

Mode Choice Modelling For Interisland Transportation in North Maluku

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Abstract. This research discusses to study and to analyze speedboat and Fast Boat users on the Ternate-Sofifi route and seeing preferences for choosing mode changes in travel costs, trips, itineraries and frequency of trips. The research activity carried out publishes the initial survey and the main survey through the distribution of questionnaires prepared by the method stated a preference. This research was conducted on 120 respondents and collected as many as 98 who met the requirements (valid). These questionnaires were distributed during field surveys directly on port speedboats and fast boats in the city of Ternate. The results of the questionnaire were further processed to obtain the characteristics of respondents and the model of a quick ship and speedboat ship mode selection. The purpose of the trip is mostly official travel for quick ship users and family / social needs for speedboat users. While the reasons for choosing the crossing, mode are considerations for quick ship and frequency reasons for speedboat ship users. Mode selection models between quick ship and speedboat ship obtained in the form of linear equations are: $U_{Q\ shtl} - U_{S\ shtl} = -4,356 - 0.00000787X_1 + 0.545X_2 + 1,275 X_3 - 0.067X_4$. With 4 attributes, they are: X_1 = Travel expenses., X_2 = Travel time X_3 = Travel schedule and X_4 = Frequency of Reception. Results Measurement of the percentage of all attributes (R^2) obtained a value of 42.7%.

Keywords: Inter-island, North Maluku, Mode choice, Transport ships.

1. Introduction

Transportation arises in human life because of the process of fulfilling needs where those needs are not met where they are but are met elsewhere [1]. With limited space, the area is filled with various community activities that are reflected in the designation and land use. Sea transportation is one of the backbones of transportation in the islands of North Maluku. Ferry crossings that serve the islands, especially between islands and mainland Halmahera Island, consist of Pelni ships, Nusantara ships, Boats, speed boats and People's Sailing Vessels, managed by the government, private sector, and individuals[2]. Seeing the current economic condition of the city of Ternate, ferry transportation is one of the transportation sub-sectors which has a very important role in serving movements between islands. The advantage of this transport is the higher reach of the facilities used (boats/speed boats) following geographical conditions, most of which are water areas. These characteristics have very implications for the amount of demand in this crossing transport sector.

2. Literature review

Transportation modelling plays an important role in supporting transportation planning. One of the main roles of transportation modelling is to estimate travel demand based on changes in the transportation system. This model is used to predict changes in travel patterns and the use of transportation systems in response to changes in land use, demographics, and socioeconomic conditions. Various models have been developed to create the actual travel patterns of people and the conditions of existing demand. One important aspect of transportation modelling is to predict travel behaviour. Mode selection is influenced by many aspects including service level attributes, subjective factors, land use and accessibility and personal and family features [3]. The results showed that gender, age, monthly income, car availability, travel destination, duration of stay at the destination, distance, characteristics of the airport/bus terminal, travel costs and comfort had an impact on the choice of inter-city travel modes in Libya [4]. The modal selection model was developed for work trips in the city of Calicut. Age, gender, income, time and cost have proven to be significant factors that influence the modal choice for employees[5]. The results showed that the variables that influence the choice of transportation mode for trips to traditional markets indicate that travel time is a significant variable on the frequency of trips in a week. In further, mode choice model related to travel demand management (TDM) is very important to predict temporal demand for planning, development, and construction of new transportation infrastructure, to test responses of demand related to improving of operational strategies of traffic control or transportation measures, and to assess the effectiveness of implementation of travel demand management measures [6]. Many previous studies have given attention to mode choice model and significant factors that influenced people to choose trip mode [7] researched determinant factors of traveler in whole choose trip mode for daily commuting trip. In the research, number of trip, and travel time were some of significant variables that contributed to mode choice of commuters. In specifically to shopping trip, [8] proposed trip frequency model for shopping trip in case shopping trip to super market for daily shopping purpose. Utilization logit model approach in order to mode choice model was adopted by many scholars, such as [9] which used multinomial logit model in case there are more than two choices of trip mode, and [10][7] which used binomial logit model in case only there are two trip mode[8]. The results showed that the certain mode attributes are found to be strongly relevant in mode choice behavior. Comfort of vehicle is perceived to be an important factor by the majority of private vehicle users, while almost half of those who disregard it as an important factor choose public transport[11]. The results suggest that objective spatial characteristics remain important in the discussion on the link between the built environment and daily modal choices [12]. The regression analysis reveals significant differences in the magnitude of the impact of explanatory variables on mode choice. Distance to public transport, population density, and automobile access have a weaker influence on car travel in the USA than in Germany [13]. Travel time, income and travel cost play an important role in the mode choice decision for the inter-city transport[14]. The travel mode choice results clearly highlight the role of travel time, number of transfers, walking time, and initial waiting time on the propensity to choose transit [15]. Considerations some elements that affect mode choice was based on generalized cost approach. Car availability and accessibility to public transit are two important factors highlighted by [16]. [17] Found passengers with higher income tended to be less concerned about fare difference when choosing mode of transport between Manila and Busuanga Island in Philippines.

