MODELING USER SATISFACTION FOR BUS RAPID TRANSIT CONSIDERING THE FACTOR OF SOCIO-ECONOMIC, OBJECTIVE AND SUBJECTIVE VARIABLES

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ABSTRACT

The bus rapid transit service has been implemented in Shaoxing for five years. Whether people are satisfied with the BRT service and what kinds of factors attribute their judgement address my attention. Taking socio-economic characteristic of passenger as well as subjective and objective perception characteristic of BRT service into consideration, this paper aims to establish a user satisfaction model for BRT service and figure out whether frequency of riding BRT or public bus have impact on level of satisfaction. The estimated model show that (1) objective perception characteristic of BRT service has dominant influence on user satisfaction; (2) frequency of riding BRT and public buses is positively associated with user satisfaction; (3) people with lower income more likely have lower satisfaction while company clerks are more satisfied with the BRT service than other occupation.

BIOGRAPHICAL SKETCH

Liangheng Tu is currently in his 2nd year of study in the Transportation Systems Engineering Program at Cornell University. In August, he will graduate with a Master of Science degree. He received a bachelor's degree in Civil Engineering from Zhejiang University, China. His research interests relate to transportation service analysis, with a focus on user satisfaction for bus rapid transit (BRT). He also focuses on service system and public system modeling. He is also interested in financial engineering and passed CFA level 1.

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INTRODUCTION

With the rapid urbanization and economic development in the world, traffic congestion has become the "urban disease" in many large cities. More and more people are concerned about time efficiency and comfort on the transport journey. In the public transport system, there are several types of travel mode. Taxi offers a fast and comfort travel service but with higher charge, which may not be a long-term plan for daily commuters. Subway and light rail transportation is a fast and convenient way while its environment is usually crowded and unsatisfactory. Traditional bus covers most region of the city, but it basically provides slower service. So how to improve time efficiency and comfort becomes a real issue.

The idea of BRT (Bus Rapid Transit) then is proposed. BRT is a "high-quality bus-based transit system that delivers fast, comfortable and cost-effective urban mobility through the provision of segregated right-of-way infrastructure, rapid and frequent operations, and excellence in marketing and customer service" (Wright and Hook, 2007)[1]. And its theory and application has been developed by many scholars and practitioners. In China, BRT is undergoing a faster development than in any other regions around the world during the first decade in 21st century. (Fjellstrom, 2010)[2].

Customer satisfaction is a psychological feeling state derived from the comparison of self-expectation and perceived effect of service. It is an essential aspect influencing travel mode choice. The performance of BRT service can be reflected by the perception of customer's satisfaction. On the other hand, by evaluating satisfaction level of BRT service, service provider may get useful information to improve service. Basically, there are several types of methods to measure customer satisfaction. Morpace International Inc. and Cambridge Systematics Inc. (1999)[3] summarized some of specific methods in a handbook, involving Bivariate (Pearson) correlation, multiple regression analysis, factor analysis, combining factor analysis and multiple regression analysis, quadrant analysis and impact score method. Another type includes Sweden Customer Satisfaction Barometer (SCSB) (Fornell, 1992)[4] and American Customer Satisfaction Index (ACSI) (Fornell et al., 1996)[5]. The ASCI model evaluates the causal interactions that derives from antecedents of overall satisfaction (customer expectations, perceived service quality and perceived value) to its consequences (customer complaints and customer loyalty). It has been widely used in many cases.

Considering the public transport system, scholars have extended the customer satisfaction index to bus service. Many works have attempted to illustrate the satisfaction level of public transport service.

The first group of contributions includes research focused on a subjective perception of public transport system. Eboli and Mazzulla (2007)[6] explored a structural equation to explain the relationship between customer satisfaction and service quality attributes.

Two years later, a new idea of Heterogeneous Customer Satisfaction Index was proposed by them, and an experimental case study in Cosenza was applied to test the methodology. Thompson and Schofield (2007)[7] concluded that ease of use has greater influence on destination satisfaction than efficiency and safety, based on their investigation of Greater Manchester. Fellesson and Friman (2012)[8] compared the perceived public transport service satisfaction in nine European countries, and identified system, comfort, staff and safety as the four satisfaction dimensions by using factor analysis. Nathanail (2008)[9] established a grading system of Hellenic railways based on six criteria (i.e. itinerary accuracy, system safety, liness, passenger comfort, servicing, and passenger information), and used quality measuring methods to assess the above variables. Itinerary accuracy and system safety was perceived having the highest grades comparing to the rest.

