Logistics Modelling for the University Transport Service using Choice Experiment

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Abstract- The use of Single Own Vehicle (SOV) among university students in the campus area has been increased lately. Many factors attributed to this scenario. One of them is the availability of the university transport service in the campus area. The benefits of using SOV to the students is undeniable. However, such a scenario gives traffic or environmental problems if the number of SOV users are not regulated. One common approach that has been applied in many universities for reducing the SOV users is by providing the university transport service to their students. But why such service fails to reduce the number of SOV users? Using a Choice Experiment (CE) technique, this study is undertaken to investigate the UUM students' preferences and satisfaction on the university transport service. The results from the Latent Class Model (LCM) show that the respondents in UUM are not satisfied with the currently provided service and put a hope that the service will be improved soon. This study also found that the respondents are willing to pay (WTP) an additional amount of money if the service is improved where the focus attributes of the service are such passengers loading and service to the nearby towns.

Keywords*: Single Own Vehicle, University Transport Service, Choice Experiment, Latent Class Model, Willing to Pay*

1. Introduction

The use of Single Own Vehicle (SOV) among university students in the campus area has been increased lately. Many factors attributed to this increase in demand but the one that will be highlighted in this article is the availability of the transport service in the campus area. Transport service or broadly speaking logistics management is a process of planning, implementing and controlling the efficient, cost-effective flow and storage of raw materials, in-process inventory, finished good, and related information flow from point-of-origin to point-of-consumption to conform to customer requirements-Council of Logistic Management as cited in [1]. It includes a public bus service.

The ultimate role of public bus service is to provide a transportation service to a larger number of people. It includes people who live around the area. And in many cases, the service is also inclusive in the campus area. The frequency of its service, however, subject to the demand from the public. If the transit agency expects that a large number of people will use its bus service, then they will provide more frequent bus service to the area. Otherwise, they will reduce the frequency of its bus service.

Location is one of the factors in determining the frequency of the public bus service. Usually, it relies on the number of prospective passengers that will use the service. Places that are located in the urban area logically get more frequent public bus service if compared to places that are located in the rural area. Take the location of the university as an example. We notice that the university that is located in the rural area, *by and large*, get less frequent public bus service if compared with their counterpart, university in the urban area. The impact of this service frequency is to the university's students. If the students' hostel is far away from the academic buildings or shops, then the students will have a problem doing their daily routine tasks such as to and from study-related activities or to go to nearby shops. They need transport and one of the solutions that they can employ is to use SOV.

The benefits of using SOV to the students is undeniable. But if the number of SOV users is not regulated then it will give problems to the university management. The common problems of unregulated SOV are traffic congestions and road accidents, air pollution and high demand for parking lots. Such anticipated problems have forced the university

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management to implement measures to reduce students' dependency on SOV. The one that is applied mostly in many universities is to provide the university transport service.

Providing university transport service gives benefits to university management. [2] classified such benefits into two categories, monetary and non-monetary benefits. For the monetary benefits, it includes the costs of providing parking lots. Costs related to parking lots that could be avoided if the university transport service is provided are such salaries of the car-park attendants; administration costs and the capital costs of establishing the car park facilities. While the non-monetary parts are the benefits that can be linked with a green campus image. The university management can use the green campus image for promoting students to enroll in the university.

Though providing the university transport service gives benefits as supported by [2], the costs of providing it are huge and escalating from year to year. Apart from that, the university has also to forgo the monetary benefits that they can receive if they are permitting students to use SOV. This is the case when students who use the SOV need a space to park their vehicles in the university area. The university can charge them for the parking facilities they use. The demand for parking lots from the students will be increased in tandem with the increase in the SOV demand. The most common available transport service in the University is a campus bus service.

An increment in cost in providing the university transport service has forced the university management to impose a bus fee to their students. In Universiti Utara Malaysia (UUM) for example, the students are required to pay MYR80[1] (or equivalent to MYR 0.70 per day) at the beginning of the semester for the campus bus service for that semester. The fee however only covers 48% of the costs and the remaining 52% is funded by the university. Such a scenario had informed us that the students are forced to pay the campus bus fee and the university management has to pay a huge cost of providing it.

But what remains unknown, are the UUM students satisfied with the current service? If not, how does the UUM management improve them and are the students willing to pay for such improvement? As revealed by [3], there were few barriers for students to use busses which included safety, accessibility to the bus stop, distance, long travel time and insufficient knowledge of the service. Therefore, understanding the student experience on the campus bus service can help us to reveal the quality of the services provided.

