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Mode Selection Model of Female Public Transportation

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Abstract: Many problems faced by women nowadays who use public transportations are mainly about trip fare, comfort and safety. By the increasing rate of violence and crimes happen to women in public and in public transportations, it is necessary to conduct a research about the needs of female public transportation. This research aims to create a model about the necessity of public transportation for women with a certainty of safety, comfort and affordable fare. The method used in this research is by surveying female passenger respondents about the characteristics of social economy, trip and stated preference. The result of this research is a model of female public transportation mode selection $U_{AUP} - U_{AU} = 0{,}419 + 0{,}104\ \Delta X_{6,}$ where this equation close to the precision of the model.

Key words: Public transportation · Female · Stated Preference

INTRODUCTION

Public transportation users in several metropolitan cities in Indonesia such as Jakarta and Surabaya, for the bus passengers in Jakarta, especially busway, the female passengers proportion takes 55%, while the male passengers proportion takes 45% [5]. Female passengers are nominating the public transportations not only in Indonesia. Based on the data from world bank of South Africa, there are 29% female and 21% male workers who use public transportation [1]. In Pune-India, public transportation users are 50% female and 35% male, in Dhaka-Bangladesh public transportation users are 52% female and 38% male, in Ashgabat-Turkmensitan public transportation users are 58% female and 50% male and in Lima-Peru public transportation users are 95% female and 85% male. In all over the Europe, female is lesser to use private transportation, whereas the majority who use public transportations is female, in Swedia 70% of private transportation users are male and in France 60% male who lives outside Paris travel using private transportations. Meanwhile, two third of the public transportation passengers are female and in United States in 2007, 55% of public transportation users are female [2].

Women with low income and especially unmarried depend on mass transportations, due to financial problem that is preventing them from owning a private vehicle [3]. Besides the trip fare problem, there are still more constraints and problems for women to use the public transportation, such as about the policy and the most important thing is there are a lot of violence toward women especially at night. Besides, the culture norms or even traditional clothes prevent females to access public transportation modes and two-wheeled vehicles [4]. The priority and essential issue of creating the most appropriate transportation system for passenger is safety [5]. Women must be the central role and are accustomed to take this challenge, because they have to hold the responsible in pursuing women's right in public and public transportation.

MATERIALS AND METHODS

This research was conducted by surveying female respondents who take public transportations daily either to school, university or office. Majority of the respondents have outdoor activities such as school, university or office.

The main research locations were at the university and industrial areas due to the high demand of transportation activities. The survey was conducted in Malang and Yogyakarta as representative of the students and Muslims majority, while Batam represents industrial city which had the equal number of Muslims and Non-Muslims. The total respondents of this research were 1060 female with the characteristics as below:

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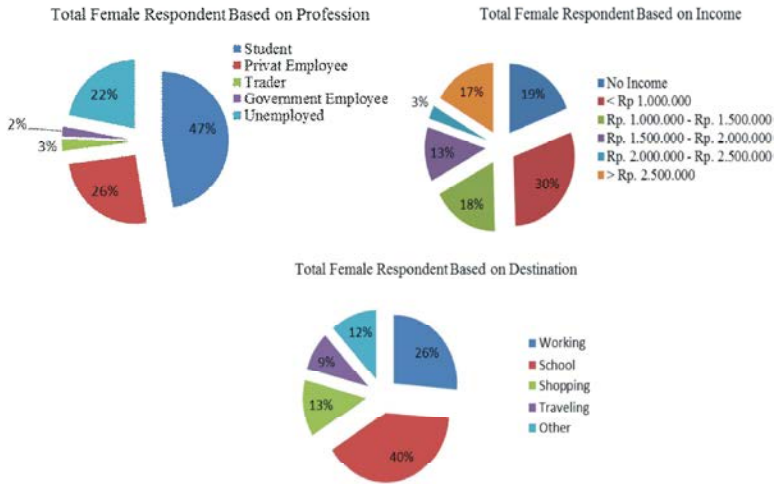

Fig. 1: Female Respondent Characteristic

RESULTS AND DISCUSSION

Mode selection model from regression analysis of trip fare attribute between ordinary public transportations operating in the city without comparing any type of transportation and additional facilities, the equation is as below:

$$U_{AUP} - U_{AU} = 1{,}041 - 0.0000345.\ \Delta X_1$$

By substituting the value of ΔX_1 into the equation, the probability will become as shown in Table 1 and Figure 2.