The second part of work focused on an objective perception of public transport system. Western et al. (1974)[10] found that Singapore residents believed adequacy of transport services and easy access to location are important attributes of satisfaction. Lucas and Heady (2002)[11] discussed the stress level of commuters with flexible schedule and those without, and proposed that commuters having less time urgency would experience less stress and higher level of satisfaction. Tyrinopoulos and Antoniou (2008)[12] employed two statistical methods (factor analysis and ordered logit modeling) to evaluate variability of users' satisfaction such as service frequency and accessibility. Cantwell et al. (2009)[13] employed the result of a survey in Dublin city center to find a decrease of commute satisfaction level associated with passengers who had long waiting time.

The third set of research touched on a topic of socio-economic attributes of satisfaction measurement. Ji and Gao (2010) [14] developed a Multi-level logistic regression model and identified that the people's socio-economic attributes such as age, family income and careers had a significant influence on their satisfaction toward public transportation and people with higher income feel less satisfied. Luigi dell'Olio et al. (2010)[15] evaluated bus users' perception of quality of public transport service, and considered socio-economic characteristics and other perception characteristics as basic independent variables.

The existing methods mainly focus on analytical perspective to study customer satisfaction, while this article try to address it by modeling. The objective of this article is attempting to consider the influence of socio-economic characteristic as well as subjective and objective perception characteristic of service.

METHODOLOGY AND DATA

User satisfaction is classified as four categories (Satisfied, Rather Satisfied, Rather Unsatisfied, Unsatisfied), which is rated by perception of passengers for BRT services. And three different parts of factors are illustrated, including socio-economic characteristic of passenger, subjective perception characteristic of BRT and objective

perception characteristic of BRT service. For socio-economic part, user satisfaction is usually affected by people from various backgrounds, such as gender, age, education, occupation, income and car ownership. For subjective part, subjective feeling of service is essential, in-vehicle cleanliness and ticket sales service are considered. For objective part, the factors such as availability of digital billboard, frequency of riding BRT weekly, frequency of riding public buses weekly (except BRT), access time, waiting time and in-vehicle time may have impacts on user satisfaction.

A questionnaire was designed (shown in Appendix 1) which contains four parts based on the above classification:1) overall satisfaction; 2) socio-economic characteristic of passenger; 3) subjective perception characteristic of BRT service; 4) objective perception characteristic of BRT service. The online and paper surveys were conducted in April,2018. The surveys were spread out from students in school to their families. And more than 300 questionnaires were collected in total. Finally, 344 results were used in modeling.

Since user satisfaction is classified as four categories (satisfied, rather satisfied, rather unsatisfied, unsatisfied), it is reasonable to consider user satisfaction is a discrete and ordinal outcome. Thus, ordinal logistic regression (OLR) model is selected to deal with discrete and ordinal dependent variables. Specifically, proportional odds model of ordinal logistic regression is applied as follows [16]:

$$\ln \frac{P(y \leq i)}{P(y > i)} = \alpha_i - \sum_{k=1}^{K} \beta_k x_k$$

where y denotes the dependent variables and it is classified into I categories; $i = 1,2, \ldots I - 1$ denotes the number of final equation equals the number of categories of dependent variables minus one. α_i denotes the i-th intercept; x_k represents the k-th independent variables; β_k denotes the corresponding coefficient of x_k; K denotes the number of independent variables.

The factors listed above now can be considered as dependent variables and independent variables. User satisfaction is a discrete and ordinal dependent variable. Gender, car ownership and availability of digital billboard can be simply regarded as binary variables. Age, education, occupation, income, frequency of riding BRT weekly, frequency of riding public buses weekly (except BRT) are categorical variables. In-vehicle cleanliness and ticket sales service are ordinal variables. And the rest variables including access time, waiting time and in-vehicle time are continuous variables. Dummy variables are used to classify categorical variables and n-1 dummy variables can represent n categorical variables. The descriptions of variables are shown in Tab.1.

