	0.62%	3.73%	1.86%	1.24%	7.45%
S\$2,000-S\$2,999	7.45%	11.80%	3.73%	3.11%	26.09%
S\$3,000-S\$3,999	2.48%	8.07%	5.59%	3.11%	19.25%
S\$4,000-S\$4,999	3.11%	6.83%	4.35%	1.86%	16.15%
S\$5,000-S\$7,999	6.83%	4.35%	3.73%	1.86%	16.77%
S\$8,000-S\$9,999	0.62%	3.11%	0.00%	1.24%	4.97%
S\$10,000-S\$14,999	0.00%	0.62%	3.11%	0.62%	4.35%
S\$15,000 & above	1.24%	1.24%	1.24%	0.00%	3.73%
Total	22.98%	39.75%	23.60%	13.66%	100%

136
 137 Assuming the sample is representative of Singapore’s commuter demographic, we find that MRT commuters are
 138 most likely to make between \$2000 and \$2999, with the proportion of commuters progressively decreasing across
 139 higher income brackets. For example, only 3.73% of commuters make \$15,000 and above, and none stated a desire
 140 to take advantage of the promotion “all the time”.

142 While this suggests that transportation modes vary by income—that is, persons who make less money are more
 143 likely to take the MRT—there is no evidence supporting our hypothesis that lower-income commuters would be
 144 more likely to take advantage of the promotion. Indeed, of commuters who make between \$2000 and \$2999, only
 145 11.92% stated that they leverage the promotion “all the time”, which is lower than the overall average of 13.66%.
 146 In contrast, the same figure stands at 16.15% for commuters who make between \$3000 and \$3999, and 24.94% of
 147 commuters who make between \$8000 and \$9999. Hence, we reject the hypothesis that the attractiveness of the
 148 promotion is negatively correlated with income levels, as findings suggest that the promotion is appealing across
 149 income segments.

150
 151 **2.2. Other Barriers and Incentives**

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 153 If there is no explicit relationship between income and the attractiveness of the promotion, the next question is:
 154 what are the particular characteristics of persons who are most reluctant (“Never”) and most willing to take
 155 advantage (“All the Time”) of the promotion? The following table treats each segment as a distinct population, as
 156 we identify their characteristics through their responses to barriers and incentives.
 157

Treatment Group	Response to Barriers and Incentives		
	Q3: Would leave early for guaranteed seating	Q6: Escort Children to School	Q5: Employers Impose Strict Attendance
Never	29.73%	18.92%	59.46%
Occasional	43.75%	10.94%	64.06%
Majority	57.89%	10.53%	44.74%
All the time	77.27%	31.82%	72.73%

158
 159 **Guaranteed Seating** In addition to fare rebates, guaranteed seating is a further incentive for pre-peak travel.
 160 Among commuters who do not intend to take advantage of promotion (“Never”), 29.73% state that they would
 161 leave early for guaranteed seating, with this figure consistently increasing among segments who are keener to
 162 take advantage of the promotion. This points at the attractiveness of guaranteed seating in convincing even the
 163 “Never” population to leave their homes early—even in the absence of rebates—and the degree to which it will
 164 further incentivise commuters who are already motivated to take advantage of the promotion. Hence, whilst it
 165 may be impossible to “guarantee” a seat, LTA may wish to advertise the greater likelihood of a seat in pre-peak
 166 travel advertisements as it is a strong selling point.

167
 168 **Escort Children to School** Commuters who escort their (presumably young) children to school are keen candidates
 169 for the campaign, as local primary and secondary schools start before 7:20am – leaving sufficient time for pre-
 170 peak travel before 8am. Accordingly, among commuters who intend to take advantage of the promotion “all the
 171 time”, 31.82% escort their children to school, a figure that is significantly higher than that for the other segments.
 172 Hence, LTA may find it especially worthwhile to target commuters who are already primed for pre-peak travel.

173
 174 **Strict Work Schedules** Depending on the length of the commute between the MRT station and their workplaces,
 175 strict work schedules may or may not be a barrier against pre-peak travel. On the one hand, pre-peak travel
 176 guarantees that employees would be early—and thus on-time for work, which is the *raison d'être* for strict work
 177 arrangements. On the other hand, while those with flexible work arrangements have the liberty to leave early if
 178 they arrive early, those with strict work schedules, and whose commutes are short, would find themselves at a
 179 disservice if they arrive at work *too* early. Our results show that the *former* trend is stronger, as 72.73% of
 180 commuters who intend to take advantage of the promotion “all the time” are subject to strict attendance, in
 181 contrast to 59.46% of those who do not intend to use the promotion.

182
 183 In summary, LTA should target commuter segments who escort their children to school, and whose employers
 184 impose strict attendance policies as these commuters are especially primed to adopt pre-peak travel. In bolstering
 185 adoption rates, its marketing material should also highlight non-monetary incentives such as the high likelihood of
 186 securing a seat. Consequently, as pre-peak travel develops into a habit with time, we may find sustained trends
 187 even in the absence of monetary incentives.