Mode selection model from regression analysis of trip fare attribute with additional air conditioner (AC) facility in female public transportations, the equation as below [6]:

$$U_{AUP} - U_{AU} = 0{,}004 - 0.0000251\ \Delta X_2$$

By substituting the value of ΔX_2 into the equation, the probability will become as shown in Table 2 and Figure 3.

Mode selection model from regression analysis of trip fare attribute with additional particular seat for pregnant women, elderly and children facility in female public transportation, the equation is as below:

$$U_{AUP} - U_{AU} = 1{,}294 - 0.\ \Delta X_3$$

By substituting the value of ΔX_3 into the equation, the probability will become as shown in Table 3 and Figure 4 [7].

Mode selection model from regression analysis of trip fare attribute with additional security service facility in female public transportations, the equation is as below:

$$U_{AUP} - U_{AU} = 1{,}480 - 0.\ \Delta X_4$$

By substituting the value of ΔX_4 into the equation, the probability will become as shown in Table 4 and Figure 5.

Mode selection model from regression analysis of trip period attribute, the equation is as below:

$$U_{AUP} - U_{AU} = 0{,}676 - 0{,}013\ \Delta X_5$$

By substituting the value of ΔX_5 into the equation, the probability will become as shown in Table 5 and Figure 5.

Mode selection model from regression analysis of frequency attribute, the equation is as below:

$$U_{AUP} - U_{AU} = 0{,}419 + 0{,}104.\ \Delta X_6$$

By substituting the value of ΔX_6 into the equation, the probability will become as shown in Table 6 and Figure 6.

Equation Models: The equations which are defined by several attributes are given in Table 7.

From Table 7, it is stated that the fifth equation is the closest model since it has the highest value of determination coefficient (R^2) and correlation coefficient (R) compared with the other models [8].

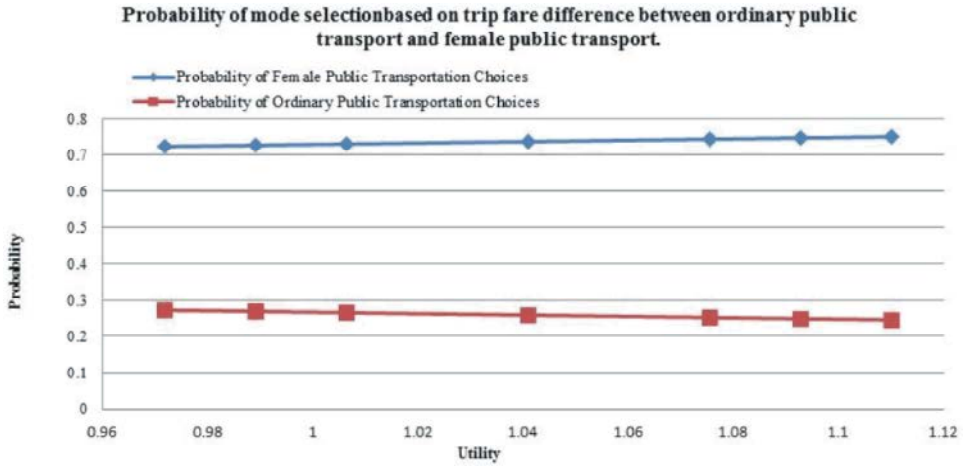

Fig. 2: Probability of mode selection based on trip fare difference between ordinary public transportations and female public transportations

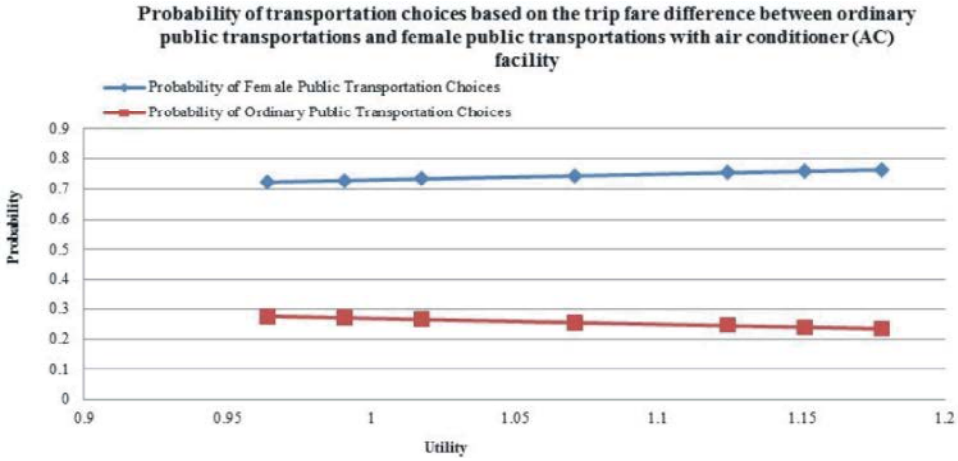

Fig. 3: Probability of transportation choices based on the trip fare difference between ordinary public transportations and female public transportations with air conditioner (AC) facility

