Role of Urban Transportation Through the Lens of Homeless Individuals: A Case Study of the City of Toronto

by

Vivian Chi-Wun Hui

A thesis submitted in conformity with the requirements for the degree of Master of Applied Science
Graduate Department of Civil Engineering
University of Toronto

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Abstract

Mobility has the potential to improve the quality of life for vulnerable population segments, including provision of opportunities for homeless individuals to break free from the cycle of poverty. Our research seeks to focus analysis on the travel behaviour of homeless individuals in the City of Toronto. The research relies on a specially designed interview instrument, which embodies both revealed preference and stated adaptation questions. The results of 159 face-to-face interviews with homeless individuals in Toronto identify the intricacies of homeless individuals’ travel decisions. We find that both travel time and cost influence street people’s mobility, and their potential to engage in employment and social activities. We find that subsidies can improve homeless individuals’ transport-related social exclusion and freedom of choice in their mode selection. Consequently, the relationship between transport-related social exclusion and homelessness is complex as the role of transportation heavily depends on one’s personal experiences.
Acknowledgments

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Vivian Chi-Wun Hui

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Chapter 1
Introduction

1 Homelessness in Canada

In Canada, the issue of homelessness is one of precedence. In fact, homelessness in Canada affects 200,000 people every year and costs the economy $7 billion (Miguel and Abughannam, 2014). In order to encourage housing stability for those living in poverty, the Government of Canada commits $119 million annually to the Homelessness Partnering Strategy (Gaetz et al., 2013, Gaetz et al., 2014). Naturally, the best way to solve the issue of homelessness is to provide affordable housing for all street people. One such example is the Housing First approach, which has provided homeless individuals with “immediate access to housing coupled with wraparound support services” (Miguel and Abughannam, 2014). Evidence has also shown that a Housing First approach can offset public sector costs across shelter, health and justice systems (Miguel and Abughannam, 2014). While such an approach is appropriate and can evidently succeed in solving homelessness, it requires much investment. In 2014, MaRS Discovery District assembled a report on the feasibility of using a social impact bond to mobilize the capital needed in this grand project (Miguel and Abughannam, 2014). Recently, in April 2015, MaRS extended a request for proposals to potential investors regarding their participation in the social impact bond. As such, it will most likely require years until the full project can transpire, and construction can begin on additional housing services for homeless individuals.

In the meantime, contemplation of ways to alleviate homelessness suggests that the issue cannot be solved using one method alone. Rather, a synthesis of various strategies is required to fully transition homeless individuals from the streets to permanent housing (Serge et al., 2006). In fact, the Housing First approach is “complemented by ongoing long-term support services adapted to the specific needs of individuals” (Miguel and Abughannam, 2014). Consequently, amongst the different strategies, transportation is found to play a vital role in solving homelessness (Kessler-Beck et al., 1997).
1.1 Homelessness in the City of Toronto

In regards to the Toronto context, the city has some of the most undesirable conditions for homeless individuals, namely due to high living costs and a high unemployment rate (Gaetz et al., 2013). In recognition of the need to address the homelessness issue, the City Council of Toronto conducted a series of “Street Needs Assessments” (City of Toronto, 2013). The studies were first prioritized in 2006, in order to “determine the services that people who are homeless need in order to help them find and keep permanent housing” (City of Toronto, 2013).

The Street Needs Assessment 2013, as the third assessment since 2006 and 2009, reveals the growing trends and concerns of the at-risk community. The assessment was comprised of two components: 1) a point-in-time method to count the number of at-risk individuals in Toronto on a particular day and 2) a 13-question survey to reveal socioeconomic attributes and desired services of the at-risk community. Analysis of the demographics signified an aging homeless population, as “the share of homeless seniors more than doubled in the past 4 years” (City of Toronto, 2013). The results also exhibited an overall underrepresented female homeless population, particularly with an extreme gender imbalance from surveys conducted on the streets (City of Toronto, 2013). While the study did not specifically ask questions pertaining to transportation, it did underscore the importance of transportation for the homeless population, in which 67% indicated that transportation services to see apartments would help them achieve permanent housing status. The significance of this finding is exhibited by the fact that transportation services placed 4th only to other services that directly deal with affordable housing: 1st: subsidized housing or a housing allowance; 2nd: help finding an affordable place; and 3rd: more money from Ontario Works or the Ontario Disability Support Program.

While both the State of Homelessness in Canada 2013 report (Gaetz et al., 2013) and the Street Needs Assessment 2013 report (City of Toronto, 2013) give little inference to the transportation needs of the at-risk community, the Fare Fair Coalition provides some indication of the “impact of the high cost of riding the Toronto Transit Commission (TTC) on the physical health and economic, mental and emotional well-being of people trying to get to [important destinations]” (Fare Fair Coalition, 2015). Presently, users of the TTC pay a single purchase fare of $3.00, although seniors (age 65+) and students (13-19) get a discounted price of $2.00 (Toronto Transit
Commission, 2015). Specifically, this fare is valid for a one-time travel from an origin to a destination within the TTC network.

Despite the transit cost existing as only one aspect of the transportation equity equation, it is an obvious hindrance to mobility options for low-income and homeless individuals in Toronto. To provide some perspective on this matter, “a single person on Ontario Works (financial assistance) receives $250 a month for basic needs, in addition to a housing allowance” (Spurr, 2013). This warrants much need for a discussion on ways to accommodate the circumstances of the at-risk community in regards to their transportation necessities.

Undeniably, the Fair Fare Coalition, as an advocacy group, offers a biased perspective on the issue of affordable public transit options. However, their work, which gathered opinions from low-income individuals in Toronto, offers some insight into the significance of cost as a barrier to using public transit, as “many participants stated that social destinations, such as visiting family or friends, as well as…going to recreation centres and volunteering, were destinations they could not reach due to cost” (Fair Fare Coalition, 2015). Moreover, several of the participants in the study also mentioned that they experienced making tradeoffs between choosing to use their money for food or for access to public transit. In fact, the study showed that “[many participants] routinely sacrifice feeding themselves adequately due in part to the budgetary restriction produced by transit costs” (Fair Fare Coalition, 2015).

The next section provides some background on the current research on the transportation field in relation to social exclusion for vulnerable population segments.

1.2 Transportation and Homelessness

Research on the field of transportation and social exclusion has been growing in recent years. The integration of these two disciplines is grounded in the idea that mobility is essential for the wellbeing of an individual (Stanley and Vella-Brodrick, 2009). Particularly, the United Kingdom, Australia and the United States have been leading the research on this field, encouraging formal policy recognition of transport-related social exclusion and the creation of transport-inclusive initiatives (Lucas, 2002, Lucas and Currie, 2012, Social Exclusion Unit, 2003, Thakuriah et al., 2011).
Existing literature have investigated transport-related social exclusion for various population segments. Such work has highlighted the importance of transportation for the low-income (Boschmann, 2011, Gurley and Bruce, 2005, Gurm et al., 2008, Hess, 2005, McCray and Brais, 2007, Mercado et al., 2012, Morency et al., 2011), the elderly (Kim 2011, Morency et al., 2011, Paez et al., 2007), the single parent (Morency et al., 2011, Paez et al., 2013), the youth (Casas et al., 2009, Marzoughi 2011, McCray and Mora, 2011) and the disabled (Casas 2007, Farber and Paez, 2010) populations.

Amongst the existing literature on transport-related social exclusion, there is seemingly little research that investigates the travel behaviour of homeless individuals, who are at the extreme ends of social exclusion. In retrospect, the first research on homelessness in the United States was motivated by the increasing cases of homelessness in the 1980s (Rowe and Wolch, 1990). Amid such research, we are aware of only one work, Wolch et al.’s (1993) study, that specifically explored the mobility needs of homeless individuals. We also identified two additional recent studies that directly engaged with the homeless community (Jocoy and Del Casino Jr., 2008 and York Region Alliance to End Homelessness, 2008). The limited research on the intersections of transportation engineering and homelessness provides a telling picture. Such research is difficult to undertake, because it requires qualified individuals whom can best engage with the homeless community, often translating to the need for strong governmental support. Thus, due to the complexity in the operation of homeless studies, the needs of this population segment are generally overlooked in transportation planning.

Indeed, the lack of research on the transport-related social exclusion of homeless individuals in Canada is attributed to similar aforementioned difficulties. Moreover, household travel surveys in Canada automatically exclude participation of those who are homeless. Our work (Hui and Habib, 2014) is recognized as the first exploration of the intersections of transportation and homelessness in the City of Toronto.

Nonetheless, there is need to further investigate the research gap of transportation and homelessness. The significance in filling the research gap lies in the results of past studies, in which homeless individuals cited shortage of transportation options as a barrier to employment opportunities (Brooks and Buckner, 1996, Serge et al., 2006). In another study, homeless women criticized the long travel time and high travel cost pertaining to public transit use as restrictions.
from finding employment and housing (Goldberg, 1999). In summary, the results from these studies suggest that the transport needs of homeless individuals should be further examined. In particular, many homeless individuals rely on transportation and its provision of mobility to access employment and housing opportunities. More importantly, both employment and housing opportunities have the potential to allow homeless individuals to break free from the cycle of poverty.

The next chapters delve into our work on one of the first studies of transportation engineering and homelessness in the City of Toronto.
Chapter 2
Preliminary Work

2 Preliminary Work

This chapter details our preliminary work (Hui and Habib, 2014) on the topic of transport-related social exclusion of low-income and homeless individuals (at-risk people) in Toronto. The pilot study was conducted from August 2012 to January 2013. A three-stage investigation methodology was developed to assess the current status of public transit experiences of the at-risk community in Toronto. We looked towards previous studies with similar objectives in exploring transport-related social exclusion (Jocoy and Del Casino Jr., 2008, McCray and Brais, 2007, York Region Alliance to End Homelessness, 2008).

We also took note of the Job Access and Reverse Commute (JARC) program for low-income workers, single parents and individuals with transportation disadvantages in the United States, which emphasizes the importance of “understand[ing] the perceptual, mobility and employment outcomes experienced by users of sample JARC services” (Thakuriah et al., 2011). The study employed a series of surveys, collecting data from a range of stakeholders, including those from regional agencies, partner agencies, program managers of operating services and service users. The interactions with such stakeholders allowed for a full evaluation of the local needs and planning processes of all members of the participating communities.

Freeman and Rossi’s (2012) paper also accentuated the significance of interagency consultation to ensure that the voices of all concerned stakeholders are considered prior to any decision-making process. In summary, our exploration of previous studies on transport-related social exclusion led us to realize the need to focus on three important players in the City of Toronto:

1) The at-risk community in Toronto
2) Local agencies supporting transit accessibility for the at-risk community
3) Transit planning professionals

We employed a structured interview approach, using a total of 12 questions which asked respondents about their most important reasons for travel, their mode of travel to their identified important destinations, their usual times and routes of transit usage, their method of payment for
transit usage, their overall transit use experience and the factors that restrict their transit use. Interviews were informal and lasted for 10 to 15 minutes each. From August 2012 to January 2013, I conducted a total of 76 face-to-face structured interviews, and recorded all the gathered responses. Seventeen of the interviews were led in partner with the sandwich runs for the homeless program, a volunteering activity run by Eyes of Hope, a student organization at the University of Toronto, in order to target the street population and individuals at shelters. Twenty-four interviews were conducted at the drop-in sessions of the Metropolitan United Church, which reached out to low-income individuals. Lastly, thirty-five interviews were conducted at the Knox Youth Dinner and Food Bank, a program that targets homeless youth.

2.1 Demographic Profile

The age and gender characteristics of the collected responses are provided in Table 1. Our demographic profile of the 76 responses shows similar trends to those in government reports. A majority (N=33 or 43%) of our respondents were male from ages 25 to 55 compared to the national statistic of 47.5% for single adult males of the same age range (Gaetz et al., 2013). The underrepresentation of female respondents aligns with Toronto’s findings that adult women are mainly found in women’s shelters and/or Violence Against Women shelters (City of Toronto, 2013).

<table>
<thead>
<tr>
<th>Age</th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>17-30</td>
<td>12</td>
<td>25</td>
</tr>
<tr>
<td>31-40</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>41-50</td>
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<td>71-80</td>
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<td>3</td>
</tr>
<tr>
<td>Undisclosed</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>58</td>
</tr>
</tbody>
</table>
2.2 Travel Patterns of At-Risk Individuals

In our preliminary work, we also investigated the travel patterns of at-risk individuals. Figure 1 displays the frequented transit routes of low-income and homeless people in Toronto. These routes are plotted in purple, and are representative of weekday and weekend trips made by the interviewed at-risk individuals. These frequented routes are mostly comprised of routes serviced by streetcars and the subway system (not bus). In addition, there were no particular trends in the usual time of travel for both weekday and weekend trips. This supports the Fair Fare Coalition’s findings, in which participants expressed that they “use transit at all times of the day…[with] about half of the respondents [reporting] that they frequently travel during “peak hours” in both the morning and the afternoon” (Fair Fare Coalition, 2015).

![Figure 1: Transit Routes Frequent by the At-Risk Community (Hui and Habib, 2014)]
2.3 Drop-in Agencies

Through phone interviews, 23 drop-agencies serving the downtown core of Toronto were contacted and were asked three primary questions:

1) Do you distribute public transit tokens (fares) to individuals using your services?
2) Is there a criterion that individuals must meet before they receive the free transit tokens?
3) What is the number of recipients of free transit tokens per day?

Thirteen of the 23 agencies expressed that they provided tokens for individuals using their services. All but 2 of the 13 agencies had specific requirements in regards to obtaining free tokens. Specifically, these agencies encourage at-risk individuals to attend their courses by offering free transit tokens to travel from the individuals’ place of stay to the agency centres. Consequently, these agencies only provided a mere 2 to 17 tokens per day, which shows that a limited amount of individuals actually attend the community programs.

Figure 2: Proximity of Agencies to Frequented Routes (Hui and Habib, 2014)
Figure 2 (Hui and Habib, 2014) illustrates the locations of agencies that provide tokens to participants of their programs. Our study (Hui and Habib, 2014) found that these agencies are, in reality, situated at locations in close proximity to transit service routes frequented by the at-risk community, as gathered from our conducted interviews.

### 2.4 Transit Planning Professionals

For the last part of our three-stage investigation, we conducted individual face-to-face interviews with two transit planning professionals, and asked three primary questions:

1) Is the at-risk community considered in planning?
2) What justifies the implementation of additional services?
3) Are there any social initiatives or plans set forth by your organization?

The two transit planning professionals represented the TTC and Metrolinx respectively, and provided us with information on current transit planning practices, and the ways in which these practices might encompass the needs of the at-risk community. Both respondents did not recognize the at-risk community being considered in planning. This lack of consideration is mainly due to current policies that justify whether or not certain transit services or mobility hubs can be offered in a particular area. Table 2 (Hui and Habib, 2014) displays a summary of the answers given by the transit planning professionals.

<table>
<thead>
<tr>
<th>Questions</th>
<th>TTC</th>
<th>Metrolinx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is the at-risk community considered in planning?</td>
<td>Respondent did not see at-risk community considered in planning</td>
<td>Respondent did not see at-risk community considered in planning</td>
</tr>
<tr>
<td>What justifies the implementation of additional services?</td>
<td>Increased service must be justified by need and policies regarding crowding and wait times</td>
<td>Implementation of new mobility hubs is justified by level of transit service and development potential</td>
</tr>
<tr>
<td>Are there any social initiatives or plans set forth by the organization?</td>
<td>Fare increases are a result of increasing trip costs and steady City subsidies; social initiatives are carried out by the City and not by TTC</td>
<td>The Big Move addresses the need to improve mobility options for the at-risk community</td>
</tr>
</tbody>
</table>
2.5 Lessons Learned

Our preliminary work (Hui and Habib, 2014) was one of the first studies focused on exploring transport-related social exclusion of homeless individuals in Canada. However, as the interviews were intentionally designed to be brief in nature to take into account the short attention span of at-risk individuals, we were unable to obtain substantial data needed for travel behaviour analysis.

Nevertheless, we were able to obtain a preliminary perspective of qualitative results in regards to at-risk individuals’ travel patterns. Our preliminary work (Hui and Habib, 2014) found that more than half of the interviewed subjects walked to their identified important travel purposes. Furthermore, more than half of the subjects accredited the high travel cost as the primary reason that deterred them from using public transit more frequently. A simple spatial representation also illustrated the fact that drop-in agencies providing free transit tokens are situated in close proximity to transit routes frequented by the at-risk community.

While our study (Hui and Habib, 2014) challenged to fill the research gap on the field of transportation engineering and homelessness studies, translation of the qualitative findings into solid policy recommendations remained difficult. Again, we stress that there were inherent limitations to the interview structure. However, by recognizing such limitations, we realized the potential for further inferences from the qualitative results. The limitations of our preliminary work raised several new questions. For example, in regards to the concern for transit costs,

1) What types of options would be most appropriate in alleviating the fare burden for the at-risk individuals in the society?

2) Is transport-related social exclusion simply a cost-based issue, or is it also a problem of spatial accessibility?