The main objective of this study is to examine the satisfaction and preferences of the UUM students on the performance of the UUM campus bus service. Investigating the preferences of the students regarding their 'perfect' bus service could help university management in designing a better provision of bus service in the future. The preferences will be analyzed using the Choice Experiment (CE) technique. The results from the Latent Class Model (LCM) indicate that the respondents in UUM put hope that the campus bus service will be improved soon. The study also found that the respondents are willing to pay for an additional amount of money if the bus services are improved.

The remaining of this paper is organized as follows. Section 2 reviews relevant literature on the campus bus service. Section 3 explains the study design where the CE method is introduced and discussed. The following section is on results and conclusions and the final section concludes the study.

2. Literature Review

Studies on transportation services in the campus area have been undertaken by many researchers. It covers various topics including, but not limited to, parking problem [4] [5], students' commuting habits [6], environmental concern [2], transportation management [7] [8], travel route and frequency [9], and services of driver [6].

The importance of reducing SOVs in the campus area has been highlighted by [2]. The author raised the issue when he observed that the majority of the roads on the campus were dominated by people who are commuting by SOV. He claimed that the key factor that encourages people to use SOV was due to the low parking fee for the parking space that they had to use. The SOV users usually pay below the cost of parking space provision. And in some cases, it is free parking. The author shared several measures that have been implemented somewhere else to reduce the numbers of SOV in the campus area. These include limiting the number of parking lots in the university area, a higher charge for the parking facility, promoting travel card for students to commute with public transports, etc. But given an option between public transport and bicycle, the author urged people to use the bicycle rather than public transport in the university area.

Bicycle including walking and public transport are examples of active transport mode. They are classified as active because such types of transport require people's physical activity. Even public transport is considered as active because it requires passengers to walk or cycle either at the beginning or end of the journey

[1] The exchange rate in 2018 figures was MYR1.00=US$0.27

[10]. The benefits of using active transport in the campus area are not limited to mitigate the parking space problem or reducing the carbon footprint. Such transport can also be used to improve the individuals' health (i.e. staff and students) and students' academic performance. This is supported by [11] [12]. In their study on adolescents' depression and academic performance, they found that the students who were active in physical activity able to reduce their depression. Such respondents also achieved high academic performance.

There is little disagreement among researchers that cycling is important for individual health and the environment [2] [10]. By cycling, individuals can improve their health levels and more importantly can help to reduce CO2 emission. With such potential benefits that individuals would gain by cycling, one unanswered question is why some individuals do not prefer to use a bicycle as their mode of transport? Studies on the topic have been carried out by many researchers [13] [14] [15] and they found that the reasons for individuals opted not to cycle, among them, are such inconsiderate drivers, travel time and distance, physical condition, traffic safety, poor air quality, and bad weather.

Weather plays an important role in encouraging people to cycle where they prefer to commute by bicycle if the weather is conducive. But having a tropical climate with characteristics of hot weather, high humidity and a lot of rainfall are not supporting the public to use the bicycle. [16] did a study on this. They found that the cyclists in the southern tip of the Malay Peninsula are not preferred to cycle if the weather is greater than 31.5ºC, the humidity level is greater than 55.8%, and rainfall (>0.28mm in past 60 minutes).

Poor air quality is another factor that could deter people from cycle. Adverse respiratory and cardiovascular are common health adversity for people who are cycling very close to vehicle emissions [17]. Since the bicycle is not the best option for the people who live in a tropical climate country like Malaysia, another option that the university can employ is providing the university transport service i.e. campus bus service.

One of the issues that constantly been discussed on the campus bus service by the university management is how the service is funded. Usually, the campus bus service is funded from the mixture of sources including student fees, car's sticker fees, and fines, and the university funding [18] [19] In UUM for example, the fund is a mixture of student fees and university funding. Another significant question on this issue as pointed out by [18] is how to treat students who are not fully utilized in the service.

The following question the management needs to address is how much students are willing to pay for the campus bus service and the mechanism of charge it, for example, whether students pay on an annual basis or pay after the ride system? Studies on people willing to pay on the public bus service have been undertaken by researchers such as [20] [21] [22]. But to the best of our knowledge, none of them were conducted on the campus bus service. Moreover, the use of the CE technique to explore this issue is still limited. Therefore, this study is undertaken to estimate the value of money that students are willing to pay for the campus bus service. The results hopefully will contribute to the existing literature on CE particularly on the campus sustainable transportation facility.

3. Methodology

3.1 Choice Experiment Technique

Choice Experiment (CE) is one of the economic valuation techniques that has been applied by many researchers [23] [24] to measure consumer economic welfare. Introduced by [25], the technique requires respondents to choose one most preferred option from a series of options presented to them. It is common to see researchers [26] [27] use three to four options including a status-quo option. The inclusion of the status quo is a must in the CE technique so that the consumer welfare that we will measure later in the technique follows the Hicksian consumer welfare measurement [28].