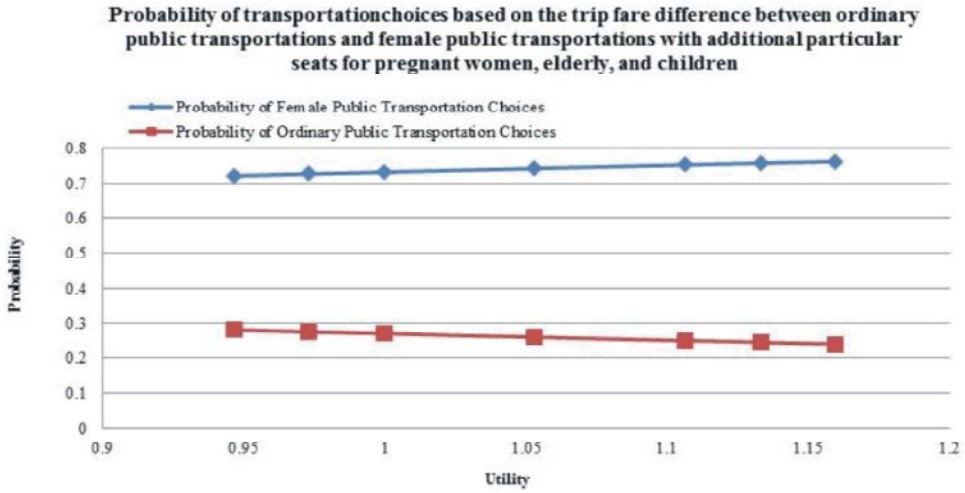

Fig. 4: Probability of transportationchoices based on the trip fare difference between ordinary public transportations and female public transportations with additional particular seats for pregnant women, elderly and children

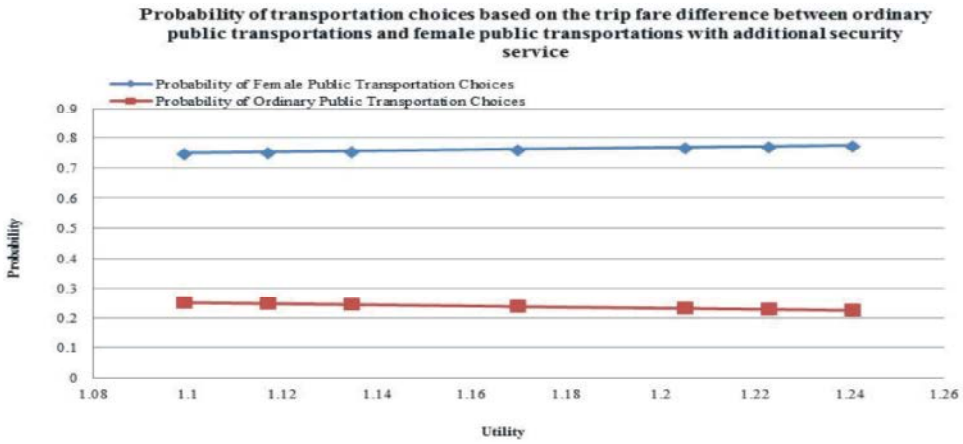

Fig. 5: Probability of transportation choices based on the trip fare difference between ordinary public transportations and female public transportations with additional security service