3) Are the “strategic agency locations” misrepresented in that at-risk individuals frequent their current transit routes because they, in fact, need to attend the agency locations?

In order to explore these questions and to make impactful policy recommendations for transport-related social exclusion, we recognized the need to redesign an interview. Such redesign required us to collect information that we had overlooked in our preliminary study, including one’s income and other financial support, a “home” location, vehicle ownership, license ownership,
frequency of trips and cost-coping strategies. In addition, the interview redesign included a travel diary, which would allow us to obtain information on one’s usual travels, including distances travelled, number of trips, duration of activities, time of activities, modes used for each trip and trip chaining behaviour.

The next chapters present our work in 2015, including the interview redesign and data collection efforts, followed by discussion of interview results. The thesis concludes with the summaries of key findings, policy recommendations and notes on future work.
Chapter 3
Research Extension 2015

The results from our preliminary work of 2013 motivated subsequent work in 2015. Firstly, we refocused our target population to solely homeless individuals, to rid of any biases in sampling both low-income and homeless individuals. We also assumed that there were most likely discrepancies in travel behaviour and travel patterns between the two population segments. Secondly, we redefined our research questions, noting that since provision of affordable housing, such as the Housing First approach, requires years of implementation:

What does the role of transportation play in improving the circumstances of homeless individuals from a short-term planning perspective?

To answer our underlying research question, we focused on three main questions:

1) Where are homeless individuals currently located and what spaces do they use?
2) What does transport-related social exclusion look like for the homeless?
3) To what degree does the provision of transport-specific services improve the circumstances of homeless individuals?

By answering these questions, we would be able to capture the transport behaviour and transport patterns of the homeless population from an analytical perspective, understand the biggest barrier to transportation and important services via transportation, and compare transport-related alternatives in improving the circumstances of homeless individuals. Overall, answering these questions would allow us to provide policy recommendations that are fitting for the context of the City of Toronto.

3 Interview Redesign

In the planning stages of the interview redesign, we particularly recognized the importance of using holistic approaches. The works of Foth et al. (2013) and McCray and Brais (2007) specifically laud the ability of holistic approaches in capturing the complex decision making processes of human subjects in transport equity research. Further investigation of McCray and Brais’ (2007) methodology reveals the use of focus groups and “self-mapping [sessions] of
individual space” to “effectively explain why individuals do what they do and what factors affect their destination choices”. Likewise, we endeavoured to use a holistic approach in our data collection implementation.

In addition to the aforementioned studies, we were specifically drawn to the interview methodology used in the works of Jocoy and Del Casino Jr. (2008), McCray (2007), Wolch et al. (1993) and the York Region Alliance to End Homelessness (2008). Moreover, as demonstrated in Agrawal et al.’s (2011) study, a semi-structured interview approach provides subjects with more opportunities to voice their opinions. In our case, such an approach would allow subjects to express their personal transport-related experiences, an issue that is particularly important for the vulnerable population. Particularly, referencing Jocoy and Del Casino Jr.’s (2008) study, we also sought to provide a comfortable interview environment by using “simple vocabulary and unambiguous terms” and by “offering to define and explain terms when necessary”. Subjects were also given the opportunity to refuse questions if they were uncomfortable in disclosing certain personal information (Jocoy and Del Casino Jr., 2008)

Lastly, in order to ensure that the questions were relatable for the homeless community, we consulted with a homeless service worker from the Toronto Drop-in Network. The worker provided several suggestions, which included the specific arrangement of the interview questions in order to maintain the subjects’ attention. In addition, the worker also provided suggestions in regards to creating more realistic hypothetical scenarios, which will be presented in Section 3.2.

3.1 Revealed Preference Design

The challenge of the interview design was mainly found in the compromise of survey methods from both the engineering and non-engineering research realms. Traditionally, household travel surveys in engineering research gather information on one’s income, home location, frequency of trips, vehicle ownership and license ownership. Likewise, we sought to include such questions found in traditional household surveys, in order to obtain the data required for travel behaviour analysis. In addition, we completed the aforementioned questions with a travel diary, which would specifically allow us to extract information on one’s trip purposes, distances travelled, duration of activities, time of activities and modes used for each trip.
For our particular study, we also assumed that the subjects’ homelessness experiences would be related to their travel behaviour decisions. As such, from a social perspective, we pursued to better understand each subject’s homelessness experience. Thus, we included questions to gather information on one’s current housing situation, overall experience of homelessness and duration of their last period of homelessness. These questions on homelessness experiences specifically referred to the terminology defined in the State of Homelessness in Canada 2013 report (Gaetz et al., 2013).

In terms of the Canadian definition of “homelessness”, Gaetz et al.’s report (2013) indicates four separate circumstances, or housing situations, of homeless individuals:

1) Unsheltered (living on the streets, in the park)
2) Emergency sheltered
3) Underhoused (temporary accommodations such as interim housing, couch surfing)
4) At risk of homelessness

Referencing Gaetz et al.’s report (2013), we also included questions on one’s overall experience of homelessness:

1) Chronic (long term shelter users, those with long-term homelessness experiences)
2) Episodic (individuals who move into and out of homelessness on a constant basis)
3) Transitional (those with short-term homelessness experiences)

Figure 3 presents the data model, which summarizes the revealed preference information that we were able to obtain through our interview questions. The data model presents three parts to the revealed preference information: 1) detailed personal information; 2) detailed personal mobility information; and 3) detailed activity schedule.
Figure 3: Data Model of Interview Redesign
3.2 Stated Adaptation Experiment Design

While the use of the data model (Figure 3) can attain subjects’ revealed preference information, we were particularly interested in capturing stated preference information, namely, the travel choices of homeless individuals when presented with hypothetical scenarios. To our knowledge, there is no current information on homeless individuals’ travel behaviour due to the research gap. Therefore, we used a stated adaptation technique to explore homeless individuals’ perceptions of travel cost and time on their travel decisions. We decided to use this technique, referencing that “games [were] used to obtain a better insight into adaptive behaviour [in the early years of activity-based research in transportation]” (van Bladel et al., 2008). Likewise, we created game-like experiments to capture the decision-making behaviour of homeless individuals. In order to create these experiments, we reviewed results from our preliminary work. We also consulted with the service worker from the Toronto Drop-in Network, who provided suggestions on ways to make the hypothetical scenarios more realistic and relatable for homeless individuals. In the end, we used a set of four stated adaptation questions, comprised of a ranking scale question and three scenarios.

3.2.1 Perceptions of Travel Cost and Travel Time

Subjects were inquired to separately rank the influence of travel cost and travel time on their decisions to travel each day. The ranking scale ranged from 1 to 5, with 1 signifying a minimal influence and 5 signifying a strong influence. The purpose of this question was to examine homeless individuals’ perception of travel cost and travel time. We also expected that the rankings obtained in this question would be correlated to the subjects’ choices in the succeeding scenarios.

3.2.2 Scenario 1: Travel to Work Location of Walking Distance

In Scenario 1, subjects were asked to assume that they received a job offer paying $12/hour, and that the job was located within a 20 to 30 minute walk from their place of stay. Emphasizing that the job was located within walking distance, subjects were asked if they would ever use public transit to get to work. In the circumstance that the subjects chose to use public transit, we were curious of the reasons behind their decisions, such as the influence of weather conditions or lateness.


3.2.3 Scenario 2: Ranking of Commuting Mode Choices

In Scenario 2, subjects were asked to assume that they received a job offer paying $20/hour. Subjects were also asked to assume that they were currently staying in the downtown core of Toronto, and that the job was located in Mississauga, a city to the west of Toronto. The purpose of this question was to investigate the subjects’ perception of travel cost and travel time on firstly, their decision to accept the job offer, and secondly, on their commuting mode choice preference. For those that decided to accept the job offer, the subjects were presented with a table (Figure 4) of six mode choice alternatives: 1) transit; 2) get a ride from friend or family member; 3) carpool as passenger; 4) cycling; 5) driving with own car; and 6) driving with rental car. We asked subjects to rank all six alternatives in the order of their preference, with 1 being their most preferred choice and 6 being their least preferred choice.

<table>
<thead>
<tr>
<th></th>
<th>Transit</th>
<th>Get a Ride from Friend or Family Member</th>
<th>Carpool as Passenger</th>
<th>Cycling</th>
<th>Driving with Own Car</th>
<th>Driving with Car Rental</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Travel Time</strong></td>
<td>1hr and 14 min</td>
<td>34 min</td>
<td>50 min</td>
<td>1hr and 35 min</td>
<td>34 min</td>
<td>34 min</td>
</tr>
<tr>
<td><strong>Travel Cost (one-way)</strong></td>
<td>$5.60</td>
<td>$0 - $1.25</td>
<td>$2.00</td>
<td>$2.65</td>
<td>$2.30</td>
<td></td>
</tr>
<tr>
<td><strong>Distance</strong></td>
<td>27.2km</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Other Costs</strong></td>
<td>Own and Operating Costs: $0-3,500/year</td>
<td></td>
<td>Used Car Cost: $5,000 Own and Operating Costs: $7,000-$10,000/year</td>
<td></td>
<td>Rental Costs: $1000/month or $10,000/year</td>
<td></td>
</tr>
</tbody>
</table>

*Figure 4: Ranking of Commuting Mode Choices*
We assembled the travel attributes of Figure 4 by selecting a shelter location in Toronto, and a blue-collar work location in Mississauga. The importance of selecting a work location in a different city is that past studies have found that at-risk individuals are usually qualified for jobs on the outskirts of the city, rather than in the downtown core (Paez et al., 2013, Sandoval et al., 2011). Furthermore, the pursuit of such employment opportunities would mean longer commuting times, and possibly higher travel costs. In fact, Mississauga has a separate transit system from Toronto, and thus, individuals must pay two separate fares when using public transit to travel from one city to the other. Lastly, in order to simulate a scenario with a higher component of realism for the subjects, we attempted to provide the most affordable travel costs in Figure 4.

3.2.4 Scenario 3: Optimization Problem of Travel Budgeting

In Scenario 3, subjects were provided with a map of an area of Toronto (Figure 5). The map presented five pre-selected locations representing different travel purposes: 1) Place of Stay; 2) Food Bank; 3) Grocery Store; 4) Part-time Work; and 5) Visit a Friend. The map also provided the “to-scale” distances to and from each location. Subjects were asked to assume that they had $10 to spend for travelling. Subjects were also asked to assume that they did not own a car. Thus, they could travel to any of the locations of interest using any one of five mode choices: 1) public transit; 2) get a ride from friend or family member; 3) carpool; 4) walk; and 5) cycle. Each mode choice was associated with a specific cost of one-way travel. Beginning at “Place of Stay”, subjects were then asked to trace the route of their travels, and to provide their corresponding mode choice for each trip. The purpose of this scenario was to examine the effects of how the provision of funds could affect one’s decisions to make trips to specific locations, using specific mode choices, in comparison to one’s usual travels. In addition, we were also interested in the existence of homeless individuals’ cost-coping strategies.
Figure 5: Optimization Problem of Travel Budgeting
Chapter 4
Interview Implementation

4 Data Collection

This chapter details the methods in which we implemented the study, including the selection of an appropriate study area and an appropriate recruitment process to attract our target sample of homeless individuals.

4.1 Study Area

It was essential to use an appropriate methodology to assess the current status of urban transportation experiences of homeless individuals. We particularly chose to focus our research on the same study area as our preliminary study, namely, in the downtown core of the City of Toronto. This location was primarily selected as the City of Toronto hosts an extensive transit network, operated by the TTC. In addition, the downtown core is home to several shelters and drop-in agencies, which provide an abundant of services to homeless individuals. As such, there is an assumption that homeless individuals in the City of Toronto are exposed to the transit system, and have a reason to travel especially if they need to access homelessness service locations.

In order to target our sample of homeless individuals, we specifically selected 8 homelessness service locations in the City of Toronto (Figure 6). The 8 locations were comprised of 2 men’s shelters: 1) Good Shepherd; 2) Christie Ossington Neighbourhood Centre Men’s Hostel (CONC), and six drop-ins: 1) Parkdale Activity-Recreation Centre (PARC); 2) Church of the Redeemer; 3) The Meeting Place; 4) Sanctuary; 5) Sistering; and 6) 6 St. Joseph House. In order to make potential comparisons of homeless individuals based on different regions in Toronto, we sought to conduct a similar number of interviews at each location. Here, we highlight that we conversed with only a small number of female respondents from the drop-in sessions at PARC, Sistering and 6 St. Joseph House. While we recognize the importance of sampling a better representation of homeless individuals in regards to gender and age, we were unable to obtain permission to visit women and youth shelters because the privacy of this population segment is highly protected.
4.2 Recruitment Process

In order to ensure that we were targeting the correct population segment, we imposed 3 pieces of eligibility criterion: 1) subjects had to be currently experiencing homelessness or have experienced homelessness within the past 3 years; 2) subjects had to comprehend English; and 3) subjects had to have good mental health. Workers at each service location ensured that subjects met all 3 pieces of criterion. The support of the workers was particularly vital to our study, as they were familiar with the homeless individuals using their services, and furthermore, they were aware of who would be willing to share personal information with the interviewer. Subjects were also informed that they would receive financial compensation in the form of a $10 grocery card or a coffee card upon completion of the full interview.

I conducted all interviews individually and face-to-face with the homeless subjects. The method of using one interviewer reduced any interview bias. I was comfortable with administering the interviews as I had three years of prior experience volunteering for the homeless community in Toronto. As I also conducted the interviews for the preliminary study in 2013, the experience was readily transferrable to this newly redesigned study. Several procedures were undertaken to ensure a comfortable interview environment for the subjects. Firstly, the interviews were
conducted in a familiar setting, at the facilities of the shelters or drop-ins. Secondly, the closed room setting was used to encourage subjects to share personal information. Thirdly, in order to protect subjects from any legal or social risks, all interviews were anonymous. Lastly, in order to speed up the interview process, all interviews were audio recorded using my laptop. The audio recording also allowed the interview process to seem like more of a friendly conversation.

Using the above methods, a total of 159 interviews were conducted across a total of 8 shelters and drop-in agencies in the City of Toronto from May 2015 to June 2015. The number of interviews conducted at each service location is displayed in Table 3.

Table 3: Interview Locations of Respondents

<table>
<thead>
<tr>
<th>Interview Location</th>
<th>Number of Interviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good Shepherd</td>
<td>32</td>
</tr>
<tr>
<td>CONC</td>
<td>26</td>
</tr>
<tr>
<td>The Meeting Place</td>
<td>29</td>
</tr>
<tr>
<td>PARC</td>
<td>25</td>
</tr>
<tr>
<td>Church of the Redeemer</td>
<td>29</td>
</tr>
<tr>
<td>6 St. Joseph</td>
<td>10</td>
</tr>
<tr>
<td>Sanctuary</td>
<td>6</td>
</tr>
<tr>
<td>Sistering</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>159</strong></td>
</tr>
</tbody>
</table>
Chapter 5
Descriptive Statistics

5 Qualitative Results

This chapter is intended to present the descriptive statistics of the 159 sampled individuals. The following sections provide information on the subjects’ socioeconomic attributes and travel attributes. We also present a comparison of the descriptive statistics from our 2015 study to those from our 2013 preliminary work, to demonstrate any similarities or differences between homeless individuals and at-risk individuals (low-income and homeless).

5.1 Descriptive Statistics

We achieved a 100% response rate, as all recruited subjects completed the full interview. Of the 159 subjects, 2 chose not to have their voice audio recorded. For the remaining 157 subjects, each interview lasted for an average of 24 minutes and 1 second. We recorded the shortest interview at 9 minutes and 55 seconds, and the longest interview at 55 minutes and 20 seconds. The wide range of interview durations portrays the fact that while some individuals wanted to quickly finish the interview to obtain the financial compensation, others expressed that they were delighted to converse with someone outside of a shelter or a drop-in, and to have an opportunity to voice their opinions.