An option in CE combines two or more attributes at different levels. Usually, various levels of attributes are used so that wide arrays of scenarios can be formed and subsequently be presented to respondents. The selection of attributes and their levels is crucial because the hypothetical scenario options that would be used in the technique depends on this. A combination of inappropriate attributes at unsuitable levels has a high possibility to produce inaccurate hypothetical scenario. If this is the case, respondents may be shown with an unrealistic hypothetical scenario. Due to its importance, [29] has suggested three main criteria for choosing attributes: demand-relevancy; policy relevancy and measurability. The discussion of the proposed criteria, however, is not presented in this article.

The first stage in CE is to identify attributes and their levels. The procedure in the study began by seeking attributes that have been used by researchers in previous relevant studies. Examples of attributes for bus service are such fare, frequency, journey time, walking time/distance to a bus stop, operating hours, the interior of the bus, comfort seat, access to real-time information [30] [31] [32]. After identifying them, we conducted four focus group meetings. All the participants in the meeting were UUM students at various semesters. During the meetings, the participants were asked to discuss the importance of each identified attributes.

The meetings found that students were concerned about several matters including how long that

they have to wait for using the campus bus service; availability of the campus bus service to ferry them to nearby towns; the passenger load and the bus fee. For the bus fee, the participants prefer a one-day bus pass approach rather than an upfront charge for a semester. The approach allows students to have multiple trips in a day with a pass that she bought on that day. The suggested fares for the one-day pass were MYR0.70, MYR0.85, MYR1.00, and MYR1.20. Then we discussed such matters with the persons that are in charge of the bus service in UUM. The discussion concluded the attributes to be used in CE are;

1) students' waiting time (in minutes);
2) types of route whether fixed-route or flexible route;
3) availability trip to nearby towns;
4) the passenger load and
5) one-day bus pass fee.

All the attributes have three levels except for the attribute route with two levels and the bus fee with four levels. The summary of these attributes is shown in Table 1.

Table 1: Attributes and their levels for a CE survey on the Bus Services

Attribute's name	Level	Variable's name
Waiting Time (WT)	15 minutes	Base level
	10 minutes	WT1
	5 minutes	WT2
Types of Bus Routes (R)	Fixed	Base level
	Flexible	R1
Trip to Nearby Town (NT)	No out campus trip	Base level
	Changloon	NT1
	Jitra	NT2
Passenger Load (PL)	Over crowded	Base level
	Not over crowded	PL1
	Seated	PL2
One-day Bus Pass Fee	MYR 0.70	
	MYR 0.85	
	MYR 1.00	
	MYR 1.20	

The second stage in CE is to generate choice cards. This stage requires different attributes and their levels to be combined to form a choice card. One of the important elements in generating choice cards is an orthogonal design property. The property ensures that a coefficient of attributes is not confounded with the other attributes' coefficient. This study used SAS software. Through the software, such a combination of attributes and their levels produces 18 choice cards. Respondents may need a long time if they were asked to answer all these 18 choice cards. Such a situation may lead to their cognitive burden and eventually will affect their answers. To avoid this possibility, the 18 choice cards were blocked into three partitions where each partition consisted of six choice cards. Then the respondents were assigned to one of the partitions. The example of the choice card is shown in Figure 1.

The final stage in CE is to seeking an estimation model for analyzing the choice data. A basic and the most frequently applied model for estimating the choice data is the Multinomial Logit Model (MNL) [26] [28]. The model, however, has a constraint where it assumes that individuals have homogeneous taste preferences. Such a constraint is not always true in the real world. Alternatively, researchers [24] use a model that obviates the MNL assumption, the Latent Class Model (LCM).

Attribute	Bus A	Bus B	Bus C
Waiting Time	5 minutes	10 minutes	15 minutes
Bus Route	Flexible	Fixed	Fixed
Trip to Nearby Town	Changloon	Jitra	No out campus trip
Passenger Load	Not overcrowded	Seated	Overcrowded
One-day Bus Pass Fee	MYR1.00	MYR1.20	MYR0.70
I prefer (please √)	☐	☐	☐

Figure 1: An Example of a CE Choice Card

Latent Class assumes the existence of *S* segments and that student *n* belongs to a particular segment *s* (*s*=1,2, …, *S*). The utility function of the LCM is shown in (1).

$$U_{in|s} = \beta_s X_{in|s} + e_{in|s} \quad (1)$$

where β refers to the taste parameter row vector and X is a column vector of alternatives attributes and individual characteristics.