Tab.1 The descriptions of variables of logistic model

Variable	Definition		Value		Variable type
User satisfaction (us)	Dependent variable		Very satisfied Rather Satisfied Rather Unsatisfied Very unsatisfied	1 2 3 4	Ordinal
In-vehicle cleanliness (ivc)	Whether it is clean in vehicle Subjective independent variable		Very satisfied Rather Satisfied Rather Unsatisfied Very unsatisfied	1 2 3 4	Ordinal
Ticket sales service (tss)	Whether ticket sales service is proper Subjective independent variable		Very satisfied Rather Satisfied Rather Unsatisfied Very unsatisfied	1 2 3 4	Ordinal
Gender (gen)	Socio-economic independent variable		Male Female	1 0	Binary
Car ownership (co)	Whether people own cars Socio-economic independent variable		Yes No	1 0	Binary
Availability of digital billboard (adb)	Whether there is a digital billboard at the station Objective independent variable		Yes No	1 0	Binary
Age	Socio-economic independent variable	age1 20-29	Yes No	1 0	Categorical (Age below 20 is reference category)
		age2 30-39	Yes No	1 0	
		age3 40-49	Yes No	1 0	
		age4 >49	Yes No	1 0	
Education	Socio-economic independent variable	edu1 High school or below	Yes No	1 0	Categorical (Bachelor is reference category)
		edu2 Master or above	Yes No	1 0	
Occupation	Socio-economic independent variable	occ1 Student	Yes No	1 0	Categorical (Other is reference category)
		occ2 Teacher	Yes No	1 0	
		occ3 Self- employed	Yes No	1 0	
		occ4 Government officer	Yes No	1 0	
		occ5 Company clerk	Yes No	1 0	
Income	Socio-economic independent variable	inc1 <6000	Yes No	1 0	Categorical (6000-8000 is reference category)
		inc2 > 8000	Yes No	1 0	

Frequency of riding BRT weekly	Objective independent variable	frbw1 3-5	Yes No	1 0	Categorical (0-2 is reference category)
		frbw2 >5	Yes No	1 0	
Frequency of riding public buses weekly (except BRT)	Objective independent variable	frpw1 3-5	Yes No	1 0	Categorical (0-2 is reference category)
		frpw2 >5	Yes No	1 0	
Access time (at)	Time spent from origin to station Objective independent variable				Continuous
Waiting time (wt)	Time spent on waiting for a BRT Objective independent variable				Continuous
In-vehicle time (ivt)	Time spent on the trip in BRT Objective independent variable				Continuous

MODEL AND RESULTS

The basic procedure for modeling user satisfaction is considering all the independent variables first, and then eliminating the insignificantly independent variables once a time, until finally all the remaining independent variables are significantly associated with user satisfaction. The reason why not eliminating all the insignificantly independent variables simultaneously is because there may exist multicollinearity among these independent variables. VIF (variance inflation factor) can be calculated to test the level of multicollinearity among independent variables. VIF less than 4 represents little multicollinearity, and VIF larger than 10 indicates there exists high multicollinearity among independent variables and should reselect the independent variables.

The first user satisfaction model is established considering all the independent variables, which is called OLR Model 1. The outcome for Model 1 is shown in Tab.2. Besides, a multicollinearity test is also shown in Tab.3. Obviously, the p-values of gender, car ownership, age and education are large than 0.05, which means these independent variables are not significantly associated with user satisfaction. And meanwhile, the VIF of age1, age2, age3, age4, edu1, occ1 and inc1 are larger than 4, which means there exists multicollinearity among these independent variables. However, single dummy variable is not allowed to remove since dummy variables must be simultaneously added or deleted from the model. Although the model 1 is not works perfectly, we can still find some significant variables, and frequency of riding BRT or public bus have significant impact on user satisfaction.