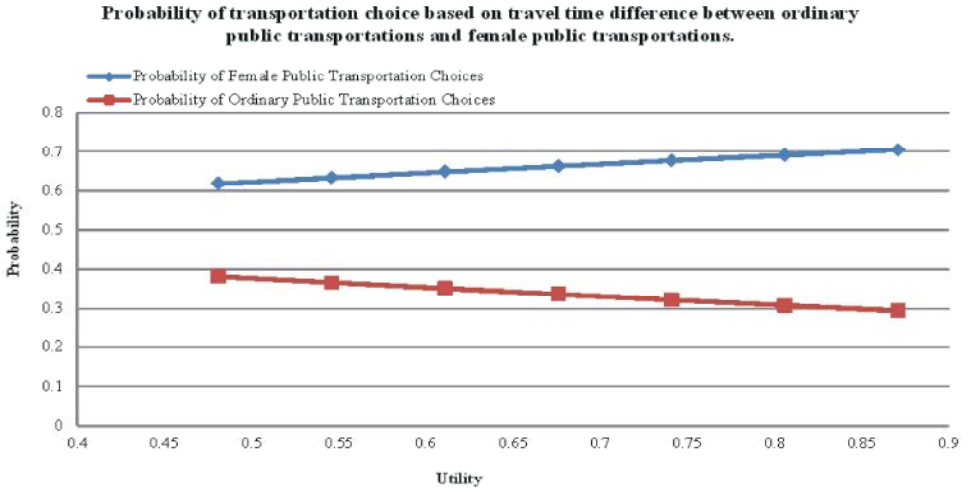

Fig. 5: Probability of transportation choice based on trip period difference between ordinary public transportations and female public transportations

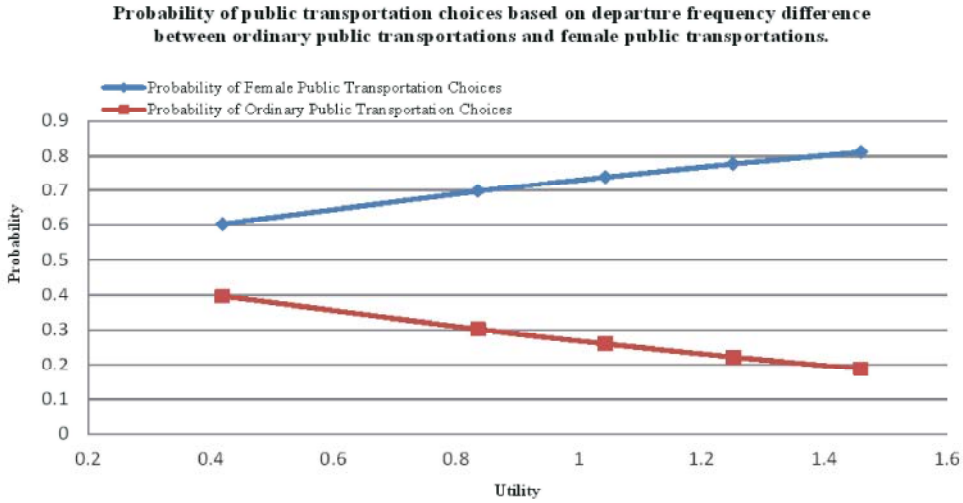

Fig. 6: Probability of public transportation choice based on departure frequency difference between ordinary public transportations and female public transportations

Table 1: Probability of mode selectionbased on trip fare difference between ordinary public transport and female public transport

Opsi	X1 Female Public Transportation Fare Difference	X1.0 Ordinary Public Transportation Fare	Utility of Female Public Transportation Choises	Probability of Female Public Transportation Choices	Probability of Ordinary Public Transportation Choices
1	-2000	0	1.110	0.752	0.248
2	-1500	0	1.093	0.749	0.251
3	-1000	0	1.076	0.746	0.254
4	0	0	1.041	0.739	0.261
5	1000	0	1.006	0.732	0.268
6	1500	0	0.989	0.729	0.271
7	2000	0	0.972	0.725	0.275

Source: Analysis Result

Table 2: Probability of transportation choices based on the trip fare difference between ordinary public transportations and female public transportations with air conditioner (AC) facility

Opsi	X2 Female Public Transportation Fare Difference	X2.0 Ordinary Public Transportation Fare	Utility of Female Public Transportation Choises	Probability of Female Public Transportation Choices	Probability of Ordinary Public Transportation Choices
1	-2000	0	1.178	0.765	0.235
2	-1500	0	1.151	0.760	0.240
3	-1000	0	1.124	0.755	0.245
4	0	0	1.071	0.745	0.255
5	1000	0	1.018	0.735	0.265
6	1500	0	0.991	0.729	0.271
7	2000	0	0.964	0.724	0.276

Source: Analysis Result

Table 3: Probability of transportation choices based on the trip fare difference between ordinary public transportations and female public transportations with additional particular seats for pregnant women, elderly and children