The socio-demographic characteristics of the 159 sampled individuals are presented in Table 4. The analysis of the socio-demographic characteristics clearly shows that homeless individuals share a variety of different experiences and backgrounds. As displayed in Table 4, the subjects share a wide range of differences in education backgrounds, monthly income, shelter status, and in the duration of their last period of homelessness. It is significant to recognize that the variety in such attributes contribute to the complexities of analyzing the travel decisions of homeless individuals, as their experiences are individually contextual. Table 5 provides the travel attributes of the 159 sampled individuals.
### Table 4: Socio-demographic Characteristics of Sample Individuals

<table>
<thead>
<tr>
<th>Variables</th>
<th>Proportions of Categories</th>
<th>Average Value</th>
<th>Minimum Value</th>
<th>Maximum Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>45.9</td>
<td></td>
<td>20</td>
<td>73</td>
</tr>
<tr>
<td>Sex</td>
<td>Male: 138 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Female: 19 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Transgender/2S: 2 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household Size</td>
<td>1 member: 155 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 members: 3 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 members: 1 individual</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shelter Status</td>
<td>Category 1: Unsheltered = 28 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Category 2: Emergency sheltered = 71 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Category 3: Underhoused = 25 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Category 4: At-risk = 3 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Category 5: Housed = 32 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homelessness Experience</td>
<td>Category 1: Chronic = 54 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Category 2: Episodic = 43 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Category 3: Transitional = 62 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration of Last</td>
<td>Category 1: 1 – 60 days = 23 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Period of Homelessness</td>
<td>Category 2: 61 – 120 days = 17 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Category 3: 121 – 240 days = 18 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Category 4: 241 – 360 days = 6 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Category 5: 361 – 720 days = 22 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Category 6: 721 – 1080 days = 12 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Category 7: 1081 – 1440 days = 17 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Category 8: 1441 – 2160 days = 17 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Category 9: 2161 days and above = 27 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education Completed</td>
<td>Category 1: Elementary = 1 individual</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Category 2: Junior High = 9 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Category 3: High School = 81 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Category 4: College = 46 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Category 5: Bachelor’s = 11 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Category 6: Master’s and above = 10 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Category 7: Undisclosed = 1 individual</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employment Status</td>
<td>Category 1: Unemployed = 122 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Category 2: Informal = 24 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Category 3: Part-time = 8 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Category 4: Full-time = 3 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Category 5: Undisclosed = 2 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income</td>
<td>Category 1: No income = 9 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Category 2: $1 - $250 = 10 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Category 3: $251 - $400 = 27 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Category 4: $401 - $600 = 26 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Category 5: $601 - $800 = 29 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Category 6: $801 - $1,000 = 17 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Category 7: $1,001 - $1,200 = 19 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Category 8: $1,201 - $1,600 = 12 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Category 9: above $1,600 = 10 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 5: Travel Attributes of Sample Individuals

<table>
<thead>
<tr>
<th>Variables</th>
<th>Proportions of Categories</th>
<th>Average Value</th>
<th>Minimum Value</th>
<th>Maximum Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>License Ownership</td>
<td>Have driver’s license: 35 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Do not have driver’s license: 96 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Have a suspended license: 28 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ownership of Vehicles</td>
<td>Automobile: 2 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bicycle: 39 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other: 2 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>None: 118 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Undisclosed: 1 individual</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transit Pass Ownership</td>
<td>Have a pass: 28 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Do not have a pass: 131 individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.2 Remarks on Comparison to Preliminary Work

One of the limitations in our preliminary work was the fact that we did not reinforce the idea that subjects could only select one answer for some of their choices. We allowed subjects to choose more than one answer because we did not want to limit their responses, especially if it could provide a better representation of their personal experiences. Consequently, in order to maintain the responses of the full sample, we had to aggregate some of their answers in our analysis, leading to some analysis bias. In our 2015 study, we counteracted this by introducing a ranking option for certain questions in order to allow subjects to choose their top 3 options, as opposed to selecting only one option. As such, we provided them with more freedom in their responses, which in return, allowed us to obtain more accurate answers in regards to their preferences. The following are comparisons of some of the questions that were posed in both our preliminary study and in our 2015 work.

5.2.1 Important Travel Purposes

In our preliminary study, the top three reasons for travel for low-income and homeless individuals were: 1) to visit a friend or family member; 2) to access shelters, food banks or soup kitchens; and 3) to visit hospitals or medical clinics (Figure 7). In particular, we found that visits for medical purposes were important for the majority of the street population and older low-income individuals, while visits for school or job-related purposes were important for the majority of the at-risk youth. Consequently, it was concerning that there were a fair amount of
individuals who stated that they had no reason to travel at all, indicating the existence of mobility barriers.

In our 2015 study, the results were very similar in that health services and visiting friends and family members were important reasons to travel (Figure 8). However, many subjects also chose visiting a drop-in as an important reason to travel, which was a significant difference from the results in our preliminary work. This can be explained by the fact that we refocused our target sample to solely homeless individuals. In fact, many homeless individuals, especially those who live in a shelter, often have to leave the shelter in the morning, and pass their time until the shelter reopens in the evening. As such, many choose to visit drop-ins, even multiple drop-ins, to pass their time each day.

![Figure 7: Important Travel Purposes (2013 Study)](image-url)
Figure 8: Important Travel Purposes (2015 Study)

5.2.2 Mode Choice for Important Travel Purposes

Yet, another intriguing analysis to these results is the mode of transport for the indicated important travel reasons (Figure 9). In our preliminary study, a majority of the respondents expressed that they usually use public transit for their indicated travels. Of this segment, most of their public transit travels were for school or job-related purposes. On further examination, we also found that amongst those who usually walk to their important travel destinations, the purposes of their trips were mainly to visit a friend or family member and to attend health services.

The above results denote the significance of public transit in allowing at-risk individuals to seek and maintain employment opportunities. In other transport-related social exclusion studies, results have found that at-risk individuals tend to be better qualified for blue-collar jobs on the outskirts of the city (Paez et al., 2013, Sandoval et al., 2011). Oftentimes, individuals require a reliable transport source, such as public transit or a motorized vehicle, to get to these job locations. While we cannot make the implications that job-seeking or employed individuals in our study have to go to the outskirts of Toronto, we can assume that public transit helps these individuals cover greater distances when finding and attending to job opportunities in the city.
For our 2015 study, we asked subjects to share with us their mode of travel to their top 3 important destinations (Figure 10). We found that homeless individuals tend to travel by walking and by public transit. Moreover, walking was the number one mode of travel. Here, we can make a few postulations. Firstly, homeless individuals are more constrained by costs than at-risk individuals. Secondly, homeless individuals tend to travel short distances that can be covered by walking. Thirdly, street people tend to specifically plan out their days to fit a walking schedule. The above postulations of homeless individual’s walking frequency will be further explored in the next sections.

**Figure 9: Mode Choices for Important Travel Purposes (2013 Study)**
Lastly, we compared the reasons that deterred one from using public transit more often. In our preliminary study, we found that a large number of at-risk individuals expressed deterrence from using public transit due to the high cost of the transit fare. This finding shows that existing social support is probably unable to cover one’s travel expenses, aligning with Spurr’s (2013) article.

Similar to our preliminary work, we found that most subjects in our 2015 study were affected by travel cost, as it was consistently ranked as the top reason that deterred them from using public transit more often. Emphasis was also placed on public transit being too crowded and having unreliable service. Many individuals chose both of these aforementioned reasons as the 2nd top reason that deterred them from using public transit more often. In this sample, it is interesting to note that in comparison to the preliminary work, cost is not a very major issue, or one that was ranked very highly in comparison to other reasons. In fact, other factors also played a major role; particularly, the reasons of public transit being too crowded and offering unreliable service. These are often factors that are experienced by the general public, which shows that homeless individuals also have reason to travel like the general public. The “other” category in Figure 11
describes reasons such as poor storage-related accessibility, poor communication of service changes, discontent with the transfer system, and need for longer hours of subway service.

Figure 11: Deterrence from Public Transit Usage (2013 Study)

Figure 12: Deterrence from Public Transit Usage (2015 Study)
5.3 Frequency of Travel by Modes and Mobility Ownership

In our analysis, we noticed that most homeless individuals travel by three primary modes: walk, public transit and bicycle. It is evident that most homeless individuals are frequent walkers. In fact, 137 subjects (86%) stated that they walk 7 days per week. Public transit is also a widely used mode, however, the frequency of this mode is much more spread out amongst the subjects. For example, while 41 subjects (26%) used public transit 7 days per week, there is also a large segment that used public transit with less frequency. Specifically, 58 individuals (36%) used public transit 1 to 3 times a week, while 27 individuals (17%) used public transit 1 to 3 days per month.

![Figure 13: Frequency of Travel by Mode](image)

On further investigation, we considered the frequency of travel based on one’s ownership of any form of mobility – automobile, bicycle, transit pass and a combination of the aforementioned mobility forms. As expected, the walking mode was most frequented by those who do not own any type of mobility form (Figure 14).

In regards to the frequency of using public transit (Figure 15), it is interesting to note that a number of the subjects who shared that they use public transit 7 days of the week are comprised
of those who hold a transit pass, as well as those who own no form of mobility at all. This implies that homeless individuals who do not own any form of mobility are, in fact, reliant on the services of public transit to access the places and services they need to locate. Lastly, the frequency of employing the cycling mode appeared to be very dependent on whether or not the subject owned a bicycle. Particularly, if the subject owned a bicycle, it was likely that they would regularly cycle. As displayed in Figure 16, 43% of the subjects who owned a bicycle chose to cycle 7 days of the week.

![Figure 14: Mobility Ownership and Frequency of Walking](image-url)
Figure 15: Mobility Ownership and Frequency of Public Transit Usage

Figure 16: Mobility Ownership and Frequency of Cycling
5.4 Travel Diary

A travel diary is a comprehensive survey that gathers information on one’s travel behaviour. In the Greater Toronto and Hamilton Area, the Transportation Tomorrow Survey (TTS) is conducted once every five years. Collected data is analyzed and used for transportation demand analysis and for travel demand forecasting. The results of the analyses are often used to draw connections to policy and planning recommendations, such as the need to construct a new road to meet the travel demand of a growing population.

In our study, we posed questions to the subjects, collecting their travel diary information for up to 11 unique trips:

1) Origin of Each Departure
2) Time of Each Departure
3) Destination of Each Arrival
4) Time of Each Arrival
5) Mode of Travel from Each Origin to Destination
6) Trip Purpose of Each Destination
7) Number of Trips in Total

Each subject was asked to share a travel diary of a typical day. However, we note that some subjects, particularly newly homeless individuals, stated that it was difficult to think of a typical travel diary due to their transition period. For example, subjects who recently moved out from their previous place of stay experienced an increase in their daily travels by having to frequent visits to their social worker, moving their belongings from one place to the next, and settling administrative-related tasks.

Of the 159 subjects, there were 9 subjects who did not provide sufficient information to allow us to map out their trips throughout the day. Some subjects also stated that they did not feel comfortable sharing the specific locations that they usually attend to. Thus, the travel attributes of these subjects are removed from the succeeding analysis.
Through the collected travel diaries, we were able to quantify the following data:

1) Number of trips of usual travel
2) Distances of usual travel
3) Mode of usual travel
4) Trip Purpose of usual travel

Examining the travel diaries, we found that the subjects made a total of 679 trips, with an average of 4.5 trips per subject, ranging from a minimum of 2 trips to 11 trips. As illustrated in Figure 17, homeless individuals tended to make anywhere from 2 to 6 trips daily, implying that street people do have reasons to travel. In fact, they exude trip chaining behaviour. In regards to the travel diary distances, the subjects traveled a total of 1710.74 km, with an average of 11.33 km per subject, ranging from a minimum of 0.09 km to 51.20 km.

![Figure 17: Number of Trip from Travel Diary](image)

In terms of mode, of the 679 trips, 455 were made by foot, 137 were made by TTC, 68 were made by cycling, 3 were made by getting a ride from family and friends, 6 were made by carpooling, and 10 were made by driving. If we observe individual trips, and observe the proportion of trips by mode for each person, an average of 67% of trips were done by walking, 20% were done by TTC, 10% by cycling, 0.4% by getting a ride, 0.9% by carpooling, and 1.5% by driving.
It is interesting to note that while getting a ride would probably be the most affordable option to travel to locations quickly, several of the homeless individuals stated that they did not want to bother a friend or family member. In addition, the subjects felt that if they got a ride from a friend or family member, they would also have to match their travel times to other’s schedules, which would reduce the flexibility of their travels.

While a majority of the subjects employed the walking mode, it is also interesting to note that the next largest portion of trips is done by public transit. This shows that homeless individuals mainly rely on two forms of travel – walking and public transit, with cycling as the third frequently used mode. These findings relate to our investigation in Section 5.3. Figure 18 shows the proportion of trips by different modes for each trip number. Data labels are provided for the three most common mode choices: walk, TTC and cycle.

Figure 18: Mode by Trip Number from Travel Diary
We further examined the types of trip purposes of the homeless individuals. In particular, we investigated three trip purposes: 1) social activity; 2) drop-in; and 3) work-related purposes. We assumed that social activities included travel purposes of visiting family and friends, shopping and going to the gym. Fifty-seven individuals made a trip for a social purpose. Most of these social trips were also done in the beginning half of the day.

Drop-in activities were very common amongst the subjects. Ninety-two individuals made a trip to a drop-in. Interestingly, 59 individuals made 1 trip, 21 individuals made 2 drop-in trips, 5 individuals made 3 drop-in trips, 3 individuals made 4 trips, 2 individuals made 5 trips, and 2 individuals even made 6 trips. This proves the fact that many homeless individuals tend to spend their days at drop-ins, in order to pass time before they return to their shelters. Since drop-ins open at different times throughout the day, it can be assumed that some homeless individuals schedule their days around the times when drop-ins open at various locations in Toronto. Lastly, we also investigated the trip purpose of work or “making money”, which in our case, included panhandling, collecting bottles and busking. In total, 20 individuals made a work trip.

5.5 Stated Adaptation Experiments

The results in this section are based on two stated adaptation questions as presented in Section 3.2. In the following sections, we specifically explore the results of one’s perception of travel cost and travel time (Section 3.2.1), and the scenario of choosing to use public transit to a work location of walking distance (Section 3.2.2).

5.5.1 Perceptions of Travel Cost and Travel Time

All 159 subjects ranked the influence of travel cost and travel time on their daily travel decisions on a scale of 1 (minimal influence) to 5 (strong influence).

Specific to travel costs, the average ranking was 3.11, implying a moderate influence. The most commonly chosen ranking was 1 (minimal influence), ranked by 54 subjects (34%). Interestingly, the second most commonly chosen ranking was 5 (strong influence), ranked by 53 subjects (33%). Naturally, we expected that travel costs would have a large impact on homeless individuals’ travel decisions, due to their lack of income. However, it was surprising that travel cost had a strong influence on the subjects, as much as it had a minimal influence. In essence, travel cost may not always be an influence on homeless individuals’ travel decisions because
they are accustomed to making trips by foot, free of cost. In addition to walking as a cost-coping strategy, homeless individuals are also experienced in reducing their transportation costs, such as through the evasion of transit fares and through the strategic scheduling of transit routes with a single public transit transfer.

In regards to the travel time, the average ranking was 2.38, implying a low to moderate influence. The most commonly chosen ranking was 1 (minimal influence), ranked by 86 subjects (54%). Supplementing our finding, a majority of the subjects, particularly those who are unemployed, shared that they are not highly influenced by travel time because they do not have particular destinations to attend to. As such, even if they had a reason to travel to a far-away destination, they would plan in advance to ensure that they would punctually reach the destination by foot. Moreover, those residing in emergency shelters shared that they are required to leave the shelters in the morning so that the shelters can prepare the beds during the day. As such, these individuals often try to pass time without cost. Many tend to roam around the neighbourhoods close to their shelters and visit one drop-in after another prior to returning to their shelters in the evening. In summary, these findings demonstrate that travel time does not influence the travel decisions of most homeless individuals.

5.5.2 Scenario 1: Travel to Work Location of Walking Distance

All 159 subjects answered this stated adaptation question. Ten subjects stated that they had difficulty relating to the scenario due to their health and personal work preference reasons, and therefore, they could not properly respond to the problem. Of the remaining 149 subjects, it was clear that most were mindful of the travel cost, especially when they could reach the work location with a 20 to 30 minute walk. As such, 62 subjects (42%) stated that they would take transit only in dire situations such as during poor weather conditions or if they were running late. Moreover, 44 subjects (30%) stated that they would not take transit to work even during times of bad weather conditions, namely because they are accustomed to making walking trips during the winter. On the contrary, 43 subjects (29%) stated that they would take transit daily in order to get to work on time and to get to work looking presentable.
5.6 Summary

This chapter provided the descriptive statistics of our sample: comparing attributes of subjects to those from our preliminary study, investigating the travel diary and qualitatively analyzing the results of two stated adaptation experiments. Descriptive statistics of the subsequent scenarios will be presented in entirety with model formulation in Chapter 7 for Scenario 2 and Chapter 8 for Scenario 3.
Chapter 6
Econometric Model Formulation

6 Random Utility Maximization

In order to further understand the behavioural choices of homeless individuals, we conducted econometric analysis. A random utility maximum (RUM) likelihood estimation method was applied to explore the combination of explanatory variables that would best represent homeless individuals’ travel choices. The RUM method assumes that individuals make decisions based on personal attributes, perception of information, and inherent random human behaviour.

