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Wiradnyana, I. G.N.P.; Suthanaya, P. A.; Wedagama, D. M.P.; Yana, A. A.G.A.; Dissanayake, D.

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Analysing the choice and pattern of needs of transportation mode for domestic tourists in Bali

I G N P Wiradnyana[1], P A Suthanaya[2], D M P Wedagama[3], A A G A Yana[4] and D Dissanayake[5].

[1]Doctor of Engineering Study Program, Faculty of Engineering, Udayana University
[2,3,4]Department of Civil Engineering, Faculty of Engineering, Udayana University
[5]School of Engineering, Newcastle University, Newcastle upon Tyne, UK

Abstract. Travel behaviour of domestic tourists concerning their choices of transportation mode has a significant role in managing traffic in the tourist destination. This study analyses the domestic tourists' choice and their pattern of needs of transportation mode in Bali as the case study. The developed models are based on utility maximisation of underlying preferences for each of the available modes of transport. Domestic tourists are randomly selected and interviewed using the questionnaire to record their daily trips. The study result indicates that income, number of visits and travel companions significantly influence the choice of transportation mode for domestic tourists. Meanwhile, income, number of visits, length of stays, trip purpose and main issues in selecting local transport mode significantly affect the pattern of needs of transportation mode for domestic tourists. For example, two accompanying persons will be three times more than that of seven persons or more to choose motorcycle and bus than a car. Domestic tourists who have visited Bali twice will be three times more than those who visited Bali once to use travel agents and rented vehicles than public and online transport and others. Further studies on short duration trips and sustainable mode of transport are suggested.

1. Introduction

Bali Province is one of the favorite tourist destinations for foreign and domestic tourists. Holiday trips in Bali do not only occur on weekends but also on weekdays and holidays. Tourist trips are considered to affect the transportation externalities in Bali including traffic delays and queues, traffic accidents and environmental problems in the Province of Bali [1].

Nationally, the number of domestic tourists travel in 2018 increased by 12.37% or equivalent to 303.4 million trips compared to these in the year 2017 which reached 270.82 million trips. This affects the spending side of domestic tourists in 2018 to 291,02 trillion rupiahs or increases by 17.89% compared to that in the year 2017 which is worth 253,45 trillion rupiahs [2].

The high contribution of holiday trips to traffic congestion and parking problems in tourist areas and the preparation of appropriate tourism infrastructure in the Province of Bali are the main motivations of this study which also be expected to reduce the negative impacts of tourism travel in Bali and maintain tourism sustainability in Bali. The number of domestic tourist arrivals in the last five years on average almost doubled compared to the number of international tourist arrivals [3], so the presence of domestic tourists has a very significant impact on tourism in Bali. This will ultimately require regulation of tourist transportation to and from tourist destinations in Bali, given that tourists have certainly needed transportation facilities and infrastructure.

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A past study of the potential demand for tourist trips in Bali concluded that the largest production and attraction of travel for tourist trips in Bali were from and to the SARBAGITA (Denpasar, Badung, Gianyar, and Tabanan) region [1]. This is because most of the tourism facilities such as five-star hotel accommodations, non-star hotels, guest houses, restaurants amounting to more than 70% are in this region, as well as tourist activities that are of most interest to tourists also in the same region. The existence of tourist objects on the island of Bali is scattered in various districts/cities, but the place to stay for tourists both in star hotels and non-dominant stars are in the area of the City of Denpasar (Sanur), Badung Regency (Kuta/Nusa Dua), Gianyar (Ubud) and Tabanan, which will result in the need for an arrangement for the distribution of trips and determining the choice of transportation mode.

Meanwhile, the decision-making process in choosing modes of transportation, tourist destinations and accommodation is very complex and requires an understanding of what influences tourist choices. Mode choice plays a significant role in transport planning and it is beneficial to policymakers [4]. This is important to planning for infrastructure, traffic management, and accessibility and environmental management.

