Proceedings of 12th IOE Graduate Conference
Peer Reviewed
ISSN: 2350-8914 (Online), 2350-8906 (Print)
Year: 2022 Month: October Volume: 12

Modeling Generalized Cost of Travel for Rural Bus Users: A Case Study of Phidim - Birtamode Road Section

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Abstract
Public transportation allows individuals to connect and access local services more cheaply, and is the most efficient way to move large numbers of commuters into and out of cities and communities. In general, the values associated with travel time and comfort level vary widely. Every monetary value of travel time and comfort level is driven by the users socioeconomic characteristics in rural Nepal. This research is aimed to estimate the generalized cost of travel along Phidim-Birtamode road section of Mechi Highway. The attributes to develop the model are associated with travel time, travel cost and comfort level. At first, the pilot survey was conducted to find out research feasiblity and later on, SP Survey was conducted to find out the values related to attributes along the study route. Data were coded in R software using package "mlogit" and multinomial logit model to estimate the coefficient of each attribute in utility equation. Estimated values for travel time and comfort level are based on the utility equation. Finally, the modeled value of travel time is NRs. 262.56 per hour and the value of comfort level is NRs. 44.31 per journey for total trip.

Keywords
Generalized Cost (GC), Travel time, Travel Cost, Comfort Level, Stated Preference (SP), Logit Model

1. Introduction

As per Central Bureau of Statistics, 2078 - Rural population in Nepal is 33.92 percent of total population. Phidim is the district headquarter of Panchthar district where people have very low car ownership. Here, the passenger transportation demand is largely served by the public transportation system. This provides individuals with mobility and access to employment, community resources, medical care, and recreational opportunities across the nation. It benefits those who choose to ride, as well as to those who have no other choice. The establishment of safe, reliable, and affordable rural transport infrastructure and services is crucial in the selected route to facilitate rural access to markets, services, enterprise and employment opportunities and the delivery of health and education, as people travel to Birtamode for these purposes. Transportation is a tool but not a goal. Hence, rural road infrastructure and services has been a valuable national asset but negligent management and maintenance have reduced asset value and hampered rural communities throughout the year. Here, rural roads receive much less attention and resources. Problems such as crowded public vehicles, lack of appropriate schedules and inconvenient journeys continue to plague the public transport system in Phidim- Birtamode road section of Mechi Highway. The value for these attributes has not been previously analyzed, detailed investigation is required to insight the travel behavior of selected populations, in small proportions. Thus, it is necessary to know user perceptions about different attributes of travel on the Phidim-Birtamode road section of the Mechi Highway in order to develop a judicious improvement plan.

In transport economics, the generalized cost is the sum of the monetary and non-monetary cost of travel or also the intensity or level of dis-utility endured is referred as the generalized cost. It has long been widely used as a measure of the attractiveness of travel alternatives.

Simply,
Generalized Cost, GC = g(C1, C2, C3, C4,. . . . . ,Cn)
Where, C1, C2, ... Cn represents various time, money and other attributes of travel
In general form,
GC= $\sum(M_i) + \sum(T_j t_j)$

where,
M_i= actual cost of journey (fare costs or fuel cost)
T_j= time costs (on vehicle time, waiting time)
t_j = monetary values per unit of these components [1]
Discrete choice model explains the choices from two or more discrete (that is, distinct, separable, and mutually exclusive) sets of alternatives. The discrete choice model works within the outline of reasonable choice. Specifically, it is believed, when faced with a variety of choices, individuals select the option of greatest utility. As per this hypothesis we can see that the worth of a choice is a function of the characteristics of the possible selections and the characteristics of the person making the choice. Discrete choice models can be differentiated from standard regression models by the explicit integration of a defined set of choices, some of which were not selected. Two types of choice data exist: (a) stated preference and (b) revealed preferences exists. Revealed preference data is the outcome of choice made in actual situations while stated preference data results from the choices made in hypothetical situations [2].