Tab.2 The OLR model 1 with all independent variables

Independent variables	Coefficient	Std. Error	p-value

Intercept 1		11.0592	2.0562	7.5101e-08
Intercept 2		18.9175	2.4678	1.7783e-14
Intercept 3		27.2252	3.0064	1.3559e-19
In-vehicle cleanliness		-2.9528***	0.3487	2.5174e-17
Ticket sales service		-2.8988***	0.3500	1.2019e-16
Gender	Male	0.3340	0.3410	0.3274
	Female(reference)			
Car ownership	Yes	0.4575	0.7858	0.5604
	No(reference)			
Availability of digital billboard	Yes	2.4724***	0.4959	6.1754e-07
	No(reference)			
Age	age1 (20-29 years)	-0.4066	1.3891	0.7698
	age2 (30-39 years)	-1.1328	1.3902	0.4152
	age3 (40-49 years)	-1.0528	1.4014	0.4525
	age4 (>49 years)	-1.1972	1.4261	0.4012
	<20 years (reference)			
Education	edu1 (high school or lower)	0.2390	0.7781	0.7587
	edu2(master or above)	0.6212	0.7124	0.3832
	bachelor (reference)			
Occupation	occ1 (student)	0.1359	1.0213	0.8942
	occ2(teacher)	-0.8445	0.6692	0.2069
	occ3(self-employed)	-0.4397	0.6599	0.5052
	occ4(government officer)	0.4492	0.7088	0.5263
	occ5(company clerk)	1.6334**	0.7684	0.0335
	others (reference)			
Income	inc1 (< 6000¥ per month)	-2.4164**	1.0890	0.0265
	inc2 (>8000¥ per month)	-0.9275*	0.5092	0.0685
	6000-8000 (reference)			
Frequency of riding BRT weekly	frbw1(3-5 per week)	0.2629	0.6180	0.6706
	frbw2 (>5 per week)	1.9944***	0.5347	0.0002
	<3 per week (reference)			
Frequency of riding public buses weekly (except BRT)	frpw1(3-5 per week)	2.0005**	0.8695	0.0214
	frpw2 (>5 per week)	0.7077	0.4491	0.1151
	<3 per week (reference)			
Access time		-0.1528***	0.0504	0.0025
Waiting time		-0.3035***	0.0685	9.3249e-06
In-vehicle time		-0.0480**	0.0229	0.0364

Note: *, **, *** significant at 0.1,0.05, 0.01, respectively

Tab.3 VIF test of OLR model 1

ivc	tss	gen	co	adb	age1	age2	age3	age4
1.6442	1.4887	1.0854	1.8076	1.4879	10.0331	16.6556	14.1472	7.0122
edu1	edu2	occ1	occ2	occ3	occ4	occ5	inc1	inc2
5.3615	2.2084	9.4208	2.9333	2.0535	2.0412	2.2228	8.2026	1.9462
frbw1	frbw2	frpw1	frpw2	at	wt	ivt		
1.4796	1.4390	1.2817	1.3066	1.4495	1.2451	1.4632		

For further modeling, gender, car ownership, education and age are deleted one by one, and a second OLR model with remaining independent variables is established, which called Model 2. The outcome for Model 2 is shown in Tab.4. Also, a multicollinearity test is also shown in Tab.5.

In model 2, occ1, occ2, occ3, occ4, inc2, frbw1 are still not statistically significant, but occ5, inc1 and frbw2 are significantly associated with user satisfaction. So these dummy variables are still remained in the model. And VIF of independent variables are mostly less than 4, which means multicollinearity not a big concern.

Tab.4 The OLR model 2 with remaining independent variables

Independent variables		Coefficient	Std. Error	p-value
Intercept 1		10.5651	1.4134	7.7188e-14
Intercept 2		18.1733	1.8905	7.0646e-22
Intercept 3		26.3863	2.5031	5.5596e-26
In-vehicle cleanliness		-2.9133***	0.3354	3.7901e-18
Ticket sales service		-2.9286***	0.3450	2.0716e-17
Availability of digital billboard	Yes	2.3408***	0.4643	4.6208e-07
	No(reference)			
Occupation	occ1(student)	0.7416	0.6888	0.2816
	occ2(teacher)	-0.7272	0.5881	0.2163
	occ3(self-employed)	-0.5628	0.6447	0.3827
	occ4(government officer)	0.3133	0.6461	0.6278
	occ5(company clerk)	1.5976**	0.6677	0.0167
	others (reference)			
Income	inc1 (< 6000¥ per month)	-1.9649**	0.7733	0.0111
	inc2 (>8000¥ per month)	-0.6665	0.4560	0.1438
	6000-8000 (reference)			
Frequency of riding BRT weekly	frbw1(3-5 per week)	0.3966	0.6075	0.5139
	frbw2 (>5 per week)	2.2381***	0.5025	8.4226e-06
	<3 per week (reference)			
Frequency of riding public buses weekly (except BRT)	frpw1(3-5 per week)	1.9994**	0.8788	0.0229
	frpw2 (>5 per week)	0.7850*	0.4376	0.0729
	<3 per week (reference)			
Access time		-0.1431***	0.0492	0.0036
Waiting time		-0.2969***	0.0678	9.325e-06
In-vehicle time		-0.0401*	0.0214	0.0612