This study aims to analyse the domestic tourists' choice and their pattern of needs of transportation mode in Bali Province as the case study area. A preference model with various attributes is constructed and verified with data collected from domestic tourists visiting Bali to identify the contributing factors on the choice of transportation mode.

An individual in selecting a mode of transport will maximise his/her utility which is known as utility maximization [5]. Random utility models contain two components. The first component is observed by the analyst which is called the deterministic part of the utility [4]. The second component is the disparity between the observed and unobserved utility of each individual [4]. Discrete choice models, which are based on maximising random utility [6], therefore, are used to investigate transport mode choice for this study.

2. Materials and methods

2.1. Variable Selection

This data collection for this study was conducted in several locations of favorite tourist attractions in Bali which are visited by many domestic tourists. The survey period for collecting data through questionnaires was carried out in December 2019 up to January 2020. Data collection was performed with surveying through the distribution and filling of questionnaires to domestic tourists which included individual and trips characteristics with the purpose and reason for choosing transportation modes. A sum of 325 domestic tourists consented to take part and finish the survey. Because of missing information, the viable respondents incorporated into the examination were 300 (92.3%) out of a total of 142 males and 158 females.

The predictor (independent variables) used for this study consist of transport mode choice related factors following the method from several past studies [7][8][9]10]. The predictors are classified into three groups consisting of criteria for transport mode choice, individual and holiday trip characteristics. Each group contains some variable classifications as shown in Table 1. For example, gender belongs to a group of individual characteristics consisting of males and females as the variable classifications. These variable classifications are used to identify the significant influencing factors on the response variables containing transport mode choice and the patterns of needs for transport mode choice. As well as the predictors, the variable classifications of the response variables can be seen in Table 1.

All predictors are categorical, but age which is a continuous variable. Dummy variables, to characterise categorical variables, are constructed according to the coding system in SPSS, software used for this study as shown in Table 1. Several variable classifications can be disregarded because of their small proportion. The magnitude (M) testing method for proportions was performed to verify whether a classification may be omitted. The following typical test M_0: $p_i = 0$ and M_a: $p_i \neq 0$, was utilised where p_i is the proportion of a variable classification.

