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Mode Choice Analysis of Urban Trips in Iloilo City

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Abstract: Urban transportation is a vital part of any city as it directly affects its ability to function. As a result, effective transport planning is needed in order for the city to further grow and develop. Moreover, large part of the urban trips are produced by everyday commuters going around the city. To better understand their characteristic and preference, a mode choice analysis, by means of a logit choice model based on revealed preference, can be done. For this study, it covers the entire network of Iloilo City together with its travelling community. The main factors that affect the travel mode choice of an individual were cost and comfort. The socio-demographic characteristic age also affected the decision of the individual.

Key words: Mode Choice, Revealed Preference, Iloilo City

1.0 INTRODUCTION

The Philippines has been enjoying an exceptional economic growth for several years now. This is not only seen in the cities of Metro Manila but also in other cities throughout the country. One of the cities is Iloilo which is located in the Province of Iloilo. It is situated in the western part of Visayas or Region VI of the Philippines as shown in Figure 1 below. It is recognized as one of the highly urbanized city in the Philippines. With a population of 425,519 and a population growth rate of 1.8% (NSO,2010), the metropolis continues to densely populate itself resulting to an increase in demand for transportation.

Figure 1 Iloilo City with respect to Western Visayas Region

Figure 2 Seven Districts of Iloilo City

One of the economic growth is seen in the gross regional domestic product (GDP) of this region, where Iloilo City resides, has increased from 3.7 to 5.5 for period of 2010 to 2011 (NSCB,2012). Western Visayas Region is composed of six provinces and Iloilo City as its regional center. This means that Iloilo City is an integral part of the development of the region. The city is basically composed of seven main districts. These are Jaro, Mandurriao, La Paz, Lapuz, Arevalo, Molo and City Proper as shown in Figure 2 above. Within these districts are further subdivided into 180 barangays that shapes the whole city.

In relation to all the economic progress of the city and region, transportation system plays an important role in achieving further development of the city. Urban commuters of Iloilo City are provided with jeepneys as its main mode of public transportation. The jeepneys are operated by independent drivers that travel at specifically defined routes set forth by transportation authority in the city. Each jeepney can carry about 20 passengers at a given time. Another mode of transport that is usually used as an access to or egress from a main transport like the jeepney is the tricycle. While other travelers have their own private motor vehicles to use just like cars and motorcycles. The photos in Figure 3 shown below the modes of transports.

Figure 3 Photos of a Jeepney(Left), Tricycle(Middle), Motorcycle(Right)

In a recent study by Landoy et al (2012), the researchers established the speed-density flow relationship along selected primary roads(National Highway, Lopez Jaena St., Diversion Road, General Luna St., and J.M. Basa St.) of Iloilo City which concluded that traffic congestion is eminent as the flow of vehicles using the Greenshield's and Greenburg's model of maximum flow of vehicles are 1398.79 veh/hr and 1090 veh/hr respectively. These values are near the optimum standards of Highway Capacity Manual(HCM) which is at 1700veh/hr for the roads mentioned and can be assumed to increase as the day goes by which consequentially would exceed the limit of 1700 veh/hr, resulting to traffic congestion within these roads.

2.0 THEORY

In logit model, it is needed to establish the role of an attribute in identifying its level of utility that it contributes to the overall utility of an alternative in a choice set. The overall utility can be subdivided into two, observed and unobserved variables, of which they are independent of one another and are additive as shown in equation 3.1.

$$U_i = V_i + \varepsilon_i \qquad (1)$$

Wherein U_i is the overall utility of an alternative, V_i signifies the observed variables, ε_i represents the unobserved variables and i stands for specific alternative.

In the observed variables, it can be composed of several attributes that are weighted to emphasize the contribute of each identified attributes to the overall representative component of utility, V_i.

$$V_{i=}\beta_{0i} + \beta_{1i}f(X_{2i}) + \beta_{1i}f(X_{1i}) + \beta_{2i}f(X_{2i}) + \cdots + \beta_{Ki}f(X_{2K}) \quad (2)$$

Where β_{0i} is the parameter not linked with any of the observed attributes; the "alternative specific constant" in which it signifies all unobserved utilities. On the other hand, β_{1i} represents the weight of an attribute, X_i and alternative i. The utilities mentioned above were derived from random utility theory.

These are to be used in models such as multinomial logit(MNL) and nested logit(NL) to measure the probability of choosing an alternative or specific mode of transport. In MNL model, the probability of a person, n, in choosing an alternative is defined by the equation 3.3

$$P_n(i) = \frac{e^{V_{in}}}{\sum_{j \in C_n} e^{V_{jn}}} \quad (3)$$

Where P is the probability of choosing an alternative denoted by i; V_i signifies the observed variables; j is the available alternatives in a choice set C_n. Taking into consideration that the value of the probability P must be more than or equal to zero but less than or equal to 1.