We denote the individuals as \( i = 1, \ldots, N \), and the alternatives as \( j = 1, \ldots, J \). In RUM theory, the utility of an alternative \( (U_{ij}) \) for any individual \( (i) \) and any alternative \( (j) \) is denoted by a systematic component \( (V_{ij}) \) and a random component \( (\varepsilon_{ij}) \), in which the systematic component \( (V_{ij}) \) is a vector consisting of explanatory variables \( (x_{ij}) \) and their corresponding coefficients \( (\beta_{x_{ij}}) \).

\[
U_{ij} = V_{ij} + \varepsilon_{ij}
\]

\[
U_{ij} = \sum_j \beta_{x_{ij}}x_{ij} + \varepsilon_{ij}
\]

The theory then assumes that individuals choose alternatives that have maximum utility. So, if an individual chooses alternative \( j \) out of \( J \) alternatives, then their choice can be expressed as follows:

\[
U_{ij} \geq max(U_{i1}, \ldots, U_{ij})
\]

Our study examines the discrete choices of homeless individuals. While discrete choices can be presented in a number of ways, we focus our analysis on solely logit models. Logit models follow the property that random components \( (\varepsilon_{ij}) \) are independently and identically distributed (IID) and extreme value type I distributed (Gumbel distributed). This assumes that “unobserved factors are uncorrelated over alternatives, [and] have the same variance for all alternatives”
(Train, 2002). As choices are assumed to be independent from each other, the probability of choosing any one alternative \( P_{ij} \) can then be expressed as follows:

\[
P_{ij} = \frac{e^{v_{ij}}}{\sum_{l} e^{v_{ij}}}
\]

The following sections provide details on the different logit models used for analysis, in which the model specification will be presented and discussed in Chapters 7 and 8.

### 6.1 Binary Logit Model

Binary logit (BL) models are appropriate for cases where the choice set for each individual \( i \) consists of two alternatives. In this case, the choice probabilities for the two alternatives (A and B) can be conveyed as follows:

\[
P(\text{Alternative } A) = \frac{e^{v_{1i}}}{e^{v_{1i}} + e^{v_{2i}}}
\]

\[
P(\text{Alternative } B) = \frac{e^{v_{2i}}}{e^{v_{1i}} + e^{v_{2i}}}
\]

In our study, a series of binary logit models were estimated to represent the decision-making behaviour of homeless individuals for Scenarios 2 and 3. These binary logit models were specifically used to estimate whether or not the individual would accept employment opportunities or travel to specific locations. In these models, attributes of alternatives were not present; but rather, the analysis was exclusively based on personal attributes of the individual.

### 6.2 Multinomial Logit Model

Building upon BL models, multinomial logit (MNL) models are appropriate for cases where the choice set for each individual consists of more than two alternatives. The probability of choosing an alternative can then be expressed as follows:

\[
P_{i} = \frac{e^{v_{ij}}}{\sum_{l} e^{v_{ij}}}
\]
6.3 Rank Ordered Logit Model

A rank ordered logit (ROL) model is best used to represent the ranking decisions of alternatives. This model is also known as an “exploded” MNL model since “the probability of any ranking of the alternatives from best to worst can be expressed as the product of logit formulas” (Train, 2002). Train (2002) provides the example of a ranking of four alternatives from the set of \{A, B, C, D\}. If one ranks the alternatives as C-B-D-A, the probability of the ranking can be expressed as follows:

\[ P(\text{ranking } C, B, D, A) = \frac{e^{V_C}}{\sum_{j=A,B,C,D} e^{V_j}} \times \frac{e^{V_B}}{\sum_{j=A,B,D} e^{V_j}} \times \frac{e^{V_D}}{\sum_{j=A,D} e^{V_j}} \]

The ROL model is commonly used in the modelling of voter’s preferences (Allison and Christakis, 1994), and is also found in transportation studies involving ranking of alternatives (Malaitham et al., 2013). In our case, the ROL model was used specifically for modelling the ranking of the six alternatives in Scenario 2.

6.4 Model Estimation Methods

All models were estimated in R using the mlogit package. This section explains the methods used to estimate the choices in Scenario 2 and Scenario 3.

6.4.1 Choice of Explanatory Variables

As mentioned in Section 6.1, the BL models were estimated for choices featuring two alternatives. In particular, two alternatives were presented in Scenario 2 - reject vs. accept the job offer, and likewise, two alternatives were presented in each of the location choices of Scenario 3. In these BL models, explanatory variables were those of one’s personal attributes, and not of the alternative’s attributes.

In comparison, the ROL model was essentially a mode choice model. Thus, the variables of travel time and travel cost were included, even if it did not prove to be significant in the model. This was done to compare substitution rates for policy purposes. The model specification was determined by assuming that commuters’ mode choices are primarily based on travel time and travel cost, and secondarily based on their respective individual specific variables. As such, the
best model was selected as the one with individual specific variables that ensured significance of the travel time and travel cost variables in the maximization of one’s final choice utility function.

6.4.2 Interaction of Variables

Interaction of variables was also important in our study, specifically for the analysis of the ranking decisions in Scenario 2. As exhibited in Figure 4, Scenario 2 presented a fixed table of alternative attributes to each subject. In modern travel surveys, it is common to provide subjects with stated preference scenarios that are based on their specific personal attributes. As such, interaction of variables was prepared in order to determine the alternative attributes varying across all subjects. In particular, these alternative attributes included the travel time and travel cost variables, both of which are significant for policy analysis.

6.4.3 Parameters

The significance of the parameters for all variables in the estimated models was investigated based on their corresponding t-stats. The t-stat values were examined on a 95% level of confidence. For variables in which there was certainty about the sign of the parameter, a one-tailed test was used, in which the variables had to have an absolute t-stat value greater than 1.64. Coefficients of the explanatory variables were also examined in order to ensure that they were reasonable. For the generic variables of travel time and travel cost, it was expected that the parameters for both variables would be negative. This is because individuals tend to prefer lower travel time and travel cost, and therefore, an increase in either one of these variables should negatively affect one’s travel utility. The analysis of the coefficients of the individual specific variables was more complex. For the individual specific variables, a “reference” alternative was chosen, in which its coefficients were fixed to 0. As such, the coefficients of individual specific variables of all other alternatives reflect the differences in preference in comparison to the “reference” alternative. These particular coefficients were made sense of by understanding the effect of the individual specific variable on the relative utility.

6.4.4 Goodness-of-Fit Test

The goodness-of-fit tests were based on the McFadden R-square values provided by the model output in R. The McFadden R-square is a rho-square value that should fall in the range of 0.2 to 0.4 or higher when representing a good fit.
Chapter 7
Results of Scenario 2

7 Employment Opportunity Decisions

This chapter is intended to investigate the decision choices of homeless individuals in regards to job opportunities. We assume that homeless individuals have a greater chance of obtaining employment through blue-collar jobs, referencing the work of Paez et al. (2013) and Sandoval et al. (2011), especially for those who do not have higher education or have been away from the workforce for a period of time. In the Greater Toronto Area, many of these jobs are located in the outskirts of the city, away from the downtown core. This implies that homeless individuals who reside in the downtown core have to search for ways to travel to these potential work locations. Sometimes, the cost and time associated with such a travel may deter one from accepting any job offer. Thus, this scenario was used to test their decisions. As explained in Section 3.2, this scenario presents a $20/hr job offer located in Mississauga.

7.1 Reject vs. Accept Job Offer

We were especially interested in understanding the types of personal attributes contributing to one’s decision to explore employment opportunities outside of the downtown Toronto core. Moreover, the job is one that provides an hourly wage that is much higher than the minimum, and thus, it was expected that most homeless individuals would accept the job.

All 159 subjects answered this stated adaptation question, with 135 subjects choosing to accept the job in Mississauga, and 24 subjects choosing to reject the job. In further examination of the 24 subjects who rejected the job, 14 (58%) contemplated the daily commute to Mississauga as too costly and time-consuming, while 6 (25%) turned down the offer due to health issues.

A BL model was used to estimate variables that affected individuals from rejecting or accepting the job offer. As there were 2 individuals that did not properly answer the follow-up question in Section 7.2, we removed their information from the model estimation to allow for potential comparison of choices in Sections 7.1 and 7.2. Thus, the model is analyzed using 157 observations in total. The reference of the model was the choice of accepting the job offer. The
following is the model specification of the BL model for the choice of rejecting vs. accepting the job offer:

\[ U_{\text{reject}} = -2.973 + 2.465\text{chronic} + 1.801\text{cyclic} + 1.257\text{street} - 0.001\text{income} \]
\[ - 0.432\ln(\text{dur}) + 0.065\text{age} - 1.471\text{pcost} \]

\[ U_{\text{accept}} = 0 \]

**Table 6: BL Model of Rejecting vs. Accepting Job Offer**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Alternative specific constants</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reject:(intercept)</td>
<td>-2.973</td>
<td>1.432</td>
<td>-2.077 *</td>
</tr>
<tr>
<td>Reject:chronic</td>
<td>2.465</td>
<td>1.049</td>
<td>2.350 *</td>
</tr>
<tr>
<td>Reject:cyclic</td>
<td>1.801</td>
<td>0.779</td>
<td>2.311 *</td>
</tr>
<tr>
<td>Reject:street</td>
<td>1.257</td>
<td>0.586</td>
<td>2.148 *</td>
</tr>
<tr>
<td>Reject:income</td>
<td>-0.001</td>
<td>0.001</td>
<td>-1.575</td>
</tr>
<tr>
<td>Reject:ln(duration)</td>
<td>-0.432</td>
<td>0.222</td>
<td>-1.945  .</td>
</tr>
<tr>
<td>Reject:age</td>
<td>0.065</td>
<td>0.025</td>
<td>2.566 *</td>
</tr>
<tr>
<td>Reject:perception of travel cost</td>
<td>-1.471</td>
<td>0.590</td>
<td>-2.495 *</td>
</tr>
</tbody>
</table>

| Number of Observations | 157          |
| Log-Likelihood         | -51.706      |
| Adjusted Rho-Square    | 0.208        |

* *** significant at the 0.001 level, ** significant at the 0.01 level
* ** significant at the 0.05 level, * .significant at the 0.1 level

Table 6 provides the BL model of choosing to either reject or accept the job offer of $20/hour in Mississauga. The coefficients of the explanatory variables can be explained as follows:

- The “chronic” and “cyclic” variables explain the subjects’ experiences with homelessness. When the situation of the homeless individual is chronic or cyclic, the preference to reject the job increases. This means that those who have experienced a shorter amount of homelessness are more willing to accept a job to get out of their situation of homelessness.
• The “street” variable explains the subject’s current place of stay. Those on the streets are also more likely to reject the job. This implies that the better the housing situation of the individual, the more likely they will accept the job offer.

• The explanatory variables also demonstrate that as age increases, homeless individuals are more likely to reject the job. This is possibly related to poor health and having less energy to work. In addition, as income increases and as duration of homelessness increases, homeless individuals are more likely to accept the job.

• Lastly, the “perception of travel cost” variable is a dummy variable coded from the ranking scale in Section 3.2.1. If one assigns a rank to travel cost that is higher than the average rank of the sample, then a “1” is allocated to the individual. From the model estimation, it shows that those who are influenced by travel costs would most likely accept the job, possibly because they feel that they can offset travel costs by accepting a well-paying job.

These alternative specific variables suggest that while homeless individuals do want to accept job offers to get out of their poverty situation, those who are at the most extreme end of homelessness (chronic and cyclic experiences, living on the streets) may not be as encouraged to do so. Some subjects shared that they were conscious of how they appeared to others, which might affect their perception of how comfortable they would be in a working environment. We continue to explore the decisions of those who accept the job offer in the next sections.

7.2 Ranking of Six Transportation Alternatives

In this section, we investigate the ranking of the six mode choice alternatives. Of the 135 subjects who accepted the job, 2 subjects could not properly rank all 6 of the mode choice alternatives. Therefore, they are excluded from the succeeding analysis. Of the remaining 133 subjects, the “cycle” and “rental car” options were chosen most frequently as the least preferred options. Specifically, 58 subjects (44%) and 49 subjects (37%) chose “cycle” and “rental car” as the least preferred alternatives, respectively. The reasons for such choices might be associated with the fact that amongst the 6 alternatives, the cycle option presented the longest travel time, while the rental car option presented one of the most expensive overhead costs in addition to the one-way travel cost.
Consequently, the “transit” and “drive” options were commonly selected as the most preferred options. To put it in perspective, 41 subjects (31%) chose transit as their first choice, while 45 subjects (34%) chose driving their own car as their first choice. Particularly, of those who chose transit as their first choice, approximately a third chose “get a ride” or “carpool” as their second preferred choice. Furthermore, of these 41 subjects, 18 subjects (44%) and 27 subjects (66%) ranked “drive” and “rental car” as their fifth or sixth options, respectively. These results suggest that those who prefer transit are tend to be more influenced by travel cost. In fact, amongst all 6 alternatives, “get a ride” and “carpool” options depict lower one-way travel costs, while “drive” and “rental car” options depict higher costs, especially with the addition of extra overhead costs.

Logically, one would expect that the transit alternative would not be a favourable option out of the six alternatives, especially considering the fact that transit presents a high one-way travel cost and a long travel time in comparison to other motorized modes. However, several subjects shared that while the above is fair and true, they are not acquainted with a friend or a family member who own an automobile. Furthermore, even if they do know someone with an automobile, they do not want to rely on others for a ride because of the inconvenience of possibly long waiting times and the need to match with other’s schedules.

When further investigating the subsequent ranking choices of the 45 subjects who chose “drive” as their most preferred alternative, we found that the “rental car” option was not commonly ranked as a second or third choice. This was surprising as both the “drive” and “rental car” options share similar travel attributes, with both being motorized modes that provide the driver with full ownership of route choices. Accordingly, the unexpected ranking can be rationalized by the idea that subjects would rather own a personal vehicle, than to pay a similar amount for a rental vehicle. Indeed, out of the 45 subjects, 28 (62%) ranked rental car as their fifth or sixth choice. In comparison, 30 (67%) ranked “carpool”, 24 (53%) ranked “get a ride” and 20 (44%) ranked “transit” as their second or third choices, respectively.
Prior to the econometric modelling process, we removed 2 observations, as there were 2 subjects who provided a tie ranking. In the end, the model estimation was completed with a total of 133 observations. We first attempted to use MNL models to explain the variables associated with the choice of each ranking number: from best (rank 1 alternative) to last (rank 6 alternative). However, these models did not prove to be significant, specifically in terms of the important variables of travel time and travel cost. As such, we expected that the ROL model would provide better results, assuming that individuals rank alternatives from best to worst as established around their perceived utility of each alternative.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Transit</th>
<th>Ride</th>
<th>Carpool</th>
<th>Cycle</th>
<th>Drive</th>
<th>Rental</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>41</td>
<td>22</td>
<td>9</td>
<td>14</td>
<td>45</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td>32</td>
<td>42</td>
<td>15</td>
<td>15</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>26</td>
<td>24</td>
<td>41</td>
<td>14</td>
<td>13</td>
<td>15</td>
</tr>
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<td>26</td>
<td>38</td>
<td>20</td>
<td>11</td>
<td>21</td>
<td>17</td>
</tr>
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<td>5</td>
<td>16</td>
<td>14</td>
<td>13</td>
<td>21</td>
<td>28</td>
<td>41</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
<td>3</td>
<td>8</td>
<td>58</td>
<td>11</td>
<td>49</td>
</tr>
</tbody>
</table>

Table 7: Ranking of Six Mode Choice Alternatives

Figure 19: Proportion of Ranking of Six Alternatives
In the ROL model, we made sure to include time and cost variables, as they have an effect on policy analysis. Here, we would like to remind that our scenario presented a fixed table to all individuals. Thus, interaction of variables was essential to our model estimation. The following explains the parameters and the explanatory variables used in our model estimation:

- The cost-income ratio variable is based on the relationship between each individual’s income and the cost of a one-way travel. This ratio was used, assuming that those with a lower income would be more affected by higher travel costs. To prepare this cost-income ratio, we added $2 to each individual’s monthly income, and then calculated the logarithm of each individual’s newly assigned monthly income. The purpose of including $2 was because some individuals had a monthly income of $0, and we needed to ensure that the cost-income ratio would be greater than 0, when dividing travel cost over one’s ln(income).

- We also included a cost variable interacted with one’s duration of homelessness category and one’s perception of cost. The perception of travel cost is a dummy category calculated as an individual’s perception of cost relative to the entire modelled sample population. Specifically, an average of all individuals’ perception of travel cost was calculated, and used as a threshold. It was assumed that subjects with a ranked perception above the average, or threshold, were affected by travel costs (denoting a 1), while others under the average were not affected by travel costs (denoting a 0).