Table 1. Variables used and selected for the study

Variables	X	N	P-value	95% Confidence level	
				Lower	Upper
Predictor variables					
X_1 Gender (individual characteristics)					
1. Male	142	300	0.473	0.417	0.530
2. Female	158	300	0.527	0.470	0.583
X_2 Age (individual characteristics-continuous data)					
X_3 Education (individual characteristics)					
1. Junior high school *	13	300	0.043	0.020	0.066
2. Senior high school	118	300	0.393	0.338	0.449
3. Vocational*	20	300	0.067	0.038	0.095
4. Undergraduate	132	300	0.440	0.384	0.496
5. Master degree*	0	300	0.000	0.000	0.000
X_4 Occupation (individual characteristics)					
1. Civil servant	13	300	0.043	0.020	0.066
2. Private	220	300	0.733	0.683	0.783
3. Officers (Policeman)	0	300	0.000	0.000	0.000
4. Others	66	300	0.220	0.173	0.267
X_5 Income (individual characteristics)					
1. < 10 million/month	173	300	0.577	0.521	0.633
2. 10-20 million/month	97	300	0.323	0.270	0.376
3. 20-30 million/month*	18	300	0,060	0.033	0.087
4. > 30 million/month*	11	300	0.037	0.015	0.058
X_6. Number of visits to Bali (trip characteristics)					
1. Once	105	300	0.350	0.296	0.404
2. Twice	77	300	0.257	0.207	0.306
3. Three times	55	300	0.183	0.140	0.227
4. Four times*	17	300	0.057	0.031	0.083
5. Five times*	11	300	0.057	0.031	0.083
6. Six times*	6	300	0.020	0.004	0.036
7. Seven times*	8	300	0.027	0.008	0.045
8. More than seven times*	21	300	0.070	0.041	0.099
X_7. Duration of stay in Bali (trip characteristics)					
1. One day*	2	300	0.007	-0.003	0.016
2. Two days*	31	300	0.103	0.069	0.138
3. Three days	70	300	0.233	0.185	0.281
4. Four days	73	300	0.243	0.195	0.292
5. Five days	51	300	0.170	0.127	0.213
6. Six days*	19	300	0.063	0.036	0.091
7. Seven days	37	300	0.123	0.086	0.161
8. More than seven days*	17	300	0.123	0.031	0.083
X_8. Favourite tourist destinations (trip characteristics)					
1. Denpasar	260	300	0.867	0.828	0.905
2. Sanur*	3	300	0.010	-0.001	0.021
3. Nusa Dua*	12	300	0.040	0.018	0.062
4. Kuta/Legian*	18	300	0.060	0.033	0.087
5. Jimbaran/Pecatu*	7	300	0.023	0.006	0.040
X_9. Holiday trip purpose (trip characteristics)					
1. Natural tourism	190	300	0.633	0.579	0.688
2. Cultural tourism	103	300	0.343	0.290	0.397
3. Artifical tourism*	6	300	0.020	0.004	0.036
X_{10} Travel companions (trip characteristics)					
1. One person*	9	300	0.030	0.011	0.049
2. Two persons	78	300	0.260	0.210	0.310
3. Three persons	50	300	0.167	0.124	0.209
4. Four persons	70	300	0.233	0.185	0.281
5. Five persons	35	300	0.117	0.080	0.153
6. Six persons*	12	300	0.040	0.018	0.062
7. Seven persons*	11	300	0.037	0.015	0.058
8. More than seven persons	35	300	0.117	0.080	0.153
X_{11} Criteria in mode choice (criteria for mode choice)					
1. Distance	40	300	0.133	0.095	0.172
2. Travel time	59	300	0.197	0.152	0.242
3. Cost	66	300	0.220	0.173	0.267
4. Comfort	87	300	0.290	0.239	0.341
5. Secure	35	300	0.117	0.080	0.153
Response variables					
Y_1. Mode choice					
1. Bus/Minibus	22	300	0.073	0.044	0.103
2. Car	211	300	0.703	0.652	0.755
3. Motorcycle	67	300	0.233	0.176	0.270
4. Bicycle*	0	300	0.000	0.000	0.000
5. Walking*	0	300	0.000	0.000	0.000
6. Others*	0	300	0.000	0.000	0.000

Y_2. Patterns of needs for mode choice					
1. Travel agent	29	300	0.097	0.063	0.130
2. Rental	233	300	0.743	0.694	0.793
3. Public transport*	9	300	0.030	0.011	0.049
4. Online Transport*	6	300	0.020	0.004	0.036
5. Others*	33	300	0.110	0.075	0.145

* Statistically insignificant at the 5% level; the 95% confidence limits include 0. where: X = number of classification (yes=1), N = sample size

Based on the test, there were three variable classifications of a bicycle, walking and others had a null-responses and were excluded from the mode choice model development stage. In the meantime, due to relatively small proportions of bus/minibus and motorcycle in comparison to a car, the variable classification of bus/minibus is merged with the motorcycle and the variable classification of the car is put as a reference variable for the mode choice model. Following the same procedure, there were three variable classifications of public and online transports and others were found insignificant at the 5% level and were merged and put as a reference variable for the transport patterns of needs for mode choice model.

Both of mode choice and patterns of needs for mode choice models are considered binominal. Binary logit or logistic regression modes are, therefore, used to contend with the binary nature of dependent variables of transport mode choice such as either riding bus & motorcycle or driving a car and the patterns of needs for transport mode choice such as either travel agent and rental or public & online transport and others.