The probability of student *n* in segment *s* choosing alternative *i* ($P_{in(s)}$) can be calculated as shown in (2).

$$P_{in(s)} = \sum_{s=1}^{S} \left[\frac{\exp(\Delta\beta_s X_{in|s})}{1+\sum_{j=1}^{J-1}\exp(\Delta\beta_s X_{jn|s})}\right]\left[\frac{\exp(\Delta\gamma_s Z_n)}{1+\sum_{s=1}^{S-1}\exp(\Delta\gamma_s Z_n)}\right] \quad (2)$$

where Z_n is a vector socio-demographic characteristics, while γ_s is a vector of parameters to be estimated. The interpretation for β and X are similar as in equation 1. The existence of heterogeneity in choice data can be detected from the adjusted pseudo-R^2. [33] pointed out that if the adjusted pseudo-R^2 increases as the number of segments are increased, it indicates there is the existence of heterogeneity in the choice data. Though information criteria (e.g. Akaike Information Criterion (AIC) or Bayesian Information Criterion (BIC)) provides a hint to determine the number of segments, other factors such as the objective of the study, expert judgment, and experience can be used as well. Finally, the amount of money that students are willing to pay for an improvement in each attribute can be calculated using (3).

$$\text{Implicit Price (IP)} = \frac{\beta_k}{\varphi} \tag{3}$$

where *k* refers to the parameter of a non-monetary *k* attribute while φ is the parameter for the bus fare.

3.2 Study Area

Universiti Utara Malaysia (UUM) is one of the public universities in Malaysia. The university is located in Sintok which is 48 km north of Alor Star and 10 km east of Changlon. Sintok is a remote area and lacking transportation links. The total land area of UUM is 1,061 hectares and it consists of infrastructures such as administrative and academic buildings, sports center, shopping complexes, and students' hostel. There is 15 students' hostel presently in UUM and all students are required to stay in one of the hostels. Due to the fact of UUM location and its big land area, students need transport for moving.

UUM provides the campus bus service for their students to use, mainly for moving them from their hostel to academic buildings and *vice versa*. The students can use the bus service for other purposes such as for extra-curriculum activities. The service starts at 8.00 am and will be finished at 11.30 pm every day during the academic term. In terms of a bus route, currently, it has four routes known as routes A, B, C and D where for each route it will cover different hostels. Route A, for example, covers few hostels including Maybank, TNB, Tradewind, Proton, and MAS. While for Route B, it covers hostels TM, MISC, BSN, Sime Darby, EON, and Petronas. All students are required to pay up-front of MYR80 at the beginning of a semester for the bus fee for one semester.

At the same time, UUM permits students to use their vehicles on the campus. However, they must get approval from the university. The university will allow them if several criteria, such as active with university activity and semester 4 and above, are met. In terms of parking space, students need to park their vehicles at the parking space that is designated for them to park. And no charge is imposed on this parking facility.

3.3 Questionnaire

The questionnaire used in the study were divided into three sections. In section A, respondents were asked about the type of transport that they are using in the campus currently. Respondents were also asked whether they use SOV or not. If yes, what type of SOV they are using and what is the main purpose of using it. Then the respondents were asked on the campus bus service. Such questions asked include the frequency of using it in a week, time that they most preferred to use it whether in the morning, noon or afternoon, and their average waiting time for the campus bus.

Respondents were also required to answer 5 Likert Scale questions in this section. They were asked to select a rating of scale that ranges from strongly agree and strongly disagree with various campus bus attributes such as waiting time, type of route, passenger load and out-campus trip. Such questions were not only useful for warm-up purposes but most importantly to make respondents focus on the subject of the study [34].

The following section in the questionnaire was the CE questions. The section began with a brief explanation about attributes and their levels used in the study to respondents. Then respondents were told about the experiment's rules. To help them understand better, respondents were shown an example of a choice card before requiring them to answer the actual ones. This section ends with the questions asking respondents to report how frequently they considering the attributes when making choices. These questions were useful to explain why some attributes are not significant in the estimation model later if any. The last section gathered information on socio-demographic characteristics, such as respondents' ethnic identities, gender, hostel, and current CGPA point.

3.4 Sampling Technique

The target population for the study consisted of undergraduate students at UUM. The study follows a stratified sampling technique, as applied by [35] [36]. The sample was stratified following three strata: the total number of students for each students' hostel; the total number of students for each semester; and the last was the students' gender.

Following the determined stratifying strategy, we interviewed 220 respondents in 2018. For collecting information form respondents, we used the popular technique that mostly applied by CE researchers [36] [35], a personal face-to-face interview survey. The

technique was also suggested by the National Oceanic Atmospheric Administration (NOAA) panel. Four enumerators were employed, including undergraduate students at local universities for interviewing respondents.