Note: *, **, *** significant at 0.1,0.05, 0.01, respectively

Tab.5 VIF test of OLR model 2

ivc	tss	adb	occ1	occ2	occ3	occ4	occ5	inc1
1.6169	1.4549	1.4344	4.2453	2.5215	1.8489	1.8735	1.8778	4.8241
inc2	frbw1	frbw2	frpw1	frpw2	at	wt	ivt	
1.6846	1.4455	1.2686	1.2601	1.2619	1.4001	1.2288	1.3831	

According to the methodology and above results, choosing the significant level of 0.05, the user satisfaction model of BRT service is established:

$$\ln\frac{P_1}{P_2+P_3+P_4} = 10.56 - 2.91\text{ivc} - 2.93\text{tss} + 2.34\text{adb} + 1.60\text{occ5} - 1.96\text{inc1} + 2.24\text{frbw2} + 2.00\text{frpw1} - 0.14\text{at} - 0.30\text{wt}$$

$$\ln\frac{P_1+P_2}{P_3+P_4} = 18.17 - 2.91\text{ivc} - 2.93\text{tss} + 2.34\text{adb} + 1.60\text{occ5} - 1.96\text{inc1} + 2.24\text{frbw2} + 2.00\text{frpw1} - 0.14\text{at} - 0.30\text{wt}$$

$$\ln\frac{P_1+P_2+P_3}{P_4} = 26.39 - 2.91\text{ivc} - 2.93\text{tss} + 2.34\text{adb} + 1.60\text{occ5} - 1.96\text{inc1} + 2.24\text{frbw2} + 2.00\text{frpw1} - 0.14\text{at} - 0.30\text{wt}$$

where P_1, P_2, P_3, P_4 represents the probability of user being very satisfied, rather satisfied, rather unsatisfied and very unsatisfied respectively. The sum of four probabilities equals to one. ivc and tss represent in-vehicle cleanliness and ticket sales service (1 is very satisfied, 2 is rather satisfied, 3 is rather unsatisfied, 4 is very unsatisfied); adb is Availability of digital billboard (yes, $\text{adb} = 1$; otherwise, $\text{adb} = 0$); occ5 indicates that the passenger's occupation is company clerk (yes, $\text{occ5} = 1$; otherwise, $\text{occ5} = 0$); inc1 indicates income of passenger is less than 6000 RMB (yes, $\text{inc1} = 1$; otherwise, $\text{inc2} = 0$); frbw2 represents the frequency of riding BRT more than 5 times per week (yes, $\text{frwb2} = 1$; otherwise, $\text{frbw2} = 0$); frpw1 represents the frequency of riding public bus except BRT between 3 to 5 times per week (yes, $\text{frpw1} = 1$; otherwise, $\text{frpw1} = 0$); at, wt represents access time, waiting time respectively.

The positive coefficients increase the likelihood of having higher satisfaction (i.e., the lower-numbered category). Conversely, negative coefficients tend to increase the likelihood of having lower satisfaction. The negative coefficient of ivc and tss implies choosing the higher category will results in lower likelihood of having higher satisfaction. The absolute value of these two coefficients (2.91 and 2.93) are biggest among all the estimation, which means in-vehicle cleanliness and ticket sales service have essential impact on satisfaction level. Availability of digital billboard has the largest positive coefficient (2.34), which means people are much more likely being satisfied with BRT service when the station equipped with digital billboard. It seems that people have higher requirement of facilities and associate it with satisfaction level.

Compared with other occupation, the coefficient of company clerks is positive, meaning they are more satisfied with the BRT service. Based on the survey, nearly 60% of them choose BRT or public bus for commute and more than 90% of them feel very satisfied and rather satisfied. Both ratios are much higher than the other occupation. The possible explanation might be that they are more appreciated for the convenience of BRT and public bus and hence having higher satisfaction level.

The parameter estimated for income less than 6000 is negative, demonstrating people with lower income are relatively more unsatisfied with BRT service. It is an interesting

discovery because intuitively poor people usually have lower requirement of satisfaction than rich groups.