3.0 METHODOLOGY

The main method of obtaining data for this study was through a Revealed Preference survey. This was done within the borders of Iloilo City. The purpose of the survey is to capture travel characteristics and perception of an individual over the available travel mode choices in the city. This is needed to replicate actual market conditions to determine how an individual chooses a travel mode over several travel parameters. For the sampled survey to be representative of the population, actual demographics of the city were compared to the sampled demographics of the respondents.

The survey was conducted in various places within the city. These include homes, offices, schools, shopping malls, public markets, and parks. The respondents were then interviewed regarding their travel mode choice. It includes their socio-demographics such as age, gender, employment, and their travel characteristics such as their origin and destination, trip purpose, mode of transport to name a few.

4.0 RESULTS

4.1 Descriptive Statistics

The total number of surveys collected for this study was 915 samples. The sampled surveys were then compared with the actual demographics available of the city. For the age group, it is mostly make up of 21 to 30 years old with 26.12% of the total respondents. Next was the age group of 31 to 40 years old consisting of 20.55%. The age group of 41 to 50 accounts for 20.33% while age group 51 to 60 years old comprises 13.77%. The age group below 21

makes up 13.66% and last the age group of above 60 accounts for 5.57%. The average age is 36.96 years old while the median age is 36. Comparing it to the actual median which is 25, there is a disparity between them but this is due to the sampled age for this study were only coming from people of 18 years old and above.

As for the sampled gender, it is distributed almost equally with male at 49.73% and female at 50.27%. Comparing it to the actual gender, the sampled values were very close to the actual values with from 49.73% to the 48.47% for male and 50.27% to the 51.53% for female.

For the employment, the resulted sampled of employed people were 72.35% while the unemployed people were 27.65%. This can be associated to the labor force participation rate since it is pertaining to the percentage of the population who are actually working. This includes people in the age group which are too young or too old to work yet. Comparing the percentage of employed people to the labor force participation rate, the values are not that far apart.

As for the household size, the sampled value was on average around 5.17 persons. Matching it to the actual average household size of 4.8 persons, it is seen that the sampled gathered was representative of the population. The summary of the results are shown in Table 1.

Table 1 Comparison of Sampled versus Actual Demographics

Sampled			Actual	
Age Distribution	Frequency	%	Age Distribution[*]	%
<21	125	13.66	0-14	28.9
21-30	239	26.12	15-64	65.9
31-40	188	20.55	65>	5.3
41-50	186	20.33	Median Age[*]	25
51-60	126	13.77	Proportion of population over 18[*]	64.73
60>	51	5.57		
Average	36.96			
Median	36			
Gender	Frequency	%	Gender(frequency)[*]	%
Male	455	49.73	201019	48.47
Female	460	50.27	213728	51.53
Employment	Frequency	%	Labor Force Participation Rate[#], %	
Employed	662	72.35	62.2	
Unemployed	253	27.65		
Average Household Size			Average Household Size[*]	
5.17			4.8	

*Based on 2007 NSO Census
#Based on NSCB Regional Statistics as of April 2013

For the monthly income, the sample is mostly in the group of below 3000 pesos making up about 29.84% of it. This is the result of the combined group of people who are still students and are studying in their respective schools while others in the group are already retired. The group of 3000 to 5999 pesos comprises the 17.70% while the 6000 to 9999 pesos make up the 17.60%. Other groups of 10000 to 14999, 15000 to 19999, and 20000 to 29999 have a percentage of 11.15%, 8.63% and 9.40% respectively. Lastly the 30000 to 49999 and the above 50000 groups make up the remaining 3.50% and 2.19% respectively.
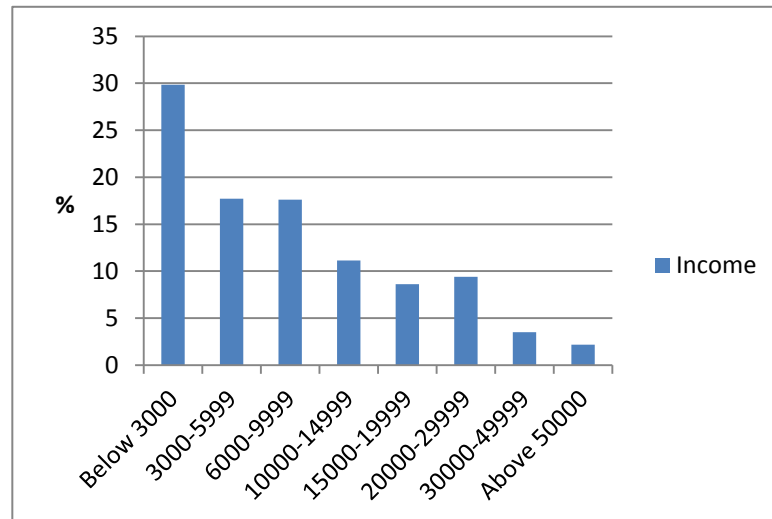
Figure 4 Income group per month of the respondents