- Lastly, we interacted the time variable with one’s age category. We assumed that age would play a factor in travel time, assuming that the higher the age, the more affected the subject would be of travel time.
The model specification of the six ranked alternatives is as follows, with the drive alternative chosen as the reference alternative:

\[
U_{\text{carpool}} = 0.362 - 0.244 \frac{\text{cost}}{\ln(\text{inc} + 2)} - 0.014t_{age30-40}age30-40 - 0.007t_{age40-50}age40-50 \\
- 0.010t_{age50-60}age50-60 - 0.016t_{age60+}age60+ - 0.158c_{\text{indur}_{0-3}}\ln d\text{u}r_{0-3}pc \\
- 0.064c_{\text{indur}_{3-5.5}}\ln d\text{u}r_{3-5.5}pc - 0.067c_{\text{indur}_{7.5-8.5}}\ln d\text{u}r_{7.5-8.5}pc \\
- 0.184c_{\text{indur}_{8.5+}}\ln d\text{u}r_{8.5+}pc - 0.349\text{license}
\]

\[
U_{\text{cycle}} = -0.521 + 0.297\text{own} - 0.014t_{age30-40}age30-40 - 0.007t_{age40-50}age40-50 \\
- 0.010t_{age50-60}age50-60 - 0.152c_{\text{indur}_{7.25-8}}\ln d\text{u}r_{7.25-8}pc - 1.183\text{license}
\]

\[
U_{\text{rental}} = -0.917 - 0.244 \frac{\text{cost}}{\ln(\text{inc} + 2)} - 0.014t_{age30-40}age30-40 - 0.007t_{age40-50}age40-50 \\
- 0.010t_{age50-60}age50-60 - 0.016t_{age60+}age60+ - 0.158c_{\text{indur}_{0-3}}\ln d\text{u}r_{0-3}pc \\
- 0.064c_{\text{indur}_{3-5.5}}\ln d\text{u}r_{3-5.5}pc - 0.067c_{\text{indur}_{7.5-8.5}}\ln d\text{u}r_{7.5-8.5}pc \\
- 0.184c_{\text{indur}_{8.5+}}\ln d\text{u}r_{8.5+}pc - 0.883\text{license}
\]

\[
U_{\text{ride}} = 0.208 - 0.244 \frac{\text{cost}}{\ln(\text{inc} + 2)} - 0.014t_{age30-40}age30-40 - 0.007t_{age40-50}age40-50 \\
- 0.010t_{age50-60}age50-60 - 0.016t_{age60+}age60+ - 0.158c_{\text{indur}_{0-3}}\ln d\text{u}r_{0-3}pc \\
- 0.064c_{\text{indur}_{3-5.5}}\ln d\text{u}r_{3-5.5}pc - 0.067c_{\text{indur}_{7.5-8.5}}\ln d\text{u}r_{7.5-8.5}pc \\
- 0.184c_{\text{indur}_{8.5+}}\ln d\text{u}r_{8.5+}pc - 0.674\text{license}
\]

\[
U_{\text{transit}} = 1.070 - 0.244 \frac{\text{cost}}{\ln(\text{inc} + 2)} + 0.297\text{own} - 0.014t_{age30-40}age30-40 - 0.007t_{age40-50}age40-50 \\
- 0.010t_{age50-60}age50-60 - 0.016t_{age60+}age60+ - 0.158c_{\text{indur}_{0-3}}\ln d\text{u}r_{0-3}pc \\
- 0.064c_{\text{indur}_{3-5.5}}\ln d\text{u}r_{3-5.5}pc - 0.067c_{\text{indur}_{7.5-8.5}}\ln d\text{u}r_{7.5-8.5}pc \\
- 0.184c_{\text{indur}_{8.5+}}\ln d\text{u}r_{8.5+}pc - 1.005\text{license}
\]

\[
U_{\text{drive}} = -0.244 \frac{\text{cost}}{\ln(\text{inc} + 2)} + 0.297\text{own} - 0.014t_{age30-40}age30-40 - 0.007t_{age40-50}age40-50 \\
- 0.010t_{age50-60}age50-60 - 0.016t_{age60+}age60+ - 0.158c_{\text{indur}_{0-3}}\ln d\text{u}r_{0-3}pc \\
- 0.064c_{\text{indur}_{3-5.5}}\ln d\text{u}r_{3-5.5}pc - 0.067c_{\text{indur}_{7.5-8.5}}\ln d\text{u}r_{7.5-8.5}pc \\
- 0.184c_{\text{indur}_{8.5+}}\ln d\text{u}r_{8.5+}pc
\]
Table 8: ROL Model of Ranked Alternatives

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative specific constants</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>carpool:(intercept)</td>
<td>0.362</td>
<td>0.189</td>
<td>1.909</td>
<td></td>
</tr>
<tr>
<td>cycle:(intercept)</td>
<td>-0.521</td>
<td>0.397</td>
<td>-1.313</td>
<td></td>
</tr>
<tr>
<td>rental:(intercept)</td>
<td>-0.917</td>
<td>0.174</td>
<td>-5.275</td>
<td>***</td>
</tr>
<tr>
<td>ride:(intercept)</td>
<td>0.208</td>
<td>0.175</td>
<td>1.194</td>
<td></td>
</tr>
<tr>
<td>transit:(intercept)</td>
<td>1.070</td>
<td>0.289</td>
<td>3.701</td>
<td>***</td>
</tr>
<tr>
<td>own</td>
<td>0.297</td>
<td>0.216</td>
<td>1.370</td>
<td></td>
</tr>
<tr>
<td>cost-ln(income) ratio</td>
<td>-0.244</td>
<td>0.100</td>
<td>-2.440</td>
<td>*</td>
</tr>
<tr>
<td>Time interacted with age 30-40</td>
<td>-0.014</td>
<td>0.007</td>
<td>-1.914</td>
<td>.</td>
</tr>
<tr>
<td>Time interacted with age 40-50</td>
<td>-0.007</td>
<td>0.007</td>
<td>-1.033</td>
<td></td>
</tr>
<tr>
<td>Time interacted with age 50-60</td>
<td>-0.010</td>
<td>0.007</td>
<td>-1.365</td>
<td></td>
</tr>
<tr>
<td>Time interacted with age 60+</td>
<td>-0.016</td>
<td>0.010</td>
<td>-1.677</td>
<td>.</td>
</tr>
<tr>
<td>Cost interacted with perception and ln(duration) 0-3</td>
<td>-0.158</td>
<td>0.120</td>
<td>-1.323</td>
<td></td>
</tr>
<tr>
<td>Cost interacted with perception and ln(duration) 3-5.5</td>
<td>-0.064</td>
<td>0.070</td>
<td>-0.921</td>
<td></td>
</tr>
<tr>
<td>Cost interacted with perception and ln(duration) 7.5-8.5</td>
<td>-0.067</td>
<td>0.090</td>
<td>-0.742</td>
<td></td>
</tr>
<tr>
<td>Cost interacted with perception and ln(duration) 8.5+</td>
<td>-0.184</td>
<td>0.157</td>
<td>-1.174</td>
<td></td>
</tr>
<tr>
<td>carpool:license</td>
<td>-0.349</td>
<td>0.361</td>
<td>-0.968</td>
<td></td>
</tr>
<tr>
<td>cycle:license</td>
<td>-1.184</td>
<td>0.429</td>
<td>-2.756</td>
<td>**</td>
</tr>
<tr>
<td>rental:license</td>
<td>-0.883</td>
<td>0.409</td>
<td>-2.161</td>
<td>*</td>
</tr>
<tr>
<td>ride:license</td>
<td>-0.674</td>
<td>0.365</td>
<td>-1.847</td>
<td>.</td>
</tr>
<tr>
<td>transit:license</td>
<td>-1.005</td>
<td>0.382</td>
<td>-2.630</td>
<td>**</td>
</tr>
<tr>
<td>Number of Observations</td>
<td>133</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log-Likelihood</td>
<td>-777.57</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjusted Rho-Square</td>
<td>0.339</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*** significant at the 0.001 level, ** significant at the 0.01 level
* significant at the 0.05 level, .’ significant at the 0.1 level
The following explains the parameters and the variables of the ROL Model:

- Owning a vehicle, in this case (bicycle, automobile, transit pass), was positively correlated to the subjects’ ranking of the alternatives. This can be explained by the idea that subjects most likely preferred alternatives that they were familiar with. For example, those who owned a transit pass would most probably prefer the transit alternative to all other alternatives.

- The individual specific variable of having a license and its effects on the model was investigated. Since the drive alternative was chosen as the reference alternative, negative alternative specific coefficients for having a license meant that the drive alternative was more preferred when individuals had a driver’s license. This is reasonable, as those who already own a license would be more attracted to driving a vehicle.

As mentioned, the model used a series of interaction variables in order to portray the effects of travel time and travel cost on each of the subjects, taking into account their diverse, complex and contextually specific experiences. The series of interaction variables consisted of: time interacted with one’s age category, and cost interacted with one’s duration of homelessness category and one’s perception of cost.

- The generic variable of the cost-income ratio, or \( \frac{cost}{\ln(Income + 2)} \), was examined. The coefficient of the cost-income ratio was negative, which was expected. This exhibits the fact that homeless individuals are sensitive to increased costs as their income decreases.

- In terms of the interaction of cost with duration of homelessness categories, the categories of \( \ln(duration) \) from 5.5-7.5 were chosen as the reference. The coefficients show that in comparison to the reference category, those who have experienced short durations of homelessness and those who have experienced long durations of homelessness are more negatively affected by travel costs. This might be explained by the idea that newly homeless individuals try to minimize their total costs as much as possible in order to get out of the homelessness situation quickly. As well, those who have experienced a long duration of homelessness are probably more affected by costs because they have been in poverty for a long period of time, and most likely cannot
afford to pay for travel costs in comparison to those in the reference category. It is assumed that the longer the duration of homelessness, the more difficult it is to get out of poverty.

- The age category of 30 and under was chosen as the reference category. The negative coefficients of time interacted with age categories show that homeless individuals, compared to those who are young and in the age category of 30 and under, are less likely to choose any of the alternatives based on travel time alone. The coefficients also demonstrate that those in the age categories of 30-40 and 60+ are more negatively affected by travel time in comparison to younger people than other age categories. This might be explained by the idea that those in the age categories of 30-40 are more active than other age groups, and have a better perception of their sensitivity of travel time. As well, those in the age categories of 60+ are most likely sensitive to travel time due to health issues and lower energy levels.

We will reexamine the significance of these coefficients in Chapter 9, in order to make policy recommendations to improve transport-related social exclusion of homeless individuals.
Chapter 8
Results of Scenario 3

8 Cost and Scheduling Strategies

This chapter is intended to investigate how homeless individuals schedule their travels when given funds to cover their travel costs. We were particularly interested in their location choice decisions, and their methods of minimizing travel cost and travel distance. The four provided location choices included: 1) Visit a Friend; 2) Part-time Work; 3) Grocery Store; and 4) Food Bank. Out of all the locations, we were particularly interested in their location choice of “Visiting a friend”. In essence, this location choice is equivalent to a social activity, and can be used to infer one’s transport-related social exclusion. We were also interested to see tradeoffs between going to the Grocery Store and the Food Bank. Since both locations share similar trip purposes of obtaining basic needs, there is possibility that subjects can choose to go to only one of the locations to save on travel cost and time.

8.1 Travel Choices and Attributes

Of the 159 subjects, two subjects stated that they would not go to any of the listed locations in the problem. The remaining 157 subjects provided their selected routes and mode choices for each trip, based on the locations displayed in Figure 5.

In general, the average travel cost spent for the subjects’ selected routes was $4.84. The majority of subjects (40%) stated that they would complete their entire schedule of selected routes at no cost, by walking or cycling. Intriguingly, this scenario allowed us to better understand their cost-coping strategies. For example, there were other subjects who stated that they would make transit trips by attempting to use a transfer when possible, even to the extent of using one transfer for the entire day. Other subjects shared their strategy of using a public transit Day Pass to save on transit costs. By considering the aforementioned cost-coping strategies, the average travel cost was readjusted and found to be $3.96.

At further examination, the route choices of homeless individuals portray their trip chaining behaviour. Subjects commonly made a total of 5 trips, with the entire sample making an average of 4.56 trips and travelling an average distance of 11.38km. The trip chaining behaviour is
similar to the travel attributes captured from their travel diaries. Again, the trip chaining behaviour might be related to the fact that most homeless individuals residing in shelters have to keep busy and pass time before they are allowed to return to the shelters in the evening.

Table 9: Summary of Mode Choices and Travel Purposes by Trip Number

<table>
<thead>
<tr>
<th>Mode Choice by Trip Number</th>
<th>Trip 1</th>
<th>Trip 2</th>
<th>Trip 3</th>
<th>Trip 4</th>
<th>Trip 5</th>
<th>Trip 6</th>
<th>Trip 7</th>
<th>Trip 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walk</td>
<td>76</td>
<td>71</td>
<td>56</td>
<td>49</td>
<td>33</td>
<td>11</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Transit</td>
<td>48</td>
<td>56</td>
<td>53</td>
<td>49</td>
<td>32</td>
<td>8</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Cycle</td>
<td>31</td>
<td>26</td>
<td>33</td>
<td>21</td>
<td>17</td>
<td>10</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Carpool</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Get a ride</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>157</td>
<td>157</td>
<td>148</td>
<td>123</td>
<td>87</td>
<td>30</td>
<td>12</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Travel Purpose by Trip Number</th>
<th>Trip 1</th>
<th>Trip 2</th>
<th>Trip 3</th>
<th>Trip 4</th>
<th>Trip 5</th>
<th>Trip 6</th>
<th>Trip 7</th>
<th>Trip 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grocery Store</td>
<td>47</td>
<td>33</td>
<td>25</td>
<td>18</td>
<td>5</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Food Bank</td>
<td>27</td>
<td>46</td>
<td>20</td>
<td>11</td>
<td>5</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Part-time Work</td>
<td>58</td>
<td>26</td>
<td>20</td>
<td>10</td>
<td>8</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Visit a friend</td>
<td>23</td>
<td>18</td>
<td>33</td>
<td>30</td>
<td>9</td>
<td>7</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Place of Stay</td>
<td>0</td>
<td>31</td>
<td>47</td>
<td>51</td>
<td>61</td>
<td>20</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>Undisclosed</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>157</td>
<td>157</td>
<td>148</td>
<td>123</td>
<td>87</td>
<td>30</td>
<td>12</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Travel Purpose and Mode Choice</th>
<th>Walk</th>
<th>Transit</th>
<th>Cycle</th>
<th>Carpool</th>
<th>Get a ride</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grocery Store</td>
<td>75</td>
<td>27</td>
<td>23</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Food Bank</td>
<td>37</td>
<td>45</td>
<td>23</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Part-time Work</td>
<td>43</td>
<td>50</td>
<td>27</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Visit a friend</td>
<td>37</td>
<td>53</td>
<td>29</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Place of Stay</td>
<td>102</td>
<td>70</td>
<td>41</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Undisclosed</td>
<td>7</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

The subjects’ choices in Scenario 3 also allowed us to investigate the relationship between mode choice by trip number, travel purpose by trip number, and the cross-tabulation of travel purpose and mode choice, as presented in Table 9. We highlight that subjects could only travel a maximum of 8 possible trips in Scenario 3. Overall, subjects tended to choose the walking option for a majority of their trips. It can be observed that subjects commonly travelled to part-time work as their first trip purpose, signifying the importance that homeless individuals place on
employment opportunities. Most of the subjects also tended to return to their place of stay at the fourth or fifth trip, corresponding with the average trip number of 4.56 trips.

In exploration of the cross-tabulation of travel purpose and mode choice, it is clear that the subjects were inclined to walk to the grocery store and to the place of stay. On the contrary, subjects were inclined to take public transit to go to part-time work and to visit a friend. These findings of the subjects’ mode choices in relation to travel purposes are expected. Firstly, the results reflect those of scenario 2, in which subjects tended to select public transit to travel to part-time work in order to be punctual or to look presentable for work. Secondly, it was expected that subjects would choose to use transit to visit a friend, as the friend’s location is situated furthest in distance from all other locations on the map.

8.2 Location Choices

The following sections provide BL models for choosing to visit each of the provided locations in Scenario 3. The explanatory variables consist of personal attributes, as well as travel attributes extracted from each subject’s travel diary. We used a series of dummy variables to represent whether or not the subjects chose to visit the four locations in Scenario 3: “visit” for visiting a friend, “work” for travelling to part-time work, “grocery” for visiting a grocery store and “food” for visiting a food bank. We also estimated the models with a “frequency” variable, which explained the number of days in a week the subjects used a certain mode of travel. In addition, we tested the models with variables from the subjects’ travel diaries including their usual number of daily trips and distances travelled.

8.2.1 Social Activity Choice

The reference category for the model estimation was the choice of not going to visit a friend. The model specification for the social activity choice is as follows:

\[ U_{visit} = -3.736 + 1.408 \text{grocery} + 0.783 \text{food} + 0.001 \text{income} - 0.036 \text{age} - 2.898 \text{full} \]
\[ - 2.069 \text{part} + 0.511 \text{walkf}q + 0.225 \text{tdtrips} \]

\[ U_{novisit} = 0 \]
Table 10: BL Model of Visiting a Friend

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visit:(intercept)</td>
<td>-3.736</td>
<td>1.622</td>
<td>-2.304  *</td>
</tr>
<tr>
<td>visit:grocery</td>
<td>1.408</td>
<td>0.562</td>
<td>2.504   *</td>
</tr>
<tr>
<td>Visit: food</td>
<td>0.783</td>
<td>0.488</td>
<td>1.606</td>
</tr>
<tr>
<td>Visit: income</td>
<td>0.001</td>
<td>0.001</td>
<td>2.542   *</td>
</tr>
<tr>
<td>Visit: age</td>
<td>-0.036</td>
<td>0.021</td>
<td>-1.717  .</td>
</tr>
<tr>
<td>Visit: part</td>
<td>-2.069</td>
<td>0.993</td>
<td>-2.084  *</td>
</tr>
<tr>
<td>Visit:walkfq</td>
<td>0.511</td>
<td>0.145</td>
<td>3.532   ***</td>
</tr>
<tr>
<td>Visit:tdtrips</td>
<td>0.225</td>
<td>0.137</td>
<td>1.647   .</td>
</tr>
</tbody>
</table>

Number of Observations 148
Log-Likelihood -62.48
Adjusted Rho-Square 0.202

* *** significant at the 0.001 level, ** significant at the 0.01 level
* * significant at the 0.05 level, . ' significant at the 0.1 level

The explanatory variables of the social activity location choice BL model are analyzed below:

- The “grocery” and “food” dummy variables explain the subjects’ location choices in Scenario 3. Those who choose to visit the grocery store and those who visit the food bank are likely to visit a friend in the scenario.