1.1 Research Objectives

The objectives of this study are to carry out in-depth investigation in understanding rural bus users' perceptions for different attributes of service (travel time, travel cost, service headway and comfort level)). The specific objectives will be as follows:

- To identify attributes of rural bus service and the ones that user value.
- To model the generalized cost of travel for rural bus users.

2. Literature Review

The concept of Generalized Cost has been widely used in transport planning since the late 1960s [3]. Generalized costs are the actual resource costs that are relevant to your investment decisions.This is a useful tool for gaining a general understanding of how travel cost fluctuations affect travel behavior.

For a trip to be worthwhile; place utility should be greater than trip disutility or generalized trip cost where place utility and generalized cost are expressed in units of time and place utility varies by trip purpose and commuter. Generalized costs provide a fundamental model that relates the cost of using (public transport) services to the demand generated. Extensive research over the last 30 years has shown that public transport choice involves both quality standards and the monetary cost of using the service.

Generalized cost can be renewed to standard units of measurements by a conversion unit, the value of time. This is sensitive to the purpose of the journey and the economic value afforded to passengers. Journeys for work are valued at about the rate of the hourly pay [4].

The phrase "generalized cost" is frequently used in the community of transport modeling to describe an overall measurement of the "cost" of a journey. It is used to aggregate different time and cost variables into a single measurement, either in terms of money or time. It is used in both cargo and passenger models, and is often used for modeling convenience and as a precaution against identification problems when estimating the model. It is also applied extensively in the appraisal literature when evaluating infrastructure [5].

SP surveys gained position over RP due to their lesser sample size requirement and their capability to accommodate hypothetical alternatives yet yield results comparable to/on par with RP results. Most of the SP studies were carried out using traditional rating-based SP preference techniques [6]. In rating-based SP studies, numbers (e.g., 1= extremely preferred, 5= extremely rejected) are used to signify the likings of people. These numbers may not signify the actual or true choice behavior of individuals due to the lack of strong hypothetical foundation consistent with economics [7].

SP studies are particularly valuable in situations where there is no verifiable information to draw conclusions. SP studies are most commonly used in transportation to examine how individuals sacrifice money for something less tangible, such as time savings, reliability, or comfort. These studies can also reveal how changes in infrastructure and services are changing travel behavior. RP data is gathered on choices made in genuine situation adding to real world scenario and reliability and legitimacy yet examination is restricted to only current options. This segment provides information on how individuals are currently reacting [8]. Revealed preference (RP) data are previously (in fact) choices made by travelers.

Random Utility Theory, the basis for several models and theories of decision making in psychology and

economics, states that the utility of each element consists of an observed (deterministic) component and a random (disturbance) component [9].

C. V. Phani Kumar, Debasis Basu, and Bhargab Maitra, 2004, collected 180 samples from twelve different locations on the study route but only 76 refined samples were used for the development of the utility equation and found that Generalized Cost (in paisa) = 33 (In-vehicle travel time in minutes) + 4.06 (headway in minutes) + 7.15 (Existing CL -1) * (Travel distance in kilometers) + Direct Travel Cost [10].

The value of journey time was reported as 42NOK per hour for public transport users in Akershus, Norway [11]. In Australia, a study of high-speed rail indicated that the value of door-to-door travel time savings ranged from $36 per hour for discount economy travel to $59 per hour for full economy travel for air business market and a line haul time value as $10.86 per hour for the car non-business market [12]. Many researcher, under different assumptions about characteristics of choice probability, showed that different discrete choice model being consistent with utility maximization [13].

With public transport crowding passengers in trains, stations, stops, and access points, it's inevitable to get an emotional look at what's the real need is. In-vehicle congestion is one of the most important logical factor, next to cost and travel time, when choosing a mode of transport. This is true for public transport, overcrowding can cause physical discomfort, psychological distress, and a sense of risk and anxiety. In-vehicle crowding of public transit is a much more crucial factor for attracting car users to shift to public transit as compared to cost and travel time [14].