The respondents are also asked for their vehicle ownership of either a private car or motorcycle. The sample resulted that 25.14% of the respondents owns a private car with 66.52% of it has 1, 24.78% has 2 and 8.70% has 3 or more. While on the other hand, 20.11% of the respondents owns a motorcycle with 82 .61% of it has 1, 13.59% has 2, and 3.80% has 3 or more.
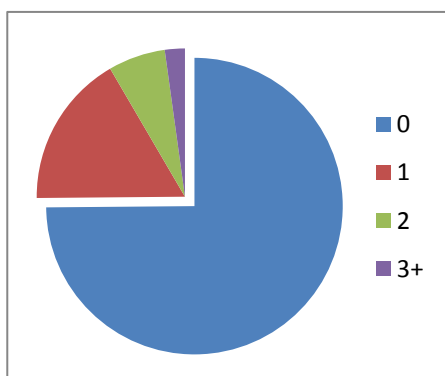

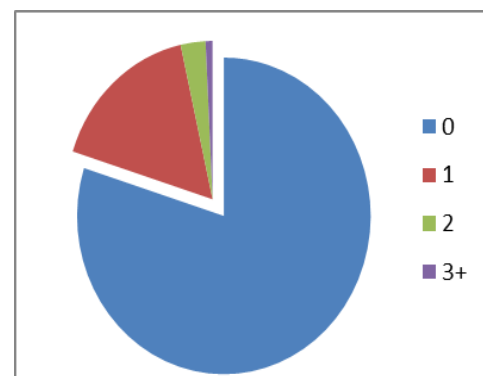Figure 5 Car Ownership of the Respondents

Figure 6 Motorcycle Ownership of the Respondents

As for the purpose of the trip, most of the trips are for work with 48.96%. Other trip purpose belonging to school, recreation (includes shopping, market, vacation), private (includes business, work out, church) consisted of 16.07%, 16.94% and 18.03% respectively.

Lastly for the trip modes used, jeepney was the most used transport with 70.82% for respondents as it is the main public transport in the city. Next were the private vehicles car

and motorcycle with 19.02% and 7.76% respectively. Respondents coming from outside of Iloilo City used provincial bus to enter the city with them comprising only 1.09%. Other modes such as vans and taxi only account to 1.31%.
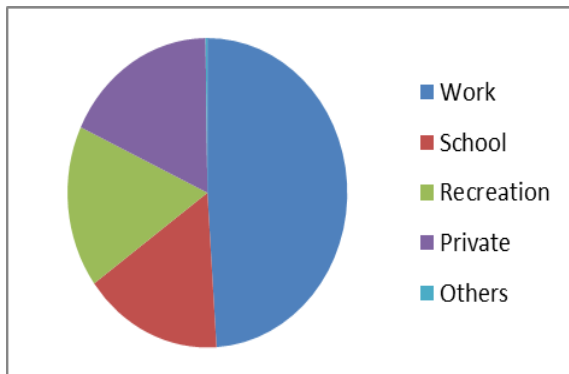

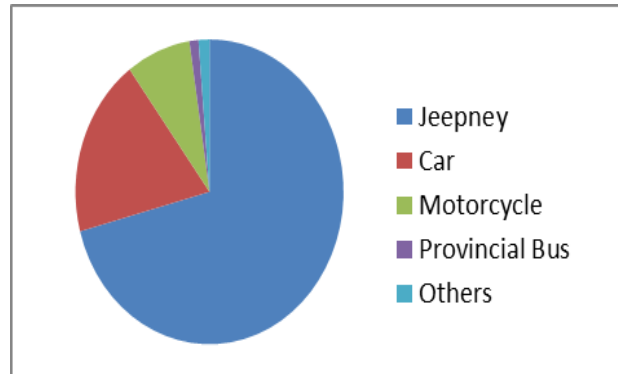Figure 7 Trip Purpose of the Respondents   Figure 8 Trip Modes of the Respondents

4.2 Logit Choice Model

Using the data gathered from the survey, the multinomial logit model was produced using the three available choices of mode of transport provided in the survey questionnaires. These are jeepney, car, and motorcycle.

