# Travel Mode Choice Preferences of Urban Commuters in Dhaka: A Pilot Study

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# Introduction

- Introduction and Objectives(pictures)
- Choice experiment Method
- Sample Characteristics
- Mode Choice Experiment
- Choice Experiment Results(preliminary findings)
- Conclusions

# Objectives

- Our study is a pilot which surveyed office commuters in Dhaka city regarding transport mode preferences between two broad categories namely private car and public bus modes.
- We wish to identify preference for and determinants of travel mode choice among individuals commuting to work who predominantly use low-occupancy private travel modes (such as private cars).
- Inform policies for reducing congestion and pollution; more specifically to encourage urban commuters to use public transportation mode by providing apposite alternative for getting to work


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# Choice Experiment: What it is?

# Choice experiment

- In a survey setting people choose their preferred alternative from a choice set
- Repeated choices! So each individual answers more than one question
- The alternatives are described by a number of attributes, including a monetary attribute
- So, each choice question is called a “choice set”.
- Each alternative is described in terms of a common set of “attributes”.
- Alternatives are differentiated by the “levels” taken on by the attributes

# Theory

- **The Economic Model( Lancaster 1966: Individuals derive utility from the characteristics of the goods). and the Statistical Model(McFadden 1974: random utility) are intrinsically linked**
- **The choice of economic and statistical model affects the design of the experiment and the analysis of the data**
- **Weak complementarity assumption.**

For our purpose we can specify the indirect utility function representing individual preference for an alternative (i) mode of transport as follows:

$$V_i = \beta_{0i} + \beta_{1i} f(X_{1i}) + \beta_{2i} f(X_{2i}) + \ \ldots + \beta_{1j} f(X_{ki})$$

whereas $\beta_{1i}$ is the parameter associated with attribute $X_1$ and alternative i (there are k=1, …K and attributes and subscripts recognizes the weights, attribute levels and the constants are specific to the ith alterantive) and $\beta_{0i}$ is the alternative i specific constant, parameter not associated with any of the observed and measured attribute, which represents on average the role of all the unobserved sources of utility.

The probability that an individual choosing alternative i is equal to the probability that the utility of the chosen alternative is greater or equal to the utility associated with an alternative j not chosen after evaluating available alternatives in a particular choice of j=1, …., i, ….J alternatives. This can be expressed as

$$prob_i = prob[(V_i + \varepsilon_i) \geq (V_j + \varepsilon_j), \forall j \in j = 1,2,\dots,J, i \neq j]$$

We can re-write the above equation to clearly specify the random utility maximization as follows:

$$prob_i = prob[(\varepsilon_i - \varepsilon_j) \geq (V_j - V_i), \forall j \in j = 1,2,\dots,J, i \neq j]$$

The workhorse choice model of discrete choice analysis is the conditional logit or multinomial logit model (see Louviere et al, 2000). The basic form[4] (below) states that the probability of an individual choosing an alternative(say i) among J alternatives is equal to the ratio of the exponential of the observed utility index for alternative i to the sum of the exponentials of observed utility indices for J alternatives including the i-th alternative

$$\text{Prob}_i = \frac{\exp V_i}{\sum_{j=1}^{J} \exp V_j}$$

# Choice Survey

# Choice Scenario

## In the questions that follow:

You will be presented with hypothetical situations where you will be asked to choose between car and bus to commute to work.

When choosing between car and bus, a number of attributes/factors are involved. Basically, you will be presented with two alternatives with varied levels of improvements or deterioration of those particular factors.

For example, some bus option will involve improved bus service at lower cost, improved comfort and safety features. Similarly, other car options will feature reduced travel time, increased parking fee, congestion fee.

Therefore, you will be asked to consider both the alternatives and their respective factors, and then choose your preferred option.

Assume that you have to choose between any two alternatives to commute to your office.

See the example below:

| | Option A<br>PRIVATE CAR  | Option B<br>BUS  |
|---|---|---|
| Travel time:  | Same as now | 15 minutes longer than car |
| Travel cost (per trip):  | 30% increase | Same as now |
| Parking fee:  | Tk. 200 Per day | — |
| Congestion charge:  | Tk. 50 for using car during peak hours | — |
| Frequency of departure:  | — | There is a bus every 20 minutes |
| Distance to bus stop:   | — | The bus stop is 10 minutes from your home |
| Comfort and security:  | — | Same as now |

Like above, you will be presented with eight choices—each with two alternatives.

Consider both the alternatives and their respective factors/attributes, and

# Attributes in choice sets

- Enumerators were given conversion formula to calculate and present the relevant numbers to respondents during the presentation of choice sets.
- Each respondent's travel time was determined by averaging the time taken to go to office and the time taken to return home from office. Values of the three different levels in the choice experiments were thus found using this "averaged time."
- Travel cost per trip for both car and bus was calculated using the distance between each respondent's office and residence (as stated by them).
- Travel cost per trip for bus, or bus fare, was found by multiplying distance with Tk. 1.55 per kilometer. This particular fare rate has been set by the Bangladesh Road Transport Corporation (BRTC) for non-air-conditioned buses in Dhaka city.
- For car, travel cost per trip was calculated by multiplying distance with fuel price per kilometer. On average, Compressed Natural Gas (CNG) costs about Tk. 7 per kilometer and octane/petrol costs about Tk. 15 per kilometer.
- The quality improvement in terms of comfort and security was hypothetical but carefully explained.