3. Methodology

Pilot study was conducted in reference to the research done in Bangladesh [15], where a series of focus group discussions with travelers, householders in the area and transport operators were conducted at the start of the study to formulate the SP questionnaires. Similarly, in this research, the exact sample size is not determined for pilot study but at the time of vehicle arrival and departure, the basic data was collected through interview. Personnel included during pilot survey were Public Service Officers, Businessman, General Public, Students (High School Level and above), Vehicle Operating Authority, Driver and Helper. The study area is Phidim-Birtamode Road Section that is approximately 142Km and includes following major stations.

- Phidim
- Samdin
- Pauwa Bhanjyang
- Ranke
- Mai Khola
- Fikkal
- Kanyam
- Budhabare
- Charaali
- Birtamode

3.1 SP Survey

This study was focused on SP design to explore alternative selection scenarios for attributes that are important to rural bus users. The SP survey itself was based on hypothetical choice and selection which required an experimental design.
A model of stated preference was developed to collect data on trip maker socioeconomic characteristics, travel characteristics, and willingness to pay based on hypothetical alternatives. The social-economic characteristics includes gender, age, marital status, family size, monthly family income, employment and number of earners in the family. The Trip Characteristics includes station, time of travel, purpose of travel, cost of travel, time taken by users to arrive at station, vehicle waiting time, in-vehicle time, time taken by users to move to their destination and comfortability.

3.2 Analysis from Pilot Study

In general, while five people travel through their own private car it takes the journey time of approximately 4.5 hours to 5 hours and considering the public transportation loss time of total 30 minutes for 10 travelers, there is still the lag of one (1) hour to (2) two hours in whole journey period. Furthermore, people wanted to save hotel expenses when total 2 hours of travel time is saved in two-way travel, Origin to Destination and vice-versa. The present scenario showed that one can pay extra amount to sit comfortably in the first seat, so, the comfortableness is the important parameter to upgrade the system. At last, the travelers have willingness to pay in saved travel time and comfortable sitting journey.

3.3 Mathematical Representation

In order to proceed for SP survey, the mathematical calculation was done by setting out the value for basics of attributes from pilot study.
Current Fare = NRs. 605.00 (fare gets fluctuated due to petroleum product values rise and fall)
Current Journey Time = 6 hours to 6.5 hours
Willingness to pay extra for one-hour reduction

- Case I - 50 to 100
  Taking Rs. 75
  i.e. 12.5% increment

- Case II - 100 to 150
  Taking Rs. 150
  i.e. 25% increment

Potential reduction in travel time

- Case I - 30 minutes
  i.e. 7.7% of x
  Taking 10%

- Case II - 1 hour
  i.e. 16% of x
  Taking 20%

Comfort Level/Comfort level

- Comfortable Seating:
  Comfortable seating was taken as the actual number of people seating on actual mentioned seat defined as standard to that vehicle.

- Congested Seating:
  Congested seating was taken as one or more people seating in mentioned seat defined as standard to that vehicle.

3.4 Using Full Factorial Design

The attributes and corresponding levels used in the study are as given below:

- Travel Time
- Travel Cost
- Comfort Level

3.4.1 Comfort Level

Comfort, a qualitative attribute, was defined and coded on an integer scale as illustrated on Table 1.

Table 1: Attribute Discomfort Representation

Condition of Travel	Comfort Level value
Comfortable Seating	1
Congested Seating	2

Other attributes and levels is in format as shown in Table 2.

Table 2: Attributes and Levels [10], [16]

Attributes	Level 1	Level 2	Level 3
Travel time	No Change	-10 %	-20%
Travel Cost	+12.5 %	+12.5 %	+25 %
Comfort Level	Comfortable Seating	Comfortable Seating	Congested Seating

From full factorial design, the total combination of designed alternatives for SP survey becomes $L^A = 3^3 = 27$ but some combinations gets repeated, so total combination became 12 as illustrated in Table 3 and the best fit design for research were taken as S.N. 1, 6, 7, 10 and 11.