- As income increases, individuals are more likely to visit a friend. As age increases, individuals are also less likely to visit a friend. Together, the income and the age variables explain that those who are older would probably prefer to visit their friend by using a mode of travel other than by walking, as the location is much further away from all other locations in the scenario. However, using such a mode would require travel costs.

- Individuals who work full-time or part-time were less likely to choose to visit a friend. This implies that individuals who usually work might be more accustomed to spending most of their day at work, and thus, less likely to have time for social activities. This was reflected in their choice to not visit a friend in the scenario.

- Interestingly, most individuals who chose to visit a friend are those who usually walk. The “walkfq” variable explains that as frequency of walking increases, individuals are
also more inclined to visit a friend. As such, it suggests that these individuals regularly make walking trips, and are not affected by the long distance required to visit their friend.

- Lastly, “tdtrips” explain the number of trips that individuals travel on a daily basis, as extracted from their travel dairies. We found that individuals who make an increasing number of trips on a daily basis were more likely to choose to visit a friend. This is a reasonable finding in regards to the scenario, as the friend’s location is situated further in distance from all other locations. As such, the decision can be induced by whether or not the individual would be inclined to make an extra trip to visit their friend.

### 8.2.2 Part-time Work Choice

The reference category for the model estimation was the choice of not going to the part-time work location. The model specification for the part-time work location choice is as follows:

\[
U_{work} = 1.424 + 1.868 \text{grocery} + 1.155 \text{food} - 1.530 \text{chronic} - 1.596 \text{cyclic} \\
+ 1.564 \text{college} - 0.042 \text{age} + 0.217 \text{ttcfq}
\]

\[
U_{nowork} = 0
\]

<table>
<thead>
<tr>
<th>Table 11: BL Model of Going to Part-Time Work</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables</td>
</tr>
<tr>
<td>Alternative specific constants</td>
</tr>
<tr>
<td>work:(intercept)</td>
</tr>
<tr>
<td>Work:grocery</td>
</tr>
<tr>
<td>work:food</td>
</tr>
<tr>
<td>Work:chronic</td>
</tr>
<tr>
<td>Work:cyclic</td>
</tr>
<tr>
<td>Work:college</td>
</tr>
<tr>
<td>Work:age</td>
</tr>
<tr>
<td>Work:ttcfq</td>
</tr>
</tbody>
</table>

Number of Observations 148
Log-Likelihood -54.019
Adjusted Rho-Square 0.245

‘****’ significant at the 0.001 level, ‘***’ significant at the 0.01 level
‘**’ significant at the 0.05 level, ‘.’ significant at the 0.1 level
The explanatory variables of the part-time work choice BL model are explained below:

- The “grocery” and “food” dummy variables explain the subjects’ location choices in Scenario 3. Those who choose to visit the grocery store and those who visit the food bank are likely to go to part-time work in the scenario.

- The “chronic” and “cyclic” variables explain the homelessness experiences of homeless individuals. Those who are experiencing the most extreme end of homelessness (chronic and cyclic) are less likely to choose to work in the scenario. As age increases, individuals are also less likely to go to work. This is similar to Scenario 2, in which individuals experiencing chronic and cyclic homelessness, and of older age, also rejected the job offer.

- Those who have college education were more likely to choose to go to the work location. This implies that individuals with college education probably want to work. Subjects with higher education also shared in their interviews that they felt that they should be able to find work, but no opportunities were available.

- Lastly, those who usually use the TTC were also more likely to choose the work location. The “ttcfq” variable explains that as frequency of using TTC increases, individuals are also more inclined to choose to go to work. It implies that most of these individuals choose to use transit to get to work. Although the work location is not too distant from the “Place of Stay” in the Scenario and is of walking distance, it shows that homeless individuals place importance on work locations and want to ensure that they get to work on time.

8.2.3 Grocery Store Choice

The reference category for the model estimation was the choice of not going to the grocery store location. The model specification for the grocery store location choice is as follows:
\[
U_{\text{grocery}} = 1.791 - 1.596food + 1.694work + 1.772\text{visit} - 0.987\text{short} + 1.393\text{housed} - 1.780\text{dropin}
\]

\[
U_{\text{no\_grocery}} = 0
\]

Table 12: BL Model of Going to the Grocery Store

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grc:(intercept)</td>
<td>1.791</td>
<td>0.848</td>
<td>2.113 *</td>
</tr>
<tr>
<td>Grc:food</td>
<td>-1.596</td>
<td>0.691</td>
<td>-2.310 *</td>
</tr>
<tr>
<td>Grc:work</td>
<td>1.694</td>
<td>0.587</td>
<td>2.883 **</td>
</tr>
<tr>
<td>Grc:visit</td>
<td>1.772</td>
<td>0.577</td>
<td>3.073 **</td>
</tr>
<tr>
<td>Grc:short</td>
<td>-0.987</td>
<td>0.553</td>
<td>-1.784 .</td>
</tr>
<tr>
<td>Grc:housed</td>
<td>1.393</td>
<td>0.755</td>
<td>1.844 .</td>
</tr>
<tr>
<td>Grc:dropin</td>
<td>-1.780</td>
<td>0.670</td>
<td>-2.658 **</td>
</tr>
<tr>
<td>Number of Observations</td>
<td>148</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log-Likelihood</td>
<td>-50.795</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjusted Rho-Square</td>
<td>0.244</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* ***: significant at the 0.001 level, **: significant at the 0.01 level
* ': significant at the 0.05 level, '.: significant at the 0.1 level

The following explanatory variables of the grocery store choice BL model are explained in more detail below:

- The “grocery”, “food” and “work” dummy variables explain the subjects’ location choices in Scenario 3. Those who choose to visit the food bank are less likely to make a trip to the grocery store. This was expected, since many individuals can obtain the food items they need from the food bank, and they can save a trip to the grocery store, which costs time and money. Those who choose to work or visit a friend are also more likely to go to the grocery store.

- The “short” variable explains the homelessness experience of the individuals. Those who experienced short, or transitional homelessness, were less likely to visit the grocery store. This might imply that these individuals want to save as much money as they can when in a transitional period, so that they can quickly get out of their homelessness situation.
• In addition, those who were “housed” were more likely to go to the grocery store. Many of the individuals shared that they had no real reason to visit a grocery store, especially if they didn’t have a stove to cook food. In fact, even when they go to the food bank, they pick up ready-to-eat food. Since people who are housed have access to a stove, it made sense that most of them also chose to go to the grocery store.

• Lastly, as extracted from the subjects’ travel diaries, those who usually go to drop-ins were less likely to go to the grocery store. This is understandable as individuals usually get free meals at drop-ins, so they do not need to spend extra time and costs to go to the grocery store.

8.2.4 Food Bank Choice

The reference category for the model estimation was the choice of not going to the food bank work location. The model specification for the food bank location choice is as follows:

\[
U_{foodbank} = 1.195 - 1.296grc + 1.121work - 0.167durbycyclic + 0.001incbydropin - 0.001incbyusualwork
\]

\[
U_{nofoodbank} = 0
\]

Table 13: BL Model of Going to the Food Bank

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative specific constants</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food:(intercept)</td>
<td>1.195</td>
<td>0.684</td>
<td>1.748</td>
</tr>
<tr>
<td>Food:grc</td>
<td>-1.296</td>
<td>0.645</td>
<td>-2.010  *</td>
</tr>
<tr>
<td>Food:work</td>
<td>1.121</td>
<td>0.491</td>
<td>2.283   *</td>
</tr>
<tr>
<td>Food:durbycyclic</td>
<td>-0.167</td>
<td>0.075</td>
<td>-2.236  *</td>
</tr>
<tr>
<td>Food:incbydropin</td>
<td>0.001</td>
<td>0.0004</td>
<td>1.726</td>
</tr>
<tr>
<td>Food:incbyusualwork</td>
<td>-0.001</td>
<td>0.0005</td>
<td>-2.269  *</td>
</tr>
<tr>
<td>Number of Observations</td>
<td></td>
<td></td>
<td>148</td>
</tr>
<tr>
<td>Log-Likelihood</td>
<td></td>
<td></td>
<td>-79.589</td>
</tr>
<tr>
<td>Adjusted Rho-Square</td>
<td></td>
<td></td>
<td>0.116</td>
</tr>
</tbody>
</table>

‘****’ significant at the 0.001 level, ‘***’ significant at the 0.01 level
‘**’ significant at the 0.05 level, ‘.’ significant at the 0.1 level
The following are the explanatory variables of the food bank BL model:

- The “grocery” and “work” dummy variables explain the subjects’ location choices in Scenario 3. Those who choose to visit the grocery store are less likely to go to the food bank, since they probably have the food items they need and can save a trip. Consequently, those who work are likely to visit the food bank.

The next variables are dummy variables that are created through interactions:

- “Durbycyclic” explains the subjects’ duration of homelessness if their experience is cyclic, and “0” is assigned for all other homelessness experiences. Those who experienced a longer duration in a cyclic experience are less likely to go to a food bank. This is interesting since it would be expected that those in a cyclic experience would want to get out of their situation as early as possible, and try to use as many services available to them. This again implies that those at the most extreme end of poverty are more discouraged in attempting to get themselves out of their homelessness situation, which is reflected in the BL model in Scenario 2 of rejecting vs. accepting the job offer.

- “Incbydropin” explains the subjects’ income if they visit drop-ins, and “0” if they do not visit drop-ins on a daily basis. Those who have an income and go to drop-ins are likely to go to the food bank. It is understandable that those who usually go to drop-ins would be inclined to use similar services found at a food bank.

- “Incbyusualwork” explains the subjects’ income if they usually go to work, and “0” if they do not usually go to work on a daily basis. Those who have higher income and usually work are less likely to go to a food bank. This is reasonable as these subjects can probably afford to purchase their food when they work, and do not need to use the food bank.

The last two variables demonstrate that income may have different effects when interacted with other variables. This suggests that income alone may not determine whether or not the individual goes to the food bank, but rather, the choice is also based on one’s usual travels. For example, those who regularly visit drop-ins will visit a food bank even with increasing income, because they are acquainted with such travel habits, and visiting a food bank can also save them food
money. As well, those who usually go to work may not use the food bank. Not only does it mean that the working homeless can probably afford to purchase food for themselves, but it may also mean that they probably spend most of their day at work and do not have much familiarity with using a food bank.

8.3 Summary of Location Choices

Table 14 summarizes the variables that explain homeless individuals’ location choices in Scenario 3. We use Table 14 to compare the variables of the subjects’ in choosing to go to the various locations in the scenario. Variables in black print signify likeliness in choosing to visit the corresponding location, whereas variables in red print signify likeliness in not choosing to visit the corresponding location.

As the grocery store and the food bank can satisfy one’s basic needs, it can be assumed that going to either one or both of the locations are essential to one’s daily travels. On the other hand, going to part-time work depends on one’s willingness to work and their current health condition. As such, we expect that not all homeless individuals would choose to go to the work location, as exemplified in the reject vs. accept situation in Scenario 2. Lastly, visiting a friend would be considered as a travel that is not of necessity, compared to the locations that satisfy one’s basic needs.

In retrospect, observation of Table 14 displays that increasing age negatively influences the likeliness of homeless individuals in visiting a friend or going to part-time work, locations that are not of “necessity”. Furthermore, both of these location choices are affected by the frequency of one’s usual mode use, specifically walking for visiting a friend and using public transit for going to work. On the contrary, the decisions to go to locations of dire necessity, namely to the grocery store and the food bank, are mainly explained by one’s personal homelessness experiences and usual daily travels.

The next chapter discusses how we can draw connections from the analysis to make policy recommendations to improve the transport-related social exclusion for homeless individuals.
<table>
<thead>
<tr>
<th></th>
<th>Visit a Friend</th>
<th>Part-time Work</th>
<th>Grocery Store</th>
<th>Food Bank</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Other locations</strong></td>
<td>Grocery Store</td>
<td>Grocery Store</td>
<td>Food Bank</td>
<td>Grocery Store</td>
</tr>
<tr>
<td></td>
<td>Food Bank</td>
<td>Part-time Work</td>
<td>Part-time Work</td>
<td>Food Bank</td>
</tr>
<tr>
<td><strong>Income</strong></td>
<td>Income</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Interacted with drop-in*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Interacted with usual work*</td>
<td></td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>Age</td>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Duration</strong></td>
<td></td>
<td></td>
<td></td>
<td>Interacted with cyclic*</td>
</tr>
</tbody>
</table>

**Categorical Variables**

<table>
<thead>
<tr>
<th>Current place of stay</th>
<th></th>
<th></th>
<th>Housed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employment status</td>
<td>Full time</td>
<td>Part time</td>
<td></td>
</tr>
<tr>
<td>Overall experience with homelessness</td>
<td>Chronic Cyclic</td>
<td>Short</td>
<td>Cyclic interacted with duration*</td>
</tr>
<tr>
<td>Education level</td>
<td>College</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency of using a certain mode</td>
<td>Walk</td>
<td>Public Transit</td>
<td></td>
</tr>
<tr>
<td>Location choice from travel diary</td>
<td>Drop-in</td>
<td></td>
<td>Drop-in interacted with income*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Usual work interacted with income*</td>
</tr>
</tbody>
</table>
Chapter 9
Links to Policy Recommendations

9 Policy Recommendations

The analysis in Chapters 7 and 8 provide us with more understanding on the attributes that explain homeless individuals’ decision to travel. The following sections provide further discussion on how we can draw connections from the analysis to make policy recommendations that will improve transport-related social exclusion of homeless individuals.

Oftentimes, we consider that homeless individuals are affected solely by costs. However, the results from the model point to the idea that cost is not the only factor, as decisions to travel also depends on one’s perception of travel time, and one’s personal attributes such as age, overall experience with homelessness and their duration of homelessness.

9.1 Willingness to Pay

In transport analysis, willingness to pay (WTP) is frequently used to explain the maximum amount that an individual is willing to sacrifice to purchase a good. In our case, we measure the willingness of homeless individuals in paying to shorten their travel times. As found in Section 7.2, travel time is indeed an important variable in explaining homeless individuals’ travel behaviour. Moreover, homeless individuals exude trip chaining behaviour, so it is natural for them to be mindful of travel time when scheduling their trips throughout the day so that they can also minimize travel costs simultaneously.

The ratio of coefficients provides the substitution rate between the two attributes of travel time and travel cost, expressed as follows:

\[
WTP = \frac{\beta_{\text{age}}} {\beta_{\text{in}} \ln (\text{dur} \times \text{pc}) + \beta_{\text{cost-income ratio}} / \ln (\text{income} + 2)}
\]

where,

- \(\beta_{\text{age}}\) is a dummy variable of an interaction of 2 variables, where age is “1” multiplied by the travel time if the individual is part of the age category, else “0”
• $\beta_{\text{Indur}} \ln(\text{dur}) \ast \text{pc}$ is a dummy variable of an interaction of 3 variables. \ln(\text{dur}) is “1” and \text{pc} is “1” multiplied by travel cost if the individual is part of the \ln(\text{duration}) category and the individual is affected by travel cost relative to the sample population.

• $\beta_{\text{Cost-income ratio}}$ is a variable of an interaction of 2 variables, which assumes that individuals perceive travel costs as a portion of their income. The inclusion of the cost-income ratio in the WTP specification is also found in Giergiczny et al.’s (2012) work.

Table 15 presents the willingness to pay for time savings when specifically looking at age and duration of homeless categories, assuming that individuals are affected by travel costs.

### Table 15: Willingness to Pay for Time Savings

<table>
<thead>
<tr>
<th>Ln(dur) category</th>
<th>Age 30-40</th>
<th>Age 40-50</th>
<th>Age 50-60</th>
<th>Age 60+</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-3</td>
<td>$5.32/hr</td>
<td>$2.66/hr</td>
<td>$3.78/hr</td>
<td>$6.08/hr</td>
</tr>
<tr>
<td>3-5.5</td>
<td>$13.13/hr</td>
<td>$6.56/hr</td>
<td>$9.38/hr</td>
<td>$15.00/hr</td>
</tr>
<tr>
<td>7.5-8.5</td>
<td>$12.54/hr</td>
<td>$6.27/hr</td>
<td>$8.96/hr</td>
<td>$14.33/hr</td>
</tr>
<tr>
<td>8.5+</td>
<td>$4.57/hr</td>
<td>$2.28/hr</td>
<td>$3.26/hr</td>
<td>$5.22/hr</td>
</tr>
</tbody>
</table>

Table 15 shows that individuals who are younger (age 30-40) and older (age 60+) are more willing to pay for time savings. Again, this points to the idea that younger people are more likely to travel for work-related purposes, and are more willing to pay to travel to such destinations. Likewise, the elderly are more willing to pay for time savings, in order to save on travel time to compromise any health conditions.