Table 2 Multinomial Logit Model

Variable	Coefficient	P-Value
COST	-0.02833585	0
COMF	2.02783696	0
TTIME	0.02840201	0.0002
CARxGEN1	0.35326311	0.0634
MOTxGEN2	1.04300854	0.0006
A_CAR	-3.50402623	0
A_MOTOR	-3.66934782	0
Jeep Constant(Base Mode)	0	0
Goodness-to-fit Measures		
Log Likelihood	-554.9882	
Log Likelihood (no coefficient)	-1005.2302	
ρ^2	0.4479	
Adjusted ρ^2	0.44578	

Going through the variables, cost (COST) has a negative value therefore it is viewed as a disutility since the individual spends money during a trip. Comfort (COMF) meanwhile has a positive value therefore it is a utility which means that the individual values comfort during a trip. The variable travel time (TTIME) has a positive value means it is a utility but contrast to what is happening, it has a negative impact since the traveler is idling while traveling. One of the reason it came out as a positive is because the City of Iloilo is a relatively small city thus traveling does not take that long to reach to the destination of the traveler. The effect of gender for both model is positive (CARxGEN1, MOTxGEN2). Since in the data input

process, male was assigned with a dummy variable of 1 while female was 0 therefore the decision of the male travelers more likely to be affected. The car constant and the motorcycle constant also were found to be negative in value.

Table 3 Direct and Cross Elasticity

Variable	Cost			Comfort			Ttime		
Mode	Car	Motorcycle	Jeepney	Car	Motorcycle	Jeepney	Car	Motorcycle	Jeepney
Car	-0.366	0.057	0.309	26.921	-4.165	-22.756	0.366	-0.057	-0.309
Motorcycle	0.057	-0.175	0.119	-4.165	13.333	-9.168	-0.057	0.176	-0.119
Jeepney	0.309	0.119	-0.427	-22.756	-9.168	31.924	-0.309	-0.119	0.428

4.3 Findings

The results of the model revealed that gender is significant in the decision of an individual's travel mode choice. Conversely, age is found to be insignificant in the three alternatives (car, motorcycle, jeepney).

Access and Egress times during a trip were found to be insignificant for the travelling population. One of the reasons for this is that the jeepney routes of Iloilo City for the most part are well connected thus commuters do not value the access and egress times during a trip. Another reason for this is that motorcycle taxi (tricycle and/or pedicab) are usually available for public transport users to use whenever needed. For private car and motorcycle users, parking is usually readily available in nearby places of their destination. Travel time is another significant in the decision making of the traveler. One reason is that the city itself is relatively small therefore traveling within the city does not take a long time. Meanwhile, both cost and comfort were found to be statistically significant as well with the later having a larger value. This indicates that comfort is more significant the decision making of the individual on which travel mode to choose and cost comes after it.

With regards to the elasticity of the variable cost, it is seen that as the cost of each mode increases, the number travelers are likely to change their current mode as seen in the values of the elasticities are negative. The jeepney is seen as the most sensitive to cost change followed by car, then motorcycle. Next is for the attribute comfort, as it improves in a certain mode, the number of ridership of it would greatly increase. Among the current mode, jeepney has the largest increase in ridership as comfort increases. This is followed by the car then the motorcycle. Lastly for the travel time, its elasticity behaves the same as the comfort wherein as the travel time improve, the more people will more likely use that mode of transport.

5.0 CONCLUSION

The multinomial logit model created was found to be statistically acceptable as shown in the goodness-to-fit measures presented. The use of multinomial logit model for the case of Iloilo City is better than a nested logit model since the urban travel options of an individual is very limited thus grouping the transport modes into public and private does not show effectly the effects of each transport mode. The findings of the study were that cost, comfort and travel time are the main factors in affecting the travel decision of an individual. Cost was a disutility since it indicates how the individual values his/her money. On the other hand comfort was a utility to the individual since the frequency of the jeepneys are high for public transport users. Other indicators are overcrowding in the jeepneys are not as prevalent. As for private transport users, their vehicle is always accessible at any given time. Lastly for the travel time, it is seen as a utility in the model created but this can be attributed to the fact that the city is

relatively small therefore travel does not last that long. Gender was also a factor in the travel mode choice of the individual. A reason would be that male drivers are more prevalent than of female especially for privately own vehicles such as car or motorcycle. Another conclusion to the study is that the travelling population are mostly using the jeepney as their main mode of transport than any other options. This is supported by the fact that 48% of the car owning and motorcycle owning individuals are still using jeepney as their main everyday travel option.

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