Since most company clerks are satisfied and most of them earn more than 6000 yuan per month, a model eliminating independent variable of company clerk is tested, considering the potential collinearity between company clerk and income. The results are shown in Appendix 2. Now, the independent variable of people with higher income is significant, so people with higher income are also more likely unsatisfied, which is consistent with the earlier research studied by Ji and Gao [14]. So the sample of company clerk do affect the results of model. And still, people with lower income are less likely satisfied with BRT service. The higher ticket price of BRT than public bus might be a good insight to explain the reason. For further study, adding the ticket price variable into the model and figure out the association between price and satisfaction seems to be meaningful. And decreasing the ticket price of BRT or providing subsidy might increase the satisfaction of people with lower income.

The coefficients for frequency of riding BRT weekly and frequency of riding public buses weekly (except BRT) are both positive. It is reasonable that people having higher likelihood of being satisfied if they enjoy the benefit of BRT. While it is quite surprising that people with high frequency of riding normal public bus are also express higher likelihood of being satisfied. The one possible explanation is because BRT owning express lane for running which saves much time when traffic is heavy. So during the peak hour in the morning or evening, people sitting in the public bus might be jealous of passenger in BRT. Besides, BRT uses electricity as energy and provides cozy environment for the passengers. So for further research, the comparison between BRT and normal public bus can be studied. Time is also an important factor associated with satisfaction level. Generally, the more time people spend on waiting or travel, the more unsatisfied they will be. So the coefficients estimated for access time and waiting time that are negative do make sense. However, the absolute value of these three coefficients are quite small, which means they have relatively smaller impact on user satisfaction level.

CONCLUSIONS

Based on the former studies and research, this paper established the user satisfaction model for bus rapid transit using OLR. The highlight of the model is considering the factors of socio-economic characteristic of passenger as well as subjective and objective perception characteristic of BRT, which can make model more generalized.

For subjective part, in-vehicle cleanliness and ticket sales service have largest absolute coefficients and have essential impact on user satisfaction. For objective part, it includes 5 variables in the final model and it has dominant influence on user satisfaction. And frequency of riding BRT and public buses are positively associated with user satisfaction. For socio-economic part, people with lower income more likely have lower

satisfaction while company clerks are more satisfied with the BRT service than other occupation.

Besides, the model would be a good reference for BRT suppliers and government department. On the one hand, BRT suppliers can still improve service to fulfill people's expectation. Based on significant independent variables, they should work harder on these factors so that people would be satisfied. On the other hand, since people with lower income are more likely unsatisfied with BRT service, a subsidy policy for these people might be considered by government department.

Furthermore, the established model can estimate user satisfaction level when the necessary information is given. More variables can be added into the model and more training data can also optimize the model. Since income is negatively associated with satisfaction level, adding the ticket price variable into the model and figure out the association between price and satisfaction seems to be promising. And it is also worthy exploring the comparison between BRT and normal public bus and identify the attraction of BRT.

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APPENDIX 1

User Satisfaction Survey

Dear Ms/Sir:

I am really appreciated for your time to complete the survey. Thank you for your support and help!

This questionnaire survey is fully used for academic research purposes and does not involve personal interest. I promise to collect all information is strictly confidential. Please fill in or select the option that best suits your actual situation according to the real situation. The accurate and complete information provided is of great significance to my research and practices.

1 Your overall satisfaction of BRT service	[1] Very satisfied	[2] Rather Satisfied	[3] Rather Unsatisfied	[4] Very unsatisfied
2.1 Gender	[1] Male	[2] Female		
2.2 Age	[1] <20	[2] 20-29	[3] 30-39	[4]40-49
	[5] >49			
2.3 Education	[1] High school or below	[2] Bachelor	[3] Master or above	
2.4 Occupation	[1] Student	[2] Teacher	[3] Self-employed	[4] Government officer
	[5] Company clerk	[6] Other		
2.5 Income	[1] Below 6000	[2] 6000-8000	[3] Above 8000	
2.6 Car ownership	[1] Yes	[2] No		
3.1 Availability of digital billboard	[1] Yes	[2] No		
3.2 Access time	_____ min	Time spent from origin to station		
3.3 Waiting time	_____ min			
3.4 In-vehicle time	_____ min			
3.5 Frequency of riding BRT weekly	[1] 0-2	[2]3-5	[3] More than 5	
3.6 Frequency of riding public buses weekly (except BRT)	[1] 0-2	[2]3-5	[3] More than 5	
4.1 In-vehicle cleanliness	[1] Very satisfied	[2] Rather Satisfied	[3] Rather Unsatisfied	[4] Very unsatisfied
4.2 Ticket sales service	[1] Very satisfied	[2] Rather Satisfied	[3] Rather Unsatisfied	[4] Very unsatisfied