In addition, Table 15 indicates that individuals who are in the lowest and the highest “duration” categories are less willing to pay. This suggests that those who are newly homeless or who are experiencing a transitional period are more likely to want to save on their costs, so that they can get out of their poverty situation as soon as possible. On the other hand, those who have experienced homelessness for a long period of time are also more likely to save on their travel costs. This might be explained by the idea that those who are homeless for long periods of time probably have low income. Furthermore, these individuals most likely have discovered the best coping strategies that fit their needs, such as either making more use of walking and strategically planning their travel routes and schedules to reduce travel costs.
Consequently, this identifies the four categories that were most unwilling to pay for travel costs:

1) Age 40-50 with ln(duration) category 0-3
2) Age 40-50 with ln(duration) category 8.5+
3) Age 50-60 with ln(duration) category 0-3
4) Age 50-60 with ln(duration) category 8.5+

For homeless individuals, employment opportunities would definitely be an essential method of helping one to be free from the cycle of poverty. Those who fall under the age categories of 40-50 and 50-60 still have a chance of finding work. However, since they are most unwilling to pay for travel costs, this might also affect their decisions of looking for work away from their immediate surroundings. It would be recommended that social services should recognize that homeless individuals in the age categories of 40-60 may have a willingness to work, but are influenced by travel costs from finding appropriate employment opportunities.

When including the coefficient of the cost-income ratio, we were able to calculate the WTP for each individual in our sample. The mean WTP for all individuals using the above formula was found to be $11.17 per hour, which is close to the wage of $20/hour offered in this scenario. The standard deviation was found to be $7.73, with WTP values ranging from $0 to $28.71. While $11.15/hr is quite a large amount considering that homeless individuals have a low income, the WTP encompasses other attributes including their age and their duration of homelessness. Figure 20 also illustrates the effect of age on one’s willingness to pay. Similar to the analysis in Table 15, we find that those who are younger and those who are older are more willing to pay larger amounts than other age groups.
Transport-related social exclusion is considered as the constraints that limit individuals from accessing services or opportunities that can improve their quality of life. We compare the travel attributes of subjects’ travel diaries to their choices in scenario 3 to demonstrate how $10 provided for travel costs can increase their freedom of choice. A total of 148 subjects provided a complete decision set of Scenario 3, as well as a complete travel diary. Thus, we measured freedom of choice using an observation of the 148 individuals.

Firstly, it is important to recognize that Scenario 3 limits the maximum number of trips to 8 trips, and the maximum trip distance to 19 km. We found that in comparison to the travel diary, 42% of the subjects chose to make more trips than their usual travels, and 64% of the subjects made longer distance trips than usual. We also compared the mode choices between one’s travel diary and Scenario 3, as presented in Table 16 and Figure 21. It was difficult to compare the “get a ride” and “carpool” modes, because not many individuals use these modes on a normal basis. However, it is interesting to note that with a given $10 in the scenario, individuals made less trips by walking, with an average percentage change of each individual of -19%. On the other hand, the average percentage change of homeless individuals choosing to use the transit mode increased by 36%.
In Sven Erlander’s book, “Cost-Minimizing Choice Behavior in Transportation Planning”, Erlander coins the term “freedom of choice” to “indicate the richness of the opportunities open to the decision makers”. Erlander (2010) introduces a quantity called the “measure of revealed freedom of choice”, with the idea that “the observed frequencies…reveal something about how constrained the decision making is”.

We can readily apply the concept of measure of revealed freedom of choice to the travel diaries of our subjects. It is evident that the subjects are constrained to mode choice decisions, as a large
portion of the subjects are inclined to walk. Based on Erlander’s theory, since “the decisions concentrate on a smaller set of the alternatives, then...the level of freedom of choice is lower”. In our case, the freedom of choice is evidently constrained by travel costs.

Referencing Erlander’s theory, the number of possible outcomes of each sample is given by the combinatorial formula:

$$\frac{N!}{(z_1! \ldots z_k!)}$$

, where the observed frequencies $z = (z_1! \ldots z_k!)$ when summed, should equal the number of individuals in the sample $\sum_{k=1}^{K} z_k = N$.

The number of possible outcomes can then be used to find the observed entropy, or the measure of revealed freedom of choice:

$$\Phi(z) = \frac{1}{N} \log \frac{N!}{(z_1! \ldots z_k!)}$$

A high value of entropy indicates that there are “many ways to obtain the sample”, and thus a higher freedom of choice.

Table 17: Observed Entropy

<table>
<thead>
<tr>
<th></th>
<th>Travel Diary</th>
<th>Scenario 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walk</td>
<td>99</td>
<td>62</td>
</tr>
<tr>
<td>Public Transit</td>
<td>33</td>
<td>53</td>
</tr>
<tr>
<td>Cycle</td>
<td>13</td>
<td>28</td>
</tr>
<tr>
<td>Get a Ride</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Carpool</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td><strong>Number of Possible Outcomes</strong></td>
<td><strong>2.53*10^{55}</strong></td>
<td><strong>2.60*10^{72}</strong></td>
</tr>
<tr>
<td><strong>Observed Entropy</strong></td>
<td><strong>0.82</strong></td>
<td><strong>1.13</strong></td>
</tr>
</tbody>
</table>

The table above compares the observed frequencies and the entropy of the mode choices of the subjects’ travel diaries to the choices in Scenario 3. As seen in Table 17, the observed entropy is greater for Scenario 3, indicating that with more money set aside for travel, homeless individuals would also be more willing to switch to using the transit mode. It is also interesting to note that
there was a slight increase in the mode switch to cycling. Although cycling is also a mode that features zero travel costs, the scenario implied that subjects had access to a bicycle. As such, having access to a bicycle would also increase mode switch to cycling, as it is a faster form of travel than walking.

In summary, our analysis shows that with costs set aside for travel, it would increase homeless individual’s freedom of choice in regards to mode choice selection. While increasing subsidies for homeless individuals would be difficult, our analysis shows the significance that a small increase could create in improving the transport-related social exclusion experiences of street people.

9.3 Recommendations for the City of Toronto

Transport policies for homeless individuals are few. In America, the McKinney-Vento Homeless Assistance Act was implemented since 1987 to specifically transport students experiencing homelessness (National Coalition for the Homeless, 2006). As mentioned by Woolley (2015), special discounts for low-income individuals are present in specific social initiatives in Canadian cities such as Calgary (Calgary Transit), Edmonton (Dubois, 2015), and the province of Saskatchewan (Government of Saskatchewan).

In June 2015, the TTC announced that they would eliminate tokens and tickets by 2017 (Moore, 2015). This measure complements the current implementation of Presto cards, which have been slowly introduced at stations and vehicles across the TTC network. The Presto card allows users to pay for public transit with credit and debit cards, instead of with tokens and tickets. While details of the replacement have yet to be announced by TTC officials, some have offered their opinions on the matter, especially on the topic of how such a change could affect those living in poverty.

In particular, Woolley (2015) of the Homeless Hub posed several questions of interest:

1) “Will card fees be waived for bulk purchases (by social agencies) or for people designated as low-income?”
2) “How can people without debit/credit cards and cell phones going to receive and maintain cards? Will this option be available at all stations/points of access, or just a few?”

Consequently, it is reassuring to know that the City of Toronto and the TTC have been considering the implementation of a low-income pass. Both parties stated that the smartcard technology in the Presto card can “allow for a wide range of fare-pricing options that could not be accommodated previously...[such as linkages] to travel time, peak/off hours, distance, or vehicle type” (Woolley, 2015).

Naturally, a fare-pricing structure for all homeless and low-income individuals would be ideal. Below, we summarize the travel behaviour of homeless individuals from our results, which justify the importance of recognizing their mobility needs and in the consideration of implementing a low-income fare-pricing structure:

1) Homeless individuals exude trip chaining behaviour, travelling close to an average of 5 trips daily.

2) Homeless individuals have reason to use public transit, as those even without a form of mobility (ownership of an automobile, bicycle, transit pass) rely on and frequently use public transit to access the services they need to attend to.

3) The ROL model shows that travel costs may be mostly affecting homeless individuals who are in the age categories of 40-60 and their willingness to find employment opportunities that are located away from their immediate surroundings.

4) The analysis of freedom of choice shows that if one were to be given travel costs for a day’s journey, their experience of transport-related social exclusion would be reduced. In particular, homeless individuals would receive more freedom in the selection of their mode choices, as well as in the freedom of going to locations for social activities.
Chapter 10
Conclusions and Future Work

10 Concluding Remarks

This thesis began with the premise that mobility can play a part in improving the quality of life for homeless individuals. As the first study on the travel behaviour of homeless individuals in the City of Toronto, there were many lessons learned. The following sections provide details on the summary of our findings, limitations of our study, and future work.

10.1 Limitations

One main limitation of our study is that we did not sample many homeless women or youth, in comparison to our preliminary study. This was mainly due to the nature of our interview, which required us to conduct the study at shelters or drop-in locations. As such, it was difficult to obtain permission from women shelters and youth shelters, due to extra protection for these population segments.

In addition, we were limited by the fact that we could not refer to any prior investigation on homeless individuals’ travel behaviour. Having prior information would have allowed us to create a stated preference experiment interacted with revealed preference choices of the subjects. As such, we were constrained to presenting a table with fixed travel attributes (Scenario 2), and thus, we had to make several assumptions in regards to the interaction of variables in the analysis.

Furthermore, we neglected collecting information on some travel attributes that would have been of interest to the analysis, including questions about one’s perception of comfort. In reflection of the results, we realize that travel time is significant to those who belong in a specific age group. However, we could have obtained more intricacies by disaggregating travel time into out-of-vehicle and in-vehicle travel time. This would have been interesting to explore in our study, especially since many subjects travel by foot, which would represent out-of-vehicle travel time.
10.2 Summary of Findings

To our knowledge, we present one of the first quantitative studies of investigating the travel behaviour of street people, a population segment that has been traditionally difficult to reach in the transportation engineering field. This was achieved through the use of stated adaptation techniques. We were also fortunate to welcome support from local agencies, allowing us to obtain interview data from homeless people spanning different experiences and socioeconomic attributes. Our methodology in the interview design, recruitment process and the data collection process is one that allowed us to collect the required data for econometric modelling. We recommend that cities that also plan to conduct such studies use similar techniques and collaborate with local support groups.

In reflection, our findings show that while travel cost and travel time can have an influence on one’s travel decisions, transport-related social exclusion of homeless individuals is a complex problem to understand. In essence, transport-related exclusion depends heavily on the individual’s personal experiences. This is specifically apparent in the analysis of the ranking scale, in which travel cost minimally influenced or strongly influenced approximately the same number of subjects. The ranking depended on the subject’s custom travel habits, as those who often travel by foot are not as affected by travel costs.

10.3 Future Work

Future work on the intersections of transportation engineering and homelessness can include the use of the travel diary data to further investigate the activity schedules of homeless individuals, and to also spatially analyze their usual travels.

Further analysis of the ROL model could also provide new findings. For example, the existence of tie rankings suggests that some subjects may have had difficulties in distinguishing a clear ranking amongst certain alternatives. As such, deciphering the top 3 rankings and the worst 3 rankings may also provide other findings. Allison and Christakis’ (1994) work on the ranking of voter preferences is an example of how tie rankings can be further investigated in ranking experiments.
In summary, future work can further explore the complexities of travel patterns of homeless individuals through advanced analysis to aid in the making of policy recommendations to supplement the research gap in this field.
References


http://www.calgarytransit.com/fares-passes/passes/low-income-monthly-pass


Fair Fare Coalition. (2015). *Affordable TTC: A Ticket to the City*. Fair Fare Coalition. 


Appendix A: Structured Interview 2013

Gender: _____  Age: _____  Location of Research Conducted: ________________________

1. What is usually your most important reason for travel within a month?
   a) Job
   b) School or job training
   c) Job interview or to look for work
   d) Hospital, medical clinic or doctor’s appointment
   e) Home of a friend or family member
   f) Shelter
   g) Food bank or soup kitchen
   h) Other _______________________

2. How do you usually get to this important destination?
   a) Public transit
   b) Getting a ride from a friend
   c) Borrowing a car or other vehicle
   d) Riding a shuttle van from a service provider
   e) Your own vehicle _______________________
   f) Other _______________________

3. Did you use public transit in the past month?
   a) Yes
   b) No

4. How do you usually pay for public transit?
   a) With cash
   b) With monthly pass you purchased
   c) With pass/token given to you
   d) Negotiate with driver for reduced fare
   e) Other _______________________

5. Which type of public transit do you use most often?
   a) TTC (streetcar)
   b) TTC (bus)
   c) TTC (subway)
   d) Other _______________________

6. What times during the weekdays do you usually use public transit?
   a) 8am – 10am
   b) 10am – 12pm
   c) 12pm – 2pm
   d) 2pm – 4pm
   e) 4pm – 6pm
   f) 6pm – 8pm
7. Which parts of the city do you visit and which routes do you take during the times you use public transit on weekdays?

______________________________________________________________________________
______________________________________________________________________________

8. What times during the weekends do you usually use public transit?
   a) 8am – 10am
   b) 10am – 12pm
   c) 12pm – 2pm
   d) 2pm – 4pm
   e) 4pm – 6pm
   f) 6pm – 8pm
   g) 8pm – 10pm
   h) Other __________________________

9. Which parts of the city do you visit and which routes do you take during the times you use public transit on weekends?

______________________________________________________________________________
______________________________________________________________________________

10. What has your experience been like with the bus/train operators?
   a) Gave you a ride with a reduced fare
   b) Gave you a free ride
   c) Refused to let you on
   d) Did not stop to pick you up
   e) Other __________________________

11. What stops you from using public transit more frequently and/or what stops you from using public transit to get to important destinations?
   a) Bus/train was too expensive
   b) Bus/train operators were unhelpful
   c) Bus/train did not go where you needed or wanted it to go
   d) Bus/train did not come on schedule
   e) Other __________________________

12. Do you have any other comments about public transportation in Toronto?
   What could be improved to the current system that would better serve your needs?

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
Appendix B: Consent Form 2015

TITLE OF PROJECT: An Investigation of Transport-Related Social Exclusion of the Homeless Community in Toronto

Investigator: Vivian Hui

INFORMATION

Purpose
This study is conducted by the Department of Civil Engineering at the University of Toronto. The aim of this project is to better understand the transportation needs of the Toronto homeless community, a group that has often been ignored in transport planning. Our aim is that our findings will gain attention in transport policy decision-making in the city.

Participation Information
You have been invited to participate in this study because you are currently experiencing homelessness or have experienced homelessness within the last 3 years. The survey will take approximately 30 minutes to complete. The full survey will be completed at this community agency’s facility.

Benefits
The benefit of participating in this survey is that you can have your voice heard on issues regarding public transportation in Toronto. Your involvement in this project will allow us to obtain information on how to address the transportation needs of the homeless community. You will also get a $10.00 grocery card at the completion of the full survey.

Risks
There is no related risk involved with this study, however, you may feel uncomfortable answering certain questions. Remember that you have the right to refuse to answer these questions.

Confidentiality and Storage
All provided data will be treated with complete confidentiality. We will not be recording your name. We will be recording your voice to speed up the survey process, however we will delete these voice recordings once we transcribe your voice into text. The transcribed data will be securely stored in a password-protected database on the investigator’s laptop. The transcribed data will be kept for an indefinite period of time to keep historical records, and to evaluate travel behavioural changes of the homeless community for future ongoing research. All physical copies of data will be stored in the locked office of the investigator. Physical copies of data will be
converted to digital records, and will be eventually destroyed by shredding when the use of data is completed for research purposes.

**Withdrawal**
You are free to withdraw from completing the survey at any time. However, you will only receive financial compensation if you complete the full survey. Data from uncompleted surveys will also be retained in a secured server environment. If there are questions you would like to refuse to answer, you can skip a question.

**Sharing of Results**
If you are interested in learning about the results of our work, we will be sharing the findings with the community agency in a poster format.

**Additional Contacts**
If you have any further questions or concerns about your rights as a research subject, please feel free to contact the Office of Research Ethics, University of Toronto, McMurrich Building, 2nd floor, 12 Queen’s Park Crescent West Toronto, ON M5S 1S8 at (416)-946-3273 or ethics.review@utoronto.ca.
CONSENT
We would now like to obtain your consent to participate in our survey. Please check the “Yes” or “No” boxes for each question to confirm your understanding of the above information and your permission to participate in our survey.