4. Results and Discussion

Of the 220 respondents interviewed, only 201 respondents were used for the analysis. The remaining were removed due to reasons such as incomplete and inconsistent answers. The interviewed respondents' socio-demographic characteristics are presented in Table 2. The majority of respondents were female with 79%. In terms of ethnic groups, the proportional breakdown was Malay with 75%, followed by Chinese (10%) and Indians and others at 15%. The percentage of respondents in semester 1 and 2 was 38%, semester 3 and 4 (33%) and semester 5 and 6 at 27%. The majority of respondents didn't use SOV at UUM currently, but 54% of them tend to use it soon.

Table 2: Socio-demographics characteristics of the respondents

Socio-demographics		Sample (%)
Gender	Male	21
Ethnic Group	Malay	75
	Chinese	10
	Indian and Others	15
Semester	1 and 2	38
	3 and 4	33
	5 and 6	27
	7 and above	2
Have an SOV in UUM	Yes	17
Intend to use SOV in UUM in the future	Yes	54

4.1 Welfare estimation and discussion

The estimation LCM employed in this study is:

$$V = \beta_1.\mathrm{WT1}+\beta_2.\mathrm{WT2} + \beta_3.\mathrm{R} + \beta_4.\mathrm{NT1} + \beta_5.\mathrm{NT2} + \beta_6.\mathrm{PL1} + \beta_7.\mathrm{PL2} + \beta_8\mathrm{Fee}$$

where all the variables are explained in Table 1.

The estimation of the LCM began by investigating the number of segments to be used in the model. For this purpose, we used the lowest information criteria values that were resulted from the LCM at different segments as recommended by [37]. The criteria were calculated based on a paper authored by [38]. The results in Table 3 show the information criteria value at different LCM segments. We found that the results were not consistent where the AIC criterion supports the four segments, while the BIC and Consistent AIC criteria support the two segments. Since the information criteria didn't conclusive, we sought an alternative approach. The one that is available in the literature is a paper by [24]. The authors suggested three criteria to determine the number of segments and one of them is parameter significance. We used this parameter significance approach and found that the number of significant parameters decreased when the number of segments was increased from two to four segments. Therefore, we used the two segments model for estimation.

Table 3: Comparison of Information Criteria Value in Different Segments

Number of Segments	1	2	3	4
Log-likelihood	-947.19906	-884.63956	-866.91724	-843.06947
No of coefficients	8	18	27	36
No of observation	1206	1206	1206	1206
AIC	1910.40	1805.28	1787.83	**1758.14**
BIC	1950.62	**1896.99**	1925.40	1941.56
Consistent AIC	1958.62	**1914.99**	1952.40	1977.56
Adjusted psuedo-R^2	0.13	0.33	0.34	0.36

The results in Table 4 show that all the coefficients are significant in segment one except the coefficient for route type (R). But for segment two, three coefficients are insignificant including route type. Such an insignificant coefficient explains that respondents in both segments do not prefer the variable, flexible route service. The largest coefficient in segment one is passenger load (at both levels) and followed with coefficients for attribute trip to a nearby town (NT) and lastly, the coefficients for Waiting Time (WT). For example, the coefficient 3.4616 for PL2 in the segment explains that respondents' utility will be increased by that value if all respondents are guaranteed to have a passenger seat when they are using the campus bus service. The adjusted pseudo-R^2 in the model was 33%.

By using a likelihood ratio (LR) test, the results show that the null hypothesis that the coefficients are jointly zero is rejected at the 1% significance level and 17 degrees of freedom, $\chi^2(0.01,17) = 33.41$. The LR statistics for the model was 884.64. The implicit price for each attribute is also shown in Table 4. It was calculated using the Wald procedure (Delta method) in Limdep 8.0 as shown in Equation 3 above. The values explain the amount of money that respondents are willing to pay

(WTP) if the campus bus attributes are improved from the baseline. For example, the WTP for attribute PL2 in segment 1 explains that respondents in the segment are willing to pay up to MYR1.80 for a one-day pass if the campus bus applies a policy that all passengers must be seated.