# Attribute and levels in Choice

Table 8: Travel Mode Attributes and Levels.

| *Mode* | *Attribute* | *Levels* |
|---|---|---|
| Car | Travel time | Same as now |
| | Cost per trip | Same as now, 20% increase, 30% increase |
| | Parking fee | Tk 100, Tk 200 |
| | Congestion fee | Tk 50, Tk 100 |
| Bus | Travel time | Same as car, 30 minutes longer than car, 15 minutes longer than car |
| | Cost per trip | Same as now, 10% increase, 20% increase |
| | Frequency of departure | Every 10 minutes, Every 15 minutes, Every 20 minutes |
| | Distance to bus stop | 5 minutes, 10 minutes, 15 minutes |
| | Comfort and security | Same as now, Much improved comfort and security features |

# Sample Characteristics

Basle line sample[choice experiment sample]

# Socioeconomic description of participants

N=1058[choice sample: 273]

| | |
|---|---|
| **Highest Level of Education** | |
| Higher Secondary | 0.9[0.6] |
| Bachelors | 19.0[13.7] |
| Masters | 67.0[71.7] |
| Above Masters | 13.1[13.7] |
| **Employment Status** | |
| Full-time | 98.7[99] |
| Part-time | 1.3[1] |
| **Income Group (Taka per month)** | |
| less than 25,000 | 9.7[4.2] |
| 25,000 to 50,000 | 34.4[22.2] |
| 50,000 to 75,000 | 23.4[27.6] |
| 75,000 to 100,000 | 12.1[22.8] |
| 100,000 and above | 20.4[23.1] |

# Mode of Travel to Work

## N=1058[choice sample: 273]

Table 2; Mode of travel to work.

| Mode | % Reporting |
|---|---|
| Walking | 6.0[3] |
| Rickshaw | 8.6[2] |
| CNG | 4.0[1] |
| Taxi | 1.2[1] |
| Tempo | 0.5 |
| Minibus | 0.5 |
| Bus | 8.1[2.3] |
| Office Bus | 4.1 |
| Car | |
| Personal | 52.9[71] |
| Office | 22.0[12] |
| Family | 4.6[9] |
| Someone else's | 1.2 |
| Other | 2.2 |

# Choice Experiment Results

**Table 8: Discrete Choice Models – Mixed Logit Estimates**

| | Restricted | Random parameter | |
|---|---|---|---|
| | Coefficient | Coefficient | Standard Deviation |
| Car Intercept | -1.278*** | -1.655 | |
| | (0.238) | (0.382) | |
| Car- Travel time | -0.024*** | 0.029*** | 0.011 |
| | (0.003) | (0.006) | (0.007) |
| Car- Cost per trip | -0.001 | -0.001 | 0.00001 |
| | (0.001) | (0.001) | (0.001) |
| Car- Parking fee | 0.076 | 0.11 | 0.024 |
| | (0.085) | (0.11) | (0.814) |
| Car- Congestion fee | 0.118 | 0.172 | 0.0042 |
| | (0.084) | (0.112) | (0.666) |
| Bus- Travel time | -0.029*** | -0.035*** | 0.002 |
| | (0.003) | (0.006) | (0.023) |
| Bus- Cost per trip | 0.023*** | 0.032** | 0.003 |
| | (0.009) | (0.013) | (0.0160) |
| Bus- Frequency of departure | -0.022** | -0.026** | 0.001 |
| | (0.011) | (0.013) | (0.104) |
| Bus- Distance to bus stop | -0.055*** | -0.069*** | 0.021 |
| | 0.011 | (0.016) | (0.11) |
| Bus- Comfort and security | 1.0303*** | 1.263*** | 2.11** |
| | (0.087) | (0.221) | (1.01) |
| Regular car user(car use inertia) | 0.692*** | 0.856*** | |
| | (0.109) | (0.382) | |
| Log-likelihood | -1592.45 | -1590 | |
| No. of observations | 2520 | 2520 | |
| Pseudo R square | 0.09 | 0.082 | |

Note: Standard errors in parenthesis. *** and ** indicate level of significance at the 1 percent and 5 percent levels respectively.

# Average Elasticity and Marginal Effects

| | Average Elasticity | | Average Marginal Effects | |
|---|---|---|---|---|
| | Direct (Car) | Cross (Bus) | Direct (Car) | Cross (Bus) |
| Increase in Travel Time (Car) | -0.731 | 0.765 | -30.35 | 29.10 |
| Increase Cost per Trip (Car) | -0.047 | 0.05 | -2.308 | 2.558 |
| | Cross (Car) | Direct (Bus) | Cross (Car) | Direct (Bus) |
| Travel Time (Bus) | -0.868 | 0.933 | 46.04 | -43.78 |
| Cost per trip (Bus) | -0.088 | 0.092 | -6.166 | 6.770 |

# Simulation Results

- **A ten minute reduction in travel time by bus produces estimated market share for bus mode increase by more than 5 percent. This increase in market share for car mode is less than 5 percent resulting from a ten minutes reduction in travel time by car.**
- **This later result is indicative of higher value of time for bus (disutility of time spent by bus likely to be higher) compared to car suggesting that reduction in travel time due to reduced congestion can have substantial benefits for population.**
- **A doubling of full cost per trip for the car alternative will produce an estimated market share for the car down by 2% only.**

# Conclusions

- **Strong inertia among regular car users to continue to choose private mode of transportation for commuting to work.**
- **Reducing travel time appears most important next to comfort/service for people to choose bus vis-à-vis private car.**
- **Motivating commuters to switch to alternate mass transit may require innovative incentive scheme(e.g. road pricing, tax increase!)**

# Thank you