Consent of Participant

☐ Yes ☐ No

☐ I have read the information presented in this letter carefully/☐ I have listened carefully to the information presented in this letter.

☐ I understand the information presented in this letter.

☐ I have had the opportunity to ask questions about this study, and have received satisfactory answers, if applicable.

☐ In case of withdrawal, I understand that anonymous data will be stored and that I will not receive financial compensation.

☐ I was informed that if I have any concerns or questions regarding my Rights as a research subject, I can contact the Office of Research Ethics at the University of Toronto.

☐ I agree, of my own free will, to voluntarily participate in this study.
Appendix C: Structured Interview 2015

Location of Interview ________________________________

Section 1: Personal Demographic Information

Q1. What is your age?
Age ____________________

Q2. Would you identify as:
   a) Male
   b) Female
   c) Transgender

Q3. Do you consider yourself to be:
   a) First Nation
   b) African Canadian
   c) Asian
   d) White
   e) Multiracial
   f) Other, please specify ____________________

Q4. How would you describe your current experience with homelessness?
   a) Unsheltered: I lack housing and I’m not accessing emergency shelters or accommodation except during extreme weather conditions
   b) Emergency Sheltered: I am accessing emergency shelter and system supports, at no cost or minimal cost
   c) Underhoused: I access accommodations that offer no prospect of permanence
   d) At risk of homelessness: My current economic and/or housing situation is risky, and does not meet public health and safety standards
   e) Other, please specify ____________________

Q5. Which best describes your overall experience with homelessness?
   a) Episodic: I have recurrent problems with housing
   b) Transitional: I am facing some sort of housing, health care, financial or job loss crisis
   c) Chronic: I have been continuously homeless for a year or more, or have had at least four episodes of homelessness in the last three years

Q6. During your last or current period of homelessness, how long were you continuously homeless?
   Years ____________
   Months ____________
   Weeks ____________
   Days ____________
Q7. What best describes your current place of stay?
   a) An emergency shelter
   b) A transitional shelter
   c) Permanent supportive housing
   d) A welfare or voucher hotel
   e) A friend or family’s house
   f) A car or vehicle
   g) An abandoned building
   h) A transportation site (subway station, bus station)
   i) At a place of business (24-hour restaurant, bar, laundromat, all night movie)
   j) Sidewalk
   k) Park
   l) Hotel or motel (that you pay for yourself)
   m) An apartment (not part of an emergency, transitional or permanent supportive housing program)
   n) A room (not part of an emergency, transitional or permanent supportive housing program)
   o) Other, please specify ______________________

Q8. What is the address of your current place of stay?
________________________________________

Q9. Do you live with any of the following?
   a) Children under 18 years
      Yes
      No
   b) A husband or wife
      Yes
      No
   c) A partner/boyfriend/girlfriend
      Yes
      No

If yes for Q9a), proceed to Q10, else skip to Q11.

Q10. How many children do you live with?
_______________________________

Q11. What is the highest level of education you have completed?
   a) Elementary School
   b) Middle School
   c) High School
   d) College
   e) Bachelor’s Degree
   f) Other, please specify ______________________
   g) None
Q12. What best describes your current employment status?
   a) Full time formal employment
   b) Part time or seasonal employment
   c) Informal employment
   d) Working from Home
   e) Worker and Student
   f) Full time Homemaker
   g) Self employed
   h) Not employed
   i) Retired
   j) Student
   k) Other, please specify _________________________

If employed, proceed to Q13, else skip to Q14.

Q13. What is the address of your current place of employment?
   ____________________________________________

Q14. Do you have a driver’s license?
   a) Yes
   b) No

If Q14a is chosen, proceed to Q15, else skip to Q16.

Q15. What class of driver’s license do you have?
   a) G1
   b) G2
   c) G
   d) Other, please specify__________

Q16. What are your sources of income? This may include:
   a) Financial support from friends or family
   b) Pension or investment income
   c) Panhandling
   d) Ontario Works
   e) Ontario Disability Support Program
   f) Employment Insurance
   g) Canada Pension Plan
   h) Guaranteed Income Supplement
   i) Old Age Security
   j) Employment
   k) Other, please specify__________
Q17. How much do you get from your sources of income? Or on average, how much per day?
______________________________________________________________________________
______________________________________________________________________________

Q18. What are the costs of residing at your current place of stay?
   a) ___________ per day
   b) ___________ per week
   c) ___________ per month
   d) ___________ per year

Section 2: Travel Diary

Before we get to the travel diary, let’s start with thinking about some of the places you normally go to that requires travelling to.

Q19. Do you own any of the following? (Circle all that apply)
   a) Automobile
   b) Motorcycle
   c) Bicycle
   d) Scooter
   e) Skateboard
   f) Other, please specify ________________
   g) Don’t know
   h) Refused

Q20. What are your top 3 important travel purposes in the last week?
   a) Food bank/soup kitchen
   b) Emergency/transitional shelter
   c) Looking for permanent housing
   d) Visiting friends/family
   e) Work
   f) School
   g) Employment
   h) Skill training
   i) Job interview
   j) Looking for work
   k) Panhandling
   l) Health services
   m) Recreation/entertainment
   n) Basic Needs
   o) Shopping
   p) Roaming
   q) Access to public transit
Q21. How would you rank your top 3 important travel purposes chosen in the previous question?
(1 – 1st most important, 2 – 2nd most important, 3- 3rd most important)

<table>
<thead>
<tr>
<th>Rank 1 Travel Purpose:</th>
<th>Rank 2 Travel Purpose:</th>
<th>Rank 3 Travel Purpose:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walk</td>
<td>Walk</td>
<td>Walk</td>
</tr>
<tr>
<td>Public Transit</td>
<td>Public Transit</td>
<td>Public Transit</td>
</tr>
<tr>
<td>Own bicycle</td>
<td>Own bicycle</td>
<td>Own bicycle</td>
</tr>
<tr>
<td>Given a ride by family/friend</td>
<td>Given a ride by family/friend</td>
<td>Given a ride by family/friend</td>
</tr>
<tr>
<td>Given a ride by service provider</td>
<td>Given a ride by service provider</td>
<td>Given a ride by service provider</td>
</tr>
<tr>
<td>Own skateboard</td>
<td>Own skateboard</td>
<td>Own skateboard</td>
</tr>
<tr>
<td>Own scooter</td>
<td>Own scooter</td>
<td>Own scooter</td>
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<tr>
<td>Borrowed a vehicle for free</td>
<td>Borrowed a vehicle for free</td>
<td>Borrowed a vehicle for free</td>
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<tr>
<td>Rented a vehicle</td>
<td>Rented a vehicle</td>
<td>Rented a vehicle</td>
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<tr>
<td>Own automobile</td>
<td>Own automobile</td>
<td>Own automobile</td>
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<tr>
<td>Own motorcycle</td>
<td>Own motorcycle</td>
<td>Own motorcycle</td>
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<tr>
<td>Own motorized vehicle</td>
<td>Own motorized vehicle</td>
<td>Own motorized vehicle</td>
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<tr>
<td>Other, please specify</td>
<td>Other, please specify</td>
<td>Other, please specify</td>
</tr>
</tbody>
</table>

Q22. How did you get to your top three travel purposes in the last week?

<table>
<thead>
<tr>
<th>Rank 1 Travel Purpose:</th>
<th>Rank 2 Travel Purpose:</th>
<th>Rank 3 Travel Purpose:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walk</td>
<td>Walk</td>
<td>Walk</td>
</tr>
<tr>
<td>Public Transit</td>
<td>Public Transit</td>
<td>Public Transit</td>
</tr>
<tr>
<td>Own bicycle</td>
<td>Own bicycle</td>
<td>Own bicycle</td>
</tr>
<tr>
<td>Given a ride by family/friend</td>
<td>Given a ride by family/friend</td>
<td>Given a ride by family/friend</td>
</tr>
<tr>
<td>Given a ride by service provider</td>
<td>Given a ride by service provider</td>
<td>Given a ride by service provider</td>
</tr>
<tr>
<td>Own skateboard</td>
<td>Own skateboard</td>
<td>Own skateboard</td>
</tr>
<tr>
<td>Own scooter</td>
<td>Own scooter</td>
<td>Own scooter</td>
</tr>
<tr>
<td>Borrowed a vehicle for free</td>
<td>Borrowed a vehicle for free</td>
<td>Borrowed a vehicle for free</td>
</tr>
<tr>
<td>Rented a vehicle</td>
<td>Rented a vehicle</td>
<td>Rented a vehicle</td>
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<tr>
<td>Own automobile</td>
<td>Own automobile</td>
<td>Own automobile</td>
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<td>Own motorcycle</td>
<td>Own motorcycle</td>
<td>Own motorcycle</td>
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<tr>
<td>Own motorized vehicle</td>
<td>Own motorized vehicle</td>
<td>Own motorized vehicle</td>
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<tr>
<td>Other, please specify</td>
<td>Other, please specify</td>
<td>Other, please specify</td>
</tr>
</tbody>
</table>
Q23. Now we will move on to the travel diary.

Indicate all the places you went to yesterday. You can draw your trips on a map, like the example, or fill out the chart.

Day of the week: ____________

For each place:
Purpose: Why did you go there?
Mode: How did you get there?
Time: When did you leave? When did you arrive?

Follow up:
Did you have to pay for parking? Did you have to pay for transit?
Is this day’s schedule similar to your usual schedule during the week, excluding weekends? If not, how is it different than your usual schedule?

<table>
<thead>
<tr>
<th>Trip Number</th>
<th>Location of Origin</th>
<th>Location of Destination</th>
<th>Time of Departure</th>
<th>Time of Arrival</th>
<th>Activity Purpose</th>
<th>Mode of Travel</th>
<th>Transit Stop (if applicable)</th>
<th>Parking Costs (if applicable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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</tr>
</tbody>
</table>
Section 3: Hypothetical Scenarios

Q24. To what extent do the following options influence your decision to travel each day?

Scale of Influence

<table>
<thead>
<tr>
<th></th>
<th>Minimal Influence</th>
<th>Moderate Influence</th>
<th>Strong Influence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Travel Cost</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Travel Time</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Accessibility to Transportation Options</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Q25. Scenario 1
Assume you have received a job offer that pays $12/hour and it is within walking distance (20-30 minute walk) from your usual place of stay.

Would you ever pay to use transit to get to work (factors may include: seasonal factors, time of day, etc.)?

Yes / No

If you would pay, up to how much would you pay to travel to work each day?

____________________________________________________________________________
____________________________________________________________________________
Q26. Scenario 2
Assume that you have received a job offer that pays $20/hour. Assume that the job is located in Mississauga, and your current place of stay is in downtown Toronto. Assume you have a class G driver’s license.

Would you accept or reject the job offer? Why?

Accept / Reject

If you would accept the job offer, rank the choices, with 1 being your 1st choice, 2 being your 2nd choice, etc.

The following information to this location (most affordable prices shown):

<table>
<thead>
<tr>
<th></th>
<th>Transit</th>
<th>Get a Ride from Friend or Family Member</th>
<th>Carpool as Passenger</th>
<th>Cycling</th>
<th>Driving with Own Car</th>
<th>Driving with Car Rental</th>
</tr>
</thead>
<tbody>
<tr>
<td>Travel Time</td>
<td>1hr and 14 min</td>
<td>34 min</td>
<td>50 min</td>
<td>1hr and 35 min</td>
<td>34 min</td>
<td>34 min</td>
</tr>
<tr>
<td>Travel Cost (one-way)</td>
<td>$5.60</td>
<td>$0 - $1.25</td>
<td>$2.00</td>
<td>$2.65</td>
<td>$2.30</td>
<td></td>
</tr>
<tr>
<td>Distance</td>
<td></td>
<td></td>
<td>27.2km</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Costs</td>
<td></td>
<td>Own and Operating Costs: $0-3,500/year</td>
<td></td>
<td>Used Car Cost: $5,000 Own and Operating Costs: $7,000-$10,000/year</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Rental Costs: $1000/month or $12,000/year</td>
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</tr>
<tr>
<td>Rank the choices</td>
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</tbody>
</table>

Follow up: Why did you choose this as your first choice?
Q27. Scenario 3
Assume that you have a budget of $10 specifically for transportation needs per day. Assume that you do not own a car. For today, you are planning to go to the following locations: Grocery store, Part-time work, Food bank, Visit a friend.

Map of destinations and distances:

<table>
<thead>
<tr>
<th>Mode</th>
<th>Cost (one-way trip)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transit</td>
<td>$3.00</td>
</tr>
<tr>
<td>Walk/Cycle</td>
<td>$0</td>
</tr>
<tr>
<td>Get a ride</td>
<td>$0 - $1.25</td>
</tr>
<tr>
<td>Carpool</td>
<td>$2.00</td>
</tr>
</tbody>
</table>

What would be the ways in which you would go about making sure you cover all the locations while trying your best to keep under the budget? Choose the order of your trip by selecting the destination that you would go to and the respective mode of travel to get to the chosen destination.

Some considerations and tips:
- Maybe schedule your day so that you reduce the costs from travelling by transit
- Maybe limit the amount of locations you visit in one day
### Section 4: Personal Mobility Information

**Q28. How many days of the week do you normally use the following modes of travel?**

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>Not applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walk</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bicycle</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Scooter</td>
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<td></td>
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<tr>
<td>Skateboard</td>
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</table>

If “0” chosen for certain modes, proceed to Q29.  
If use of automobile chosen in Q28, proceed to Q30, else skip to Q31.

**Q29. How often do you normally use the following modes of travel per month?**

<table>
<thead>
<tr>
<th></th>
<th>1-3 days per month</th>
<th>Less than once a month</th>
<th>Never or almost never</th>
<th>Not applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walk</td>
<td></td>
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</tr>
<tr>
<td>Bicycle</td>
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<tr>
<td>Scooter</td>
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<tr>
<td>Skateboard</td>
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<td>Public Transit</td>
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<td>Carpool</td>
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<td>Automobile</td>
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<td>Motorcycle</td>
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<td>Other, please</td>
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<tr>
<td>specify</td>
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</tbody>
</table>

If use of automobile chosen in Q29 or Q30, proceed to Q31, else skip to Q32.

**Q30. How much do you spend on automobile expenditures per week?**

<table>
<thead>
<tr>
<th></th>
<th>Amount in $</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel</td>
<td></td>
</tr>
<tr>
<td>Carpool Fees</td>
<td></td>
</tr>
<tr>
<td>Parking</td>
<td></td>
</tr>
<tr>
<td>Other, please specify</td>
<td></td>
</tr>
</tbody>
</table>


Q31. Did you use public transit in the last week?
   a) Yes
   b) No
   c) N/A

Q32. When you used public transit in the last week, how did you pay for it? (Circle all that apply)
   a) With transit pass that you own
   b) With free tokens from services/agencies
   c) With cash (single fare purchase)
   d) With tokens that you purchased as a bundle
   e) Negotiated with driver for reduced fare
   f) Negotiated with driver for free ride
   g) Hopped on without paying
   h) Other, please specify ______________________
   i) I didn’t use public transit in the last week

Q33. Do you have a pass for transportation?
   a) Yes
   b) No

If no for Q33, skip to Q34.

Q34. What kind of pass do you have? This may include:
   a) Weekly pass
   b) GTA weekly pass
   c) Monthly Metropass
   d) Metropass Discount Plan
   e) Downtown Express
   f) PRESTO Fare System
   g) Other, please specify ______________________

Q35. Do you receive free tokens from services or agencies?
   a) Yes
   b) No

If no for Q35, skip to Q36.

Q36. What is the name or names of the services or agencies that provide you with free tokens?

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
Q37. Rank the top 3 reasons that stop you from using public transit more frequently, with 1 being the most important reason.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a) Cost of transit</td>
</tr>
<tr>
<td></td>
<td>b) Route you want to take is not available</td>
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<tr>
<td></td>
<td>c) Unreliable service (long waiting times)</td>
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<td></td>
<td>d) Distance to closest station is too far</td>
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<td></td>
<td>e) Other mode of travel is faster</td>
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<td></td>
<td>f) Don’t feel safe taking transit</td>
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<td></td>
<td>g) Too crowded</td>
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<td></td>
<td>h) Other transit passengers hassled you</td>
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<td></td>
<td>i) Other reason 1, please specify</td>
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<td></td>
<td>j) Other reason 2, please specify</td>
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<tr>
<td></td>
<td>k) Other reason 3, please specify</td>
</tr>
</tbody>
</table>

Q38. What types of strategies do you use in order to manage or save on your transportation costs?
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

Q39. Would you ever consider using a car sharing service? (e.g. Zipcar, Autoshare, Car2Go)

Car sharing information:
- Good for short periods of travel when you need a car
- An hourly rate of approximately $9.25 includes gas, insurance and mileage
- Need to pick up and return the car at a designated parking lot

If yes, for what purposes would you use a car sharing service? Do you see any benefits in car sharing?
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

Q40. How does inability to afford or access transportation affect you? (For example, you had to quit a job, or you were unable to accept a job offer, or it restricted you from looking for affordable housing)
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________