Table 4: Coefficients of Latent Class Model and Willingness to Pay for Attributes

Att.	Segment 1		Segment 2	
	Coeff.	**WTP**	**Coeff.**	**WTP**
WT1	0.96** (0.41)	0.50** (0.20)	0.21 (0.17)	0.10 (0.08)
WT2	1.25*** (0.38)	0.65*** (0.20)	0.50*** (0.17)	0.22** (0.09)
R1	-0.20 (0.13)	-0.10 (0.06)	0.24 (0.15)	0.13* (0.07)
NT1	1.50*** (0.40)	0.75*** (0.23)	0.77*** (0.18)	0.37*** (0.10)
NT2	1.48*** (0.40)	0.77*** (0.22)	0.61*** (0.18)	0.29*** (0.10)
PL1	2.78*** (0.48)	1.44*** (0.32)	0.42* (0.22)	0.20 (0.12)
PL2	3.46*** (0.55)	1.80*** (0.39)	0.22 (0.26)	0.10 (0.13)
Price	-1.92*** (0.49)		-2.10*** (0.50)	
Model Statistics				
Class Prob.	0.60*** (0.03)		0.40*** (0.07)	
R^2	0.33			
LL	-884.64			
Obs.	1206			

Note: ***significant at 1%, **significant at 5% and *significant at 10%; standard errors are in brackets

It is noteworthy to understand the respondents' socio-demographic characteristics for both segments. Table 5 shows the descriptive statistics for each segment. We assigned a respondent to the segment where the respondent has the highest probability of being located. Then we investigating respondents' socio-demographic characteristics by segment.

Based on Table 5, we can conclude that respondents in segment 1 are those who using SOV in UUM currently. They are also considered as senior students (semester 3 and above). If compared to respondents' characteristics in segment 2, most likely respondents in the segment would like to use their vehicles in the future. And the majority of them are new students.

Table 5: Descriptive Statistics for the Characteristics of Each Segment

Characteristics	Class 1 (%)	Class 2 (%)	Significant
Male	18.75	26.97	
Malay	71.43	79.78	
Use SOV in UUM currently (Yes)	21.43	12.36	*
Use SOV in the future (Yes)	34.44	55.7	***
Sem 1 and 2	0	86.52	***
Sem 3 and 4	58	13	***
Sem 5 and above	41.96	0	***

Note: ***significant at 1%, **significant at 5% and *significant at 10%;

By linking the implicit prices shown in Table 4 with respondents' characteristics for each segment (see Table 5), two important conclusions can be drawn regarding respondents' preferences. Firstly, respondents in segment 1 are willing to pay more for the campus bus attributes improvement compared to respondents in segment 2. The majority of them are in semester 3 and above. Perhaps their previous experiences using the service have advocated them to put a higher WTP value for better service soon. Studying in UUM in at least in two semesters, the respondents in the segment are hoping UUM to improve the service but to no avail. As a consequence, they use SOV.

Secondly, the results in segment 2 explain that the new students (i.e. semester 1 and 2) in UUM have focused on attribute trips to nearby towns. Being the new students, they need transport to go outside UUM. And taking into account its location where the service of the public bus is limited, such demand from the new students is expected. The significant WTP value for the attribute indicates that they are willing to pay an additional MYR0.40 if such improvement is made. Therefore, if the UUM management is serious in reducing the number of SOVs, they need to consider extending the campus bus service including trips to nearby towns.

5. Conclusion

The campus bus service is one of the facilities provided at university. Its availability has many benefits such as reducing carbon footprints in the campus area, reduce traffic congestions and accidents, and save space for parking lots. However, the cost of providing it is costly and in many circumstances, the university management has to sacrifice other activities for the service to be provided. Since the cost is huge and is increasing from year to year, the management has to investigate whether or not the students receive benefits from the service or not. This can be known if we solve questions such as:

a) are students satisfy with the current bus service?
b) if no, what attributes of the bus service that need to be improved to make them satisfied?
c) are they willing to pay for such improvements? and
d) how much are they willing to pay?

Such questions become the purpose of this study where we have investigated the analysis of students' preferences for attributes on the campus bus service. The two classes latent class model was used for investigating the preferences. Using a case study in UUM, the results in the models shown above indicate that the most preferred attribute for the service is passenger load, follow with a trip to nearby towns and lastly attribute waiting time. The range amount of money that they are willing to pay for a one-day pass is between MYR0.30 and MYR1.80.

When characterizing the socio-economic characteristics into segments in the latent class models, the results show that the majority of respondents in segment 1 are students in semester 3 and above, and they are using SOV in UUM currently. The characteristics in the segment also reveal that they are willing to pay more compared to their friends in segment 2. This information is useful for the university's manager to focus on attributes that need to be improved. In terms of a one-day bus pass price, the manager can use the estimated WTP values as a basis to determine the price.

This present study, however, has two limitations. One, it focuses only on the demand side of the campus bus service where the amount of money that students are willing to pay becomes the main objective to be achieved. Analysis on the supply side including the revenue and cost recovery of the service, however, was not addressed. Additional information on such analysis is important and useful in designing the bus fare policy so that the service is sustained in the future.