3. Methodology

The design or research design is a detailed plan used as a guideline for research studies that lead to the objectives of the study, [18]. The research method used is descriptive-analytical, which describes an event and then conduct an analysis of the problems that arise. The study begins by gathering literature and secondary data relating to the research conducted, then determining the survey technique used. In this research, the events to be observed are the choice of fast boat and speedboat modes. The variables studied are the characteristics of the trip in terms of travel costs, travel time, scheduled departure and frequency of departure. Data collection techniques are by interviewing or distributing questionnaires to users of the crossing mode with a randomized system. The form of a survey question form is planned to cover two things. First, the question is focused on finding out the existing conditions of the characteristics of current crossing mode users. In this case, you want to know information about trips that are done by using crossing mode. Using the respondents' perception data, an analysis is then carried out to determine the crossing mode preferences on inter-island trips. The respondents chosen in this survey were respondents who were 17 years or older. The sample size in this study was 120 respondents. This questionnaire consists of various parameters that characterize the trip such as travel mode, travel time, travel costs as well as the characteristics of the respondents which include age, gender, income, vehicle ownership, SIM ownership and education level of the respondent. This research was conducted in the area of Ternate, especially crossing mode users, namely employees and the public who use quick ship and speedboats ship, which were conducted personally to respondents, especially when distributing questionnaires. This research is conducted on every working day.

4. Data analysis

the binomial logit model used in the mode selection study between speedboats and speedboats is a function of the difference in utility in the two types of modes presented as linear parameters. The analysis used to obtain the utility difference function is a regression approach for stated preference data. The general form of a linear equation with four attributes is:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 \tag{1}$$

Whereby, Y = Speedboat ship and quick ship Utility, X₁ = travel expenses, X₂ = Travel time, X₃ = Departure schedule, X₄ = Frequency of departure.

The alternative equation formed is the highest utility difference function (highest R²)

Mode Equation Model Equations:

$$P_{Q \text{ shtti}} = \frac{e^{[U_{Q \text{ shtti}} - U_{S1 \text{ shtti}}]}}{1 + e^{[U_{Q \text{ shtti}} - U_{S1 \text{ shtti}}]}} \tag{2}$$

And the probability of selecting the Quick ship mode is:

$$P_{Q \text{ ic shtti}} = 1 - P_{Q \text{ shtti}} \tag{3}$$

5. Discussion

Data processing from the results of the survey is done by re-checking the completeness of the data from the results of the questionnaire intended for each respondent, then tabulated according to the data items in the questionnaire. Individual characteristics describe respondents' characteristics based on: gender, age, level of education, income, vehicle ownership and respondent's SIM ownership.

The socio-demographic characteristics of the respondents are mapped briefly in the following Table 1:

Table 1. Types of variables and attribute

No	Characteristics of Respondents		Percentage (%)
1	Gender	a. Male	58,6
		b. Female	41,4
2	Age	a. 17 - 25	22,1
		b. 26 - 35	36
		c. 36 - 45	37,2
		d. > 45	4,7
3	Education	a. SMA	17,3
		b. Diploma	37,9
		c. S1	40,9
		d. S2	3,9
4	Household income	a. 1.5	7,2
		b. 2.75	24,3
		c. 3.75	48,6
		d. 4.75	15,8
		e. > 5	4,1
5	Car ownership	a. >1 car & 1 mtrcycle	1,8
		b. 1 car & 1 mtrcycle	10,5
		c. 1 car	19,3
		d. 1 mtrcycle	57,6
		e. 0 car & mtrcycle	10,8
6	SIM ownership	a. SIM A	12,7
		b. SIM C	64,2
		c. SIM A dan SIM C	11
		d. 0 SIM	12,1

The equation of the difference between the utility of fast boats and speedboats obtained from SPSS processing is:

$$U_Q - U_{S_1} - U_{S_2} = -4,356 - 0,00000787X_1 - 0,545X_2 + 1,275 X_3 - 0,067X_4$$

Where: X_1 = Travel costs, X_2 = Travel time X_3 = Departure schedule X_4 = Frequency of departure

From the equation it is found that the variable cost and time is inversely proportional to the utility of fast boats and speedboats. If the cost and time of utilities will get lower and vice versa. For departure, schedule variable is directly proportional to the utility. If the departure schedule is high then the utility will be higher and vice versa if the departure schedule is low then the utility will be lower. The departure schedule variable has the most influence on utility and the cost variable has the least influence on utility.

6. Model sensitivity

Change in the probability value of quick ship mode selection when a change in the value of its service attributes is made, namely:

1. Travel costs increased or decreased
2. travel time is accelerated or slow
3. departure schedule change
4. frequency of departure increased or decreased

For the changes to the sensitivity values obtained using the s quick ship and speedboat ship utility equation are: heir attributes

$$U_{Q \text{ sht}} - U_{S \text{ sht}} = -4,356 - 0,00000787X_1 + 0,545X_2 + 1,275 X_3 - 0,067X_4$$

7. Conclusion

The results showed the difference model of the utility of quick ship and speedboats ship is: $U_{Q \text{ sht}} - U_{S \text{ sht}} = -4,356 - 0.00000787X_1 + 0.545X_2 + 2.275 X_3 - 0.067X_4$. The attribute value (R^2) obtained as the effect of these four factors is 42.7%. While the influence of attributes that have not been considered at 57.3% such as travel distance and other additional costs. Sensitivity analysis shows that the probability of choosing a fast boat is great if the difference between the cost sensitivity and travel frequency attributes is greater. Conversely, if the difference in sensitivity attribute is small, respondents prefer speedboats. Whereas the choice of speedboat mode is greater if the time-sensitivity attribute is fast and if time sensitivity is slow then the probability of choosing a speedboat is smaller

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