2.2. Logistic Regression Model

Logistic regression is one of the discrete choice models used to estimate a binary dependent variable as a function of predictor variables. Logistic regression aims to identify the best fitting model that describes the relationship between a binary dependent variable and a set of independent or explanatory variables. The dependent variable is the probability (P) that the resulting outcome is equal to 1. Parameters obtained for the independent variables can be used to estimate odds ratios for each of the independent variables in the model [11]. The logit is the *LN* (to base *e*) of the odds, or likelihood ratio that the dependent variable is 1, such that

$$\text{Logit (P)} = LN\left(\frac{P_i}{1-P_i}\right) = B_o + B_i.X_i \quad (1)$$

where:

B_o : the model constant
B_i : the parameter estimates for the independent variables
X_i : set of independent variables (i = 1,2,.....,n)
P : probability ranges from 0 to 1
$\left(\frac{P_i}{1-P_i}\right)$: the natural logarithm ranges from negative infinity to positive infinity

The logistic regression model considers a continuous or discrete relationship between the binary choice of dependent and independent variables. The logistic regression curve is approximately linear in the middle range and logarithmic at extreme values. A simple transformation of equation (1) produces

$$\left(\frac{P_i}{1-P_i}\right) = \exp^{B_o+B_i.X_i} = \exp^{B_o}.\exp^{B_i.X_i} \quad (2)$$

When independent variables X increases by one unit, with all other factors remaining constant, the odds $[P_i/(1-P_i)]$ increases by a factor $\exp^{B_i}$. This factor is called the odds ratio (OR) and ranges from 0 to positive infinity. It indicates the relative amount by which the odds of the outcome increase (OR>1)

or decreases (OR<1) when the value of the corresponding independent variable increases by 1 unit. There is no true R^2 value in logistic regression, as there is in Ordinary Least Squares (OLS) regression. Alternatively, Pseudo R^2 can be a proxy of an R^2 including Cox & Snell Pseudo-R^2 and Nagelkerke Pseudo-R^2 [12].

$$\text{Cox \& Snell Pseudo-}R^2 = R^2 = 1 - \left[\frac{-2LL_{null}}{-2LL_k}\right]^{2/n} \quad (3)$$

The null model includes only the constant while the *k* model contains all explanatory variables in the model. Cox & Snell R^2 value cannot reach 1.0 so that Nagelkerke is used to revise it.

$$\text{Nagelkerke Pseudo-}R^2 = R^2 = \frac{1-\left[\frac{-2LL_{null}}{-2LL_k}\right]^{2/n}}{1-(-2LL_{null})^{2/n}} \quad (4)$$

2.3. Model Validation

The entry method of logistic regression in IBM SPSS version 23 is used to construct the model. The omnibus tests of both mode choice and the patterns of needs for mode choice model coefficients are examined to measure whether data fit the model as shown in Table 2. It shows the chi-square difference tests for the specified model relative to a null model which covers only an intercept and no independent variables. The specified model is significant ($p < 0.05$) so it is assumed that the independent variables enhance the predictive power of the null model.

Table 2. Omnibus tests of model coefficients

	Mode choice		Patterns of needs for the mode of choice	
	Chi-square	Sig.	Chi-square	Sig.
Step	93.572	0.000	69.835	0.000
Block	93.572	0.000	69.835	0.000
Model	93.572	0.000	69.835	0.000

Table 3. Goodness of fit (pseudo R^2)

	Pseudo R^2 Test		
Developed Model	-2 Log likelihood	Cox & Snell R^2	Nagelkerke R^2
Mode choice	271.236	0.268	0.381
Patterns of needs for mode choice	193.967	0.208	0.355

Table 4. Classification accuracy

Mode Choice			Predicted	Percentage Correct
	Observed	Bus & Motorcycle	Car	
Null Model	Bus & Motorcycle	0	89	0
	Car	0	211	100
			Overall Percentage	70.3
Full Model	Bus & Motorcycle	44	45	49.4
	Car	22	189	89.6
			Overall Percentage	77.7
Patterns of needs for mode choice			Predicted	Percentage Correct
	Observed	Travel agent & rental	Public & Online Transport & Others	
Null Model	Travel agent & rental	252	0	100.0
	Public & Online Transport & Others	48	0	0.0
			Overall Percentage	84.0
Full Model	Travel agent & rental	245	7	97.2
	Public & Online Transport & Others	34	14	29.2
			Overall Percentage	86.3