Opsi	X3 Female Public Transportation Fare Difference	X3.0 Ordinary Public Transportation Fare	Utility of Female Public Transportation Choises	Probability of Female Public Transportation Choices	Probability of Ordinary Public Transportation Choices
1	-2000	0	1.160	0.761	0.239
2	-1500	0	1.133	0.756	0.244
3	-1000	0	1.106	0.751	0.249
4	0	0	1.053	0.741	0.259
5	1000	0	1.000	0.731	0.269
6	1500	0	0.973	0.726	0.274
7	2000	0	0.946	0.720	0.280

Source: Analysis Result

Table 4: Probability of transportation choices based on the trip fare difference between ordinary public transportations and female public transportations with additional security service

Opsi	X4 Female Public Transportation Fare Difference	X4.0 Ordinary Public Transportation Fare	Utility of Female Public Transportation Choises	Probability of Female Public Transportation Choices	Probability of Ordinary Public Transportation Choices
1	-2000	0	1.241	0.776	0.224
2	-1500	0	1.223	0.773	0.227
3	-1000	0	1.205	0.769	0.231
4	0	0	1.170	0.763	0.237
5	1000	0	1.135	0.757	0.243
6	1500	0	1.117	0.753	0.247
7	2000	0	1.099	0.750	0.250

Source: Analysis Result

Table 5: Probability of transportation choice based on travel time difference between ordinary public transportations and female public transportations.

Opsi	X1 Female Public Transportation Travel time Difference	X2 Ordinary Public Transportation Travel time	Utility of Female Public Transportation Choises	Probability of Female Public Transportation Choices	Probability of Ordinary Public Transportation Choices
1	-15	0	0.871	0.705	0.295
2	-10	0	0.806	0.691	0.309
3	-5	0	0.741	0.677	0.323
4	0	0	0.676	0.663	0.337
5	5	0	0.611	0.648	0.352
6	10	0	0.546	0.633	0.367
7	15	0	0.481	0.618	0.382

Source: Analysis Result

Table 6: Probability of public transportation choices based on departure frequency difference between ordinary public transportations and female public transportation

Opsi	X1	X2	Utility of Female Public Transportation Choises	Probability of Female Public Transportation Choices	Probability of Ordinary Public Transportation Choices
	Female Public Transportation Frequency Difference	Ordinary Public Transportation Frequency			
1	10	0	1.459	0.811	0.189
2	8	0	1.251	0.777	0.223
3	6	0	1.043	0.739	0.261
4	4	0	0.835	0.697	0.303
5	0	0	0.419	0.603	0.397

Source: Analysis Result

Table 7: Equation Models

No	Equation Models	R^2	R
1	$U_{AUP} - U_{AU} = 1{,}041 - 0.0003.\ \Delta X_1$	0,061	0,004
2	$U_{AUP} - U_{AU} = 1{,}071 - 0.00005341.\ \Delta X_2$	0,098	0,010
3	$U_{AUP} - U_{AU} = 1{,}053 - 0.00005327.\ \Delta X_3$	0,097	0,009
4	$U_{AUP} - U_{AU} = 1{,}170 - 0.00003531.\ \Delta X_4$	0,077	0,277
5	$U_{AUP} - U_{AU} = 0{,}676 - 0{,}013.\ \Delta X_5$	0,016	0,127
6	$U_{AUP} - U_{AU} = 0{,}419 + 0{,}104.\ \Delta X_6$	0,743	0,551

Source: Analysis Result

CONCLUSION

- Survey indicates that the characteristic from 1060 respondents consisted of 47% students and 31% female workers, 30% respondent with income less than Rp 1.000.000/month and 19% with no income, with the purpose of the trip is 40% to school and 26% to the office.
- The probability of female public transportation mode selection is based on the cheaper fare (Rp 2.000) with several different attributes. 75% female passengers agree without any additional facilities, 76% demand air-conditioned facility, 76% demand particular seats for pregnant women, elderly and children, 77% demand security officers. In short, among 100 respondents, more than 70% respondents need female public transportations. Based on the trip period attribute; 15 minutes shorter, shows that the probability of female public transportations demand is 92% whereas the trip frequency difference 10 times of the probability of female public transportation choices is 86%.
- From several model equations from the attributes, we have selected an attribute model based on the frequency difference with the equation

$$U_{AUP} - U_{AU} = 0{,}419 + 0{,}104\ \Delta X_6,$$

where this equation is the closest to the precision of the model.

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