Table 3: Total Combination for SP Survey

S.N.	In Vehicle Travel Time	Travel Cost	Comfort Level
1	No Change	+12.5 %	Comfortable Seating
2	No Change	+25 %	Comfortable Seating
3	No Change	+12.5 %	Congested Seating
4	No Change	+25 %	Congested Seating
5	-10 %	+12.5 %	Comfortable Seating
6	-10 %	+25 %	Comfortable Seating
7	-10 %	+12.5 %	Congested Seating
8	-10 %	+25 %	Congested Seating
9	-20 %	+12.5 %	Comfortable Seating
10	-20 %	+25 %	Comfortable Seating
11	-20 %	+12.5 %	Congested Seating
12	-20 %	+25 %	Congested Seating

3.4.2 Data Collection Tools and Procedures

The data collection tools and procedure was based on survey and interview and the following process were adopted.

At first, questionnaire created based on multi-criteria decision making were distributed among sample population, then after interview was done, when necessary, for uneducated, old aged and differently able group. The calculated minimum sample size was 384 and this was increased to obtain required sample size. Filled survey forms were duly collected.

1. Study Population
   The study population are targeted as:
   - Road users of each stations
   - Bus service providers

2. Sample Size
   A total of 750 observations from study area were collected to perform SP survey. Discarding the incomplete and inconsistent data, 699 observations were used for analysis. The categorical summary of collected data is illustrated in Table 4.

3. Analysis
   The multinomial and mixed logit models were calibrated using the statistical software R from the study of stated preference survey. Generalized Cost of travel for different income group and mode was computed from the ratio of parameters based on time, cost and comfort level.

4. Estimation of Generalized Cost
   Generalized Cost is estimated as ratio of time to cost coefficient in the utility equation. Comfort Level was denoted by 1 for comfortable seating and 2 for congested seating. The attributes were taken as:
   TC equals Travel Cost in rupees per journey trip.
   TT is travel time in Hour.
   CL represents the Comfort Level per journey trip [1 for comfortable seating and 2 for congested seating].
   The utility function has the form
   Ut $=\alpha TC+\beta TT+\gamma CL+\varepsilon$
   The travel time to travel cost ratio indicates the monetary value of travel time perceived by commuters. Therefore, value of travel time (a1) = α/β. Similarly, value of comfort (a2) = γ/β.

5. Goodness of Fit
   ρ^2, informal goodness of fit, likelihood ratio index, Pseudo R^2 is frequently used in discrete choice models to evaluate whether the model fits the data.
   ρ^2 = 1 - LL(β)/LL(0)
   Where, LL(β) is value of log-likelihood function at estimated parameters and LL(0) is its value when all parameters are set to zero. In general, ρ^2, does not have interpretable meaning for values lying between 0 and 1. Though the interpretation is not similar, values of ρ^2 between 0.2 and 0.4 are equivalent to ρ^2 values of 0.7 to 0.9 for linear regression to obtain the best fit [17].