Table 3 contains the two pseudo R^2 measures that are Cox and Snell and Nagelkerke. It is usually better to assess Nagelkerke's measure as this divides Cox and Snell by the maximum to give a measure that does range between zero and one. In this example, the mode choice and the patterns of needs for mode choice models explain 38% and 36% respectively of the variance in the dependent variable. Meanwhile, Table 4 gives the overall percentage of cases that are correctly predicted by the full model. For mode choice and patterns of needs for mode choice models, the percentages have increased from 70.3 and 84.0 respectively for the null model to 77.7 and 86.3 for the full model.

3. Results and Discussion

The model results in Table 5 shows that the domestic tourists who have visited Bali twice and three times were less likely to ride bus/minibus and motorcycle than to drive a car. The odd that the domestic tourists who have visited Bali twice and three times will be riding bus/minibus and motorcycle were about 43% and 49% respectively lower than for driving a car. Thus, the probabilities of the domestic tourists who have visited Bali twice and three times were 23% and 25% respectively to ride bus/minibus and motorcycle. These indicate that trip frequency to Bali is the important determinant of domestic tourists' choice of transportation mode. In the sense that domestic tourists have already familiarise themselves with traffic and road infrastructure, tourist accommodation and destination while they are on holiday in Bali.

On the other hand, domestic tourists whose income is between 10 and 20 million per month, travel companions of two and more than seven persons were more likely to ride bus/minibus and motorcycle than to drive a car. The odd that the domestic tourists whose income is between 10 and 20 million per month, travel companions of two and more than seven persons will be riding bus/minibus and motorcycle were about 3.6 times, 12.9 times and 4.4 times respectively higher than for driving a car. Thus, the probabilities of the domestic tourists whose income is between 10 and 20 million per month, travel companions of two and more than seven persons were 78%, 93%, and 81% respectively to ride bus/minibus and motorcycle.

Table 5. Model results

Variables	Transportation mode choice			Patterns of needs for mode choice		
	B	Sig.	Exp(B)	B	Sig.	Exp(B)
Constant	-11.946	.047	.000	-9.559	.044	.000
Male	.106	.749	1.112	-.437	.305	.646
Age	.003	.840	1.003	.000	.980	1.000
Senior High School	-.099	.830	.905	.579	.286	1.784
Undergraduate	-.826	.078	.438	.328	.542	1.388
Private	1.527	.187	4.602	.044	.959	1.045
Others (of Occupation)	2.090	.080	8.087	-.016	.987	.984
< 10 million/month	1.082	.094	2.950	**-1.629**	**.041**	**.196**
10-20 million/month	**1.292**	**.048**	**3.641**	.540	.560	1.716
Once	-.522	.243	.594	**1.206**	**.025**	**3.341**
Twice	**-1.202**	**.017**	**.301**	**2.409**	**.000**	**11.125**
Three times	**-1.116**	**.035**	**.328**	1.141	.061	3.129
Three days	.789	.101	2.202	**-1.257**	**.043**	**.285**
Four days	.428	.386	1.534	-.171	.798	.842
Five days	-.011	.984	.989	-1.132	.087	.322
Seven days	.452	.454	1.571	-.357	.618	.700
Denpasar	.317	.550	1.373	**1.239**	**.025**	**3.452**
Natural tourism	1.407	.305	4.085	.577	.585	1.780
Cultural tourism	.637	.647	1.890	1.320	.228	3.742
Two persons	**2.554**	**.000**	**12.863**	-.184	.802	.832
Three persons	.661	.347	1.937	-.400	.606	.670
Four persons	1.290	.053	3.631	-.039	.959	.962
Five persons	-1.824	.131	.161	-.462	.624	.630
More than seven persons	**1.475**	**.037**	**4.373**	-.485	.568	.616
Distance	2.059	.094	7.842	.949	.269	2.584
Travel time	1.839	.131	6.289	**2.821**	**.004**	**16.789**
Cost	1.995	.099	7.352	.944	.245	2.570
Comfort	1.074	.370	2.927	1.329	.092	3.777
Secure	1.583	.200	4.872	1.485	.103	4.417

Note: Bold figures are significant at 95%.