Two, this study has to ignore the income variable in the analysis because the majority of respondents were unable to state their parents' income. However, university management still can design a subsidy program that is based on income. For instance, students who have come from lower-income families can apply for a bus fare subsidy program, if any. These students can also be required to stay at the hostel that is near to the academic buildings. This may reduce students' dependency on the campus bus service for moving to academic buildings.

References

[1] C. C. Martha, M. L. Douglas and D. Janus, "Supply Chain Management: More Than a New Name for Logistics," *The International Journal of Logistic Management*, vol. 8, no. 1, pp. 1-14, 1997.

[2] R. Tolley, "Green campuses: cuttimg the environmntal costs of commutting," *Journal of Transport Geography*, vol. 4, no. 3, pp. 213-217, 1996.

[3] R. J. Schneider and L. Hu, "Bicycle and Bus Commuting to an Urban Campus: Overcoming the Barriers," in *Transportation Research Board 93rd Annual Meeting*, 2014.

[4] S. Huayan, L. Wenji and H. Haijun, "Empirical Study of Parking Problem on University Campus," *J Transpn Sys Eng & IT*, vol. 7, pp. 135-140, 2007.

[5] A. Aoun, M. Abou-Zeid, I. Kaysi and C. Myntti, "Reducing parking demand and traffic congestion at the American University of Beirut," *Transport Policy*, no. 25, pp. 52-60, 2013.

[6] K. Shaaban and I. Kim, "The influence of bus service satisfaction on university students' mode choice 50:.," *Journal of Advanced Transportation,*, vol. 50, pp. 935-948, 2016.

[7] T. Limanond, B. Tanissara and C. Chutima, "Travel behavior of university students who live on campus: A case studu of a rural university in Asia," *Transport Policy*, vol. 18, pp. 163-171, 2011.

[8] L. Rotaris and R. Danielis, "The impact of transportation demand management policies on commuting to college facilities: A case study at the University of Trieste, Italy," *Transportation Research Part A*, vol. 67, pp. 127-140, 2014.

[9] F. Charbatzadeh, C. M. Ojiako and A. Marshall, "Determinants of satisfaction with campus transportation services: Implications for service quality. 10: a203.," *Journal of Transport and Supply Chain Management*, vol. 10, p. a203, 2016.

[10] T. Shannon, B. Giles-Corti, T. Pikora, M. Bulsara, T. Shilton and F. Bull, "Active commuting in a university setting: Assessing commuting habits and potential for modal change," *Transport Policy*, vol. 13, p. 240–253, 2006.

[11] T. Field, M. Diego and C. Sanders, "Adolescent depression and risk," *Adolescence*, vol. 36, no. 143, p. 491–498, 2001.

[12] T. Field, M. Diego and C. Sanders, "Exercise is positively related to adolescents' relationships and academics," *Adolescence*, vol. 36, no. 141, p. 105–110, 2001.

[13] H. McClintock and J. Clearly, "Cycle facilities and cyclists' safety," *Transport Policy,* vol. 3, pp. 67-77, 1996.

[14] B. Gatersleben and K. Appleton, "Contemplating cycling to work; attitudes and perceptions in different stages of change," *Transportation Research Part A: Policy and Practice,* vol. 41, pp. 302-312, 2007.

[15] S. Kingham, J. Dickenson and J. Copsey, "Travelling to work: will people move out of their cars," *Transport Policy,* vol. 8, pp. 151-160, 2001.

[16] M. Meng, J. Zhang, Y. D. Wong and P. H. Au, "Effect of weather conditions and weather forecast on cycling travel behavior in Singapore," *International Journal of Sustainable Transportation,* vol. 10, no. 9, pp. 773-780, 2016.

[17] S. Weichenthal, R. Kulka, A. Dubeau, C. Martin, D. Wang and R. Dales, "Traffic-Related Air Pollution and Acute Changes in Heart Rate Variability and Respiratory Function in Urban Cyclists," *Environmental Health Perspective,* vol. 119, no. 10, p. 1373, 2011.

[18] J. Hough, G. Hegland, 2. J. Miller and D. Ulmer, "Small Urban University Transit: A Tri-Campus Case Study," Mountain-Plains Consortium, 2005.

[19] Transit Cooperative Research Program, "Transportation on College and University Campuses," Transportation Research Board National Research Council, Washington D.C., 2001.

[20] L. Eboli and G. Mazzulla, "A Stated Preference Experiment for Measuring Service Quality in Public Transport," *Transportation Planning and Technology,* vol. 31, no. 5, pp. 509-523, 2008.

[21] J. Shen, Y. Sakata and Y. Hashimoto, "Is individual environmental consciousness one of the determinants in transport mode choice?," *Applied Economics,* vol. 40, no. 10, pp. 1229-1239, 2008.