Table 4: Summary of Categorical Data

Variable	Details	Numbers
Observations		699
Gender	Male	468
	Female	231
Marital Status	Married	458
	Unmarried	241
Age Group	15-24 Years	239
	25-34 Years	181
	35-44 Years	137
	45-60 Years	106
	>=60 Years	36
Family Size	<=3	113
	4	230
	5	201
	>=6	155
Earners in the Family	1	220
	2	287
	>=3	192
Employment	Business	169
	Government Job	137
	Private Job	100
	Self Employed	31
	Student	168
	Retired	9
	Unemployed	63
	Others	22
Monthly Family Income ('000)	<15	62
	15-30	115
	30-45	143
	45-60	152
	60-75	111
	75-90	70
	>90	46
Start Station of Travel	Phidim	286
	Samdin	33
	Pauwa bhanjyang	98
	Ranke	143
	Illam	63
	Maikhola	76
Time of Travel	5:30 A.M. – 7:45 A.M.	495
	7:45 A.M. – 10:00 A.M.	161
	10:00 A.M. – 12:15 A.M.	34
	12:15 A.M. – 2:30 A.M.	9
Purpose of Travel	Business	162
	General Work	312
	Study	124
	Social/Recreational	98
	Other	3
Present Comfort Status	Comfort	92
	Discomfort	607

4. Data Analysis and Result

Travel demand along this road is mostly served by jeep service. The jeep service takes about 6 to 6.5 hours to cover the distance of 142 Km and serves about 7 intermediate stops. Most people were involved in some sort of business and have a wide range of income level among them. Majority of people travel for the reason of general work while other travel for either business or study or social and recreational activity

Respondents were asked to choose between five alternatives provided through questionnaire survey. The observed data were converted to processed long format and fed into software R. Here, Multinomial Logit Model, Uncorrelated Random Parameter Mixed Logit Model and Correlated Mixed Logit Model were formulated using "mlogit" package in software R. The obtained coefficients are divided by priced coefficient in order to get values in monetary term.

Table 5: Generalized Cost using Multinomial Logit Model

	Estimate	**z-value**	**Pr($>|z|$)**
Travel Cost	-0.016	-27.124	<2.2e-16
Travel Time	-4.201	-29.241	<2.2e-16
Comfort level	0.709	9.3059	<2.2e-16
Number of Samples		699	
Log-Likelihood, LL(β)		-1708.80	
LL (0)		-2412.857	
Pseudo R^2		0.292	
Travel Time/Travel Cost		262.56	
Comfort level/Travel Cost		-44.31	

From Table 5, the model estimates the utility function and generalized cost as: U= -0.016 (TC) -4.201 (TT) + 0.709 (CL) and, Generalized Cost = TC + 262.56(TT) -44.31(Present CL – 1) This shows that the value of travel time as NRs. 262.56 per hour and the value of comfort level as NRs. 44.31 per journey. The ratio of parameters travel time (-4.201) and comfort level (0.709) is 5.92, which means that travel time is 5.92 times as important as comfort. Here, the coefficients are significant in Pseudo R^2 value that is 0.29179 seems quite reliable and fits the model.

The general summary of utility equation and generalized cost for each group of employment and trip purpose is given in Table 6. It shows that for employment of business group, the value of travel time is NRs. 229.06 and the value of comfort is NRs. 439.9. Whereas, for government job holder value of travel time is NRs. 186.80, for this group the comfort level doesn't seem a significant parameter so coding is done accordingly. For, private job holders the value for travel time is NRs. 246.15 and value for comfort is NRs. 37.40. This study shows that, student also value of travel time and comfort level like other employment group that is the value for travel time is NRs. 350.83 and value for comfort is NRs. 72.50. This might be the effect of higher range of monthly income of the family and the longer distance of travel to be covered. Self-employed group has the higher value of value for travel time, that is NRs. 449.50 and the value of comfort is NRs. 128.13. Unemployed group of population also has value for travel time to be NRs. 273.63 and value for comfort to be NRs. 41.42. This result is relatively higher than other group, as it might be the effect of trip purpose and family income.

Model developed for business trip has the value for travel time is NRs. 232.38 and value for comfort is NRs. 35.00. Similarly, trip done for the purpose of general work has value for travel time to be NRs. 257.58 and value for comfort to be NRs. 41.95. Furthermore, the study purpose of travel has the value for travel time as NRs. 314.92 and value for comfort as NRs. 49.62. Finally, the social/recreational trip has value of NRs. 236.67 and NRs. 61.87 for travel time and comfort level respectively.