These are consistent with a past study finding that tourists travelling with companions tend to ride a bus/minibus than a car [13]. Interestingly, a past study conducted by Ilahi, et.al (2017) [14] found that the value of travel time savings of cars is lower compared to the public transports of Trans SARBAGITA and the feeder. Besides, a past study carried out in the Middle East by Masoumi (2019) [15] found that personal preference for cars, comfort, and convenience compared to public transport prevents passengers from walking, biking, and using public transport. This study considers comfort, cost and security as the predictors, however, these do not appear to have a significant impact on the transport mode choice in Bali.

Meanwhile, the domestic tourists whose income are less than 10 million per month and duration of stay for three days were less likely to use travel agent and rentals than to ride public and online transport and others. The odd that the domestic tourists whose income are less than 10 million per month and duration of stay for three days will be using travel agent and rentals were about 24% and 40% respectively lower than for riding public and online transport and others. Thus, the probabilities of the domestic tourists whose income are less than 10 million per month and duration of stay for three days were 16% and 22% respectively to use travel agent and rentals.

On the other hand, domestic tourists who have visited Bali at once and twice, whose favourite destination is the capital city Denpasar and whose main criteria to choose the mode of transport is travel time were more likely to use travel agent and rentals than to ride public and online transport and others. The odd that the domestic tourists who have visited Bali at once and twice, whose favourite destination is the capital city Denpasar and whose main criteria to choose a mode of transport is travel time will be using travel agent and rentals were about 3.3 times, 11.1 times, 3.5 times and 16.8 times respectively higher than for riding public and online transport and others. Thus, the probabilities of the domestic tourists who have visited Bali at once and twice, whose favourite destination is the capital city Denpasar and whose main criteria to choose the mode of transport is travel time were 77%, 92%, 78%, and 94% respectively to use travel agent and rentals. These are consistent with a past study finding that one of the influencing factors the mode choice is the value of travel time. The study concluded that time value is the extra cost the passenger would like to pay to avoid increasing the travel time while using a typical mode of transport [4].

The relatively large constant in both models indicated that there will be some other factors, for instance, road infrastructure and traffic conditions related factors that may be impacted on mode choice and the patterns of needs for mode choice. Further study, therefore, is suggested to investigate the causality factors to prevent domestic tourists from the sustainable mode of transport including walking, biking, and riding public transport.

The travel behavior analysis of domestic tourists concerning the number of visits and transport mode choice will be beneficial to the local government. These results can be used as guidelines for local governments to manage tourist destinations, which include local traffic arrangements and accessibility by identifying the need for transportation infrastructure, facilities, services and reducing the impact of traffic jams (delay and queue of motor vehicles) especially in high and holiday seasons and air pollution mitigation. Furthermore, it can be sought by transferring travel demands to more integrated and environmentally friendly modes of transportation.

4. Conclusions

This study constructs binary logit models to analyse the domestic tourists' choice and their pattern of needs of transportation mode in Bali Province as the case study area. A total number of 300 domestic tourists in the SARBAGITA region were effectively employed as respondents. This study found that trip frequency, household income, and travel companions significantly appears as the determinant of transport mode choice for domestic tourists. Meanwhile, household income, stay periods, trip frequency, favourite tourists destination and travel time significantly exists as the determinant of the pattern of needs of transport mode choice for domestic tourists.

Further study is suggested to investigate the causality factors to prevent domestic tourists from the sustainable mode of transport including walking, biking, and riding public transport. Also, further

studies are recommended to incorporate clustering travel mode choice to capture the short duration trips as these may have different features against the long duration trips. Besides, segmenting domestic tourists is useful to be investigated using two broad segments of a package tour and independent types concerning the transport mode choice.

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