APPENDIX 2

Test without company clerk considering all variables

Independent variables		Coefficient	Std. Error	p-value
Intercept 1		9.7934	2.3766	3.7766e-05
Intercept 2		17.7939	2.7521	1.0088e-10
Intercept 3		26.3674	3.2738	8.0127e-16
In-vehicle cleanliness		-2.9399***	0.3700	1.9149e-15
Ticket sales service		-2.9886***	0.3867	1.0900e-14
Gender	Male Female(reference)	0.1389	0.3606	0.7001
Car ownership	Yes No(reference)	0.9165	0.8540	0.2832
Availability of digital billboard	Yes No(reference)	2.4747***	0.5194	1.8955e-06
Age	age1 (20-29 years)	0.2235	1.9111	0.9069
	age2 (30-39 years)	0.3649	1.8801	0.8461
	age3 (40-49 years)	0.1789	1.8615	0.9234
	age4 (>49 years)	0.4090	1.9254	0.8318
	<20 years (reference)			
Education	edu1 (high school or lower)	0.1647	0.8677	0.8495
	edu2(master or above)	0.6668	0.7710	0.3871
	bachelor (reference)			
Occupation	occ1 (student)	-0.3836	1.0804	0.7225
	occ2(teacher)	-0.8367	0.6944	0.2283
	occ3(self-employed)	-0.4407	0.6731	0.5222
	occ4(government officer)	0.4735	0.7316	0.5175
	others (reference)			
Income	inc1 (< 6000¥ per month)	-0.6695	1.7816	0.7071
	inc2 (>8000¥ per month)	-1.0519*	0.5439	0.0531
	6000-8000 (reference)			
Frequency of riding BRT weekly	frbw1(3-5 per week)	0.1105	0.6393	0.8628
	frbw2 (>5 per week)	2.0505***	0.5869	0.0005
	<3 per week (reference)			
Frequency of riding public buses weekly (except BRT)	frpw1(3-5 per week)	2.1191**	0.9151	0.0206
	frpw2 (>5 per week)	0.8239*	0.4990	0.0987
	<3 per week (reference)			
Access time		-0.1943***	0.0572	0.0007
Waiting time		-0.3123***	0.0742	2.5523e-05
In-vehicle time		-0.0386	0.0247	0.1174

Note: *, **, *** significant at 0.1,0.05, 0.01, respectively

Test without company clerk considering all significant variables

Independent variables		Coefficient	Std. Error	p-value
Intercept 1		9.7027	1.3464	5.7576e-13
Intercept 2		17.3558	1.9049	8.1504e-20
Intercept 3		25.7336	2.5951	3.5400e-23
In-vehicle cleanliness		-2.8741***	0.3502	2.2461e-16
Ticket sales service		-2.8704***	0.3646	3.4968e-15
Availability of digital billboard	Yes	2.4272***	0.4864	6.0206e-07
	No(reference)			
Income	inc1 (< 6000¥ per month)	-0.9540**	0.4727	0.0436
	inc2 (>8000¥ per month)	-0.7469*	0.4353	0.0862
	6000-8000 (reference)			
Frequency of riding BRT weekly	frbw1(3-5 per week)	0.2291	0.6056	0.8052
	frbw2 (>5 per week)	2.0711***	0.5130	5.4089e-05
	<3 per week (reference)			
Frequency of riding public buses weekly (except BRT)	frpw1(3-5 per week)	1.9023**	0.8877	0.0321
	frpw2 (>5 per week)	0.8546*	0.4745	0.0717
	<3 per week (reference)			
Access time		-0.2244***	0.0507	9.6066e-06
Waiting time		-0.3222***	0.0726	9.0584e-06

Note: *, **, *** significant at 0.1,0.05, 0.01, respectively