Due to very low respondents in employment group of other employment and retired population and in case of trip purpose, the other activity are not taken for individual analysis.

From Table 7, the model estimates the utility function and generalized cost using mixed logit model as:

U= -0.022 (TC) -6.507 (TT) + 1.120 (CL)
and,
Generalized Cost = TC + 295.77(TT) -50.91(Present CL – 1)

Table 7 shows that the value of travel time is NRs. 295.77 per hour and the value of comfort level is NRs. 50.9 1per journey. The ratio of parameters travel time (-6.507) and comfort level (1.120) is 5.8, which means that travel time is 5.8 times as important as comfort. Here, the coefficients are significant and Pseudo R^2 value is 0.34953 which seems quite reliable and fits the model. From Table 5 and Table 7, it is seen that, though the coefficients are significant, the Pseudo R^2 is higher in the model calibrated from Mixed Logit Model (0.34953) than model calibrated from

Table 6: Utility Equation and Generalized Cost

	Utility Equation	Generalized Cost Equation
For Total Trip	U= -0.0163(TC) -4.201(TT) + 0.791 (CL)	GC = TC +262.56(TT) -44.31(Present CL – 1)
For Employment		
Business	U= -0.016 (TC) -3.665 (TT) + 0.639(CL)	GC= TC + 229.06(TT) -39.94(Present CL – 1)
Government Job	U= -0.025 (TC) -4.669 (TT)	GC= TC + 186.80(TT)
Private Job	U= -0.020 (TC) -4.923 (TT) + 0.748(CL)	GC= TC + 246.15(TT) -37.40(Present CL – 1)
Self Employed	U= -0.008 (TC) -3.596 (TT) + 1.025(CL)	GC= TC + 449.50(TT) -128.13(Present CL – 1)
Student	U= -0.012 (TC) -4.209 (TT) + 0.869(CL)	GC= TC + 350.83(TT) -72.50(Present CL – 1)
Unemployed	U= -0.019 (TC) -5.199 (TT) + 0.787(CL)	GC= TC + 27633.(TT) -41.00(Present CL – 1)
For Trip Purpose		
Business	U= -0.016 (TC) -3.718 (TT) + 0.559(CL)	GC= TC + 232.38(TT) -35.00(Present CL – 1)
General Work	U= -0.019 (TC) -4.894 (TT) + 0.797(CL)	GC= TC + 257.58(TT) -41.95(Present CL – 1)
Study	U= -0.013 (TC) -4.094 (TT) + 0.645 (CL)	GC= TC + 314.92(TT) -49.62(Present CL – 1)
Social/Recreational	U= -0.015 (TC) -3.55 (TT) + 0.928(CL)	GC= TC + 236.67(TT) -61.87(Present CL – 1)

Multinomial Logit Model (0.29179). Although the Pseudo R^2 is higher for Mixed Logit Model, here Multinomial Logit model is adopted, this is because the code processing and outcome time of result is quite time consuming and doesn't seem realistic than Multinomial Logit Model for this set of data from SP Survey. The score test was run on the correlated model and then on the uncorrelated model. The Wald test was performed using a mixed logit model with correlation set to true and then to false.

A linear hypothesis test was performed to see if the elements of the correlation matrix are zero. Thus, tests showed the presence of randomness, but no correlation.