[22] M. Quddus, F. Rahman, F. Monsuur, J. de Ona and M. Enoch, "Analyzing bus passengers' satisfaction in dhaka using discrete choice models," *Journal of the Transportation Research Board,* vol. 2673, pp. 758-768, 2019.

[23] G. Garrod and K. G. Willis, Economic Valuation of the Environment: Methods and Case Studies, Cheltenham, UK; Northamton, MA, USA: Edward Elgar, 1999.

[24] E. Ruto, G. Garrod and R. Scarpa, "Valuing animal genetic resources: A choice modeling application to indigenous cattle in Kenya," *Agricultural Economics,* vol. 38, no. 1, pp. 89-98, 2008.

[25] J. Louviere and G. Woodworth, "Design and analysis of simulated consumer choice or allocation experiments: An approach based on aggregate data," *Journal of Marketing Research,* vol. 20, no. NOVEMBER, pp. 350-367, 1983.

[26] R. Blamey, J. Rolfe, J. Bennett and M. Morrison, "Valuing remnat vegetation in Central Queensland using choice modelling," *Australian Journal of Agricultural and Resource Economics,* vol. 44, no. 3, pp. 439-456, 2000.

[27] M. Morrison and J. W. Bennett, "Valuing New South Wales rivers for use in benefit transfer," *Australian Journal of Agricultural and Resource Economics,* vol. 48, no. 4, pp. 591-611, 2004.

[28] N. Hanley, S. Mourato and R. E. Wright, "Choice modelling approaches: A superior alternatives for environmental valuation?," *Journal of Economic Surveys,* vol. 15, no. 3, pp. 435-462, 2001.

[29] J. Bennett and V. Adamowicz, "Some Fundamentals of Environmental Choice Modelling," in *The Choice Modelling Approach to Environmental Valuation*, J. Bennett and R. Blamey, Eds., Cheltenham,UK; Northhampton,USA, Edward Elgar, 2001.

[30] P. Waerden, E. Couwenberg and G. Wets, "Travelers' preferences regarding the interior of public buses: a hierarchical information integration approach," *Public Transport,* vol. 10, p. 529–543, 2018.

[31] M. Nyarko, PhilOwusu-Ansah. and C. Kwofie, "Modeling commuter preferences for a bus," *European Scientific Journal,* vol. 11, p. 1857 – 7881, 2015.

[32] P. Bourgeat, " A revealed/stated preference approach to bus service configuration," *Transportation Research Procedia,* vol. 6, p. 411 – 423, 2015.

[33] P. C. Boxall and W. L. Adamowicz, "Understanding heterogenous preferences in random utility models: a latent class approach," *Environ. Res. Econ,* vol. 23, pp. 441-446, 2002.

[34] A. Krupnick and V. Adamowicz, "Supporting Questions in Stated Choice Studies," in *Valuing Environmental Amenities Using Stated Choice Studies: A Common Sense Approach to Theory and Practice*, The Netherlands, Springer, 2007.

[35] C. H. Bullock, "Valuing urban green space: Hypothetical alternatives and the status quo," *Journal of Environmental Planning and Management,* vol. 51, no. 1, pp. 15-35, 2008.

[36] D. Campbell, W. G. Hutchinson and R. Scarpa, "Incorporating discontinuous preferences into the analysis of discrete choice experiments," *Environmental and Resource Economics,* vol. 41, no. 3, pp. 401-417, 2008.

[37] B. Provencher, K. A. Baerenklau and R. C. Bishop, "A finite mixture logit model of recreational angling with serially correlated random utility.," *American Journal of Agricultural Economics*, vol. 84, no. 4, pp. 1066-1075, 2002.

[38] R. Scarpa and M. Thiene, "Destination choice models for rock climbing in the Norteastern Alps: A latent-class approach based on intensity of preferences.," *Land Economics*, vol. 81, no. 3, pp. 426-444, 2005.

[39] L. Rotaris and R. Danielis, "The impact of transportation demand management policies on commuting to college facilities: A case study at the University of Trieste, Italy," *Transportation Research Part A*, no. 67, pp. 127-140, 2014.

[40] S. Huayan, L. Wenji and H. Haijun, "Empirical Study of Parking Problem on University Campus," *J Transpn Sys Eng & IT*, vol. 7, no. 2, pp. 135-140, 2007.

[41] T. Limanond, B. Tanissara and C. Chutima, "Travel behavior of university students who live on campus: A case studu of a rural university in Asia," *Transport Policy*, vol. 18, pp. 163-171, 2011.

[42] E. M. Delmelle and E. C. Delmelle, "Exploring spatio-temporal commuting patterns in a university environment," *Transport Policy*, no. 21, pp. 1-9, 2012.