Table 7: Generalized Cost using Mixed Logit Model

	Estimate	**z-value**	**Pr($>|z|$)**
Travel Cost	-0.022	-24.046	<2e-16
Travel Time	-6.507	-23.544	<2e-16
Comfort level	1.120	10.332	<2e-16
Number of Samples		699	
Log-Likelihood, LL(β)		-1569.50	
LL (0)		-2412.857	
Pseudo R2		0.34953	
Travel Time/Travel Cost		295.77	
Comfort level/Travel Cost		-50.91	

5. Conclusion

To rationally improve public transportation, it is important to understand the attributes that user's value most. The study found that given preference data is useful for developing utility models that encompass different attributes of travel, even in non-urban scenarios. Based on utility equations, values for travel time and comfort level are estimated. From the observed data the estimated value of travel time is NRs. 262.56 per hour and the value of comfort level is NRs. 44.31 per journey for total trip. It can be seen that traveler's wiliness to pay are not same for all purpose of trip, this yields different value of travel time and value of comfort. Here, estimated value of travel time is higher for study purpose followed by general work, other activity, social/recreational activity and business travel respectively. Whereas, the estimated value for comfort is higher for social/recreational activity followed by other activity, study purpose, general work purpose and lastly for business travel. Finally, a generalized cost model was developed based on survey route. Estimates related to travel time and comfort were found to be significant and consistent. From the observed data, it is almost clear that the user prefers to travel in the morning time than day. As, the vehicle leave in its pre-schedule and this leads to discomfort in the journey as all people tends to get in rush in the morning. This hustle is created as maximum number of travelers prefer to complete their works as soon as possible and save their work time and return to their origin of travel as shown from pilot study. From the study it is also found that, those people who travel in morning doesn't find their trip comfortable but to those who travel in day time are okay with the current scenario.

6. Recommendations

Following tasks are recommended for further studies.

- It is required to refine the model because the modeled values derived in the current work are generally in agreement with the limited available facts.

- Safety and Reliability can be taken for further study.
- Study of travel time reliability for public and private vehicle in Phidim -Birtamode road section.

References

[1] Rickard Wall. Determinants of market area size of production plants and service providers. 40th Congress of the European Regional Science Association: "European Monetary Union and Regional Policy", August 29 - September 1, 2000, Barcelona, Spain, Louvain-la-Neuve, 2000. European Regional Science Association (ERSA).

[2] Columbia University Mailman School of Public Health, 2022.

[3] Mark Wardman and Jeremy Toner. Is generalised cost justified in travel demand analysis? *Transportation*, 47(1):75–108, 2020.

[4] L Lesley. Generalised costs and the value of time as a method of patronage forecasting. *Acta Technica Jaurinensis*, 2(1):57–68, 2009.

[5] J. Rich. Generalized cost for transport. *International Encyclopedia of Transportation*, pages 555–559, 01 2021.

[6] J. D. Hunt. Stated preference analysis of sensitivities to elements of transportation and urban form. *Transportation Research Record*, 1780(1):76–86, 2001.

[7] Wiktor Adamowicz, Jordan Louviere, and Joffre Swait, 1998.

[8] David A. Hensher, John M. Rose, and William H. Greene. *Applied Choice Analysis*. Cambridge University Press, 2 edition, 2015.

[9] MCGILL UNIVERSITY, 2006.

[10] CV Kumar, Debasis Basu, and Bhargab Maitra. Modeling generalized cost of travel for rural bus users: a case study. *Journal of Public Transportation*, 7(2):4, 2004.

[11] Åse Nossum. Tøi report 633/2003. *transport*, 32(23):20, 2003.

[12] David Hensher. Predicting demand for high speed rail in the sydney-canberra corridor, 1997.

[13] Kenneth Train. Discrete choice methods with simulation, 2009.

[14] Kun Gao, Minhua Shao, and Lijun Sun. Roles of psychological resistance to change factors and heterogeneity in car stickiness and transit loyalty in mode shift behavior: A hybrid choice approach. *Sustainability*, 11(17):4813, 2019.

[15] IT Transport. The value of time in least developed countries (knowledge and research (kar) 2000/01 dfid research no. r7785): Final report, 2002.

[16] Ashim Gautam and Anil Marsani. Estimation of value of travel time saving for commuter trips: A case study of kathmandu keywords. 08 2021.

[17] Joffre D. Swait Jordan J. Loviere, David A. Henser, 2000.