`Transportation Mode Choice Models for Domestic Tourists in Bali

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Abstract: The significant contribution of holiday trips to the problem of traffic congestion and parking in tourist destinations and the provision of adequate tourism infrastructure in Bali are the main motivations for this study. Data from 296 domestic tourists in Bali were effectively used to construct the model. Multinomial Logit (MNL) and Multinomial Probit (MNP) models were used in this analysis to evaluate the important factors that affect domestic tourists' decisions about their mode of transportation. Despite fundamental differences between MNL and MNP, these two models show similar results of significant variables that influence domestic tourist mode choices in Bali. Both models suggest that accommodations in well-known places are encouraged to offer more access to buses/vans to meet the travel needs of domestic tourists. The study suggests policy implications for local governments to promote the use of public transport by attracting passengers from seniors, group-sized domestic tourists, and the well-known accommodations

Keywords: Mode Choice, Multinomial Logit, Multinomial Probit, Tourism, Travel Behaviour,

1. STUDY BACKGROUND

Numerous tourist sites now experience traffic issues due to population development, particularly in urban areas, and the associated rise in demand for leisure and tourism activities (Qi, et.al, 2020). Travel to tourist locations has increased as a result of several causes, including an increase in trips made per person and an increase in foreign visitors, as the global tourism industry continues to expand quickly. The primary drivers behind this study, which aims to reduce the negative effects of tourism and sustain tourism in Bali, are the significant contribution of leisure travel to the issue of parking and traffic congestion at tourist locations. Research on travel behavior, however, during vacation stays is still underreported (Schmöcker, 2021). Little is known about how and why tourists move within destinations. It is also difficult to predict the total traffic volume due to tourist movements. This is because this part of the population is not considered in the transport demand model. As a result, municipalities and governments do not have the necessary empirical evidence to formulate strategies and must make decisions based on assumptions. (Bursa et al., 2022).

Meanwhile, domestic tourist arrivals in Bali nearly doubled on average in the five years before the pandemic compared to international tourist arrivals (Statistics of Bali Province, 2019; Hermawati, et.al., 2019; Wiradnyana, et.al., 2021). As a result, the number of domestic tourists

greatly affects Bali's tourism industry. There will eventually be a need for control of tourist transport to and from tourist areas in Bali because tourists undoubtedly demand transportation infrastructure and facilities. Given the significance of domestic tourism for the advancement of society, a deeper understanding of domestic tourists' travel behavior is necessary. A better understanding of the mechanisms of travel behavior to mitigate transport problems during holidays can lead to more effective transport policies (Wu, et.al., 2012).

Numerous studies on travel behavior have focused on tourism strategies when it comes to modes of transportation. Sociodemographic factors like age, income, gender, and education are significant determining factors, as are travel-related factors like length of stay, type of destination, and time of visit, as well as travel factors like distance, time, and cost (Trinh and Le., 2017); Hermawati, et al., 2019; Subbarao et al., 2020; Tang et al., 2020).

This study focuses on mode choice in the travel behavior of domestic tourists. Domestic tourism can be defined as tourism in which a resident of a country not only travels within the country itself but also travels outside the state or province of origin. Border crossings at points of entry are not included (Choo, 2015). This study, therefore, aims to investigate how domestic tourists choose their mode of transportation. In addition, this study looked at how sociodemographic elements, aspects of travel, and travel-related variables affect domestic tourists' decisions regarding their mode of transportation in Bali, Indonesia.

The model built generally assumes that tourists have their own preferred choices among the alternative they make. They face many restrictions from time to time. However, the majority of these models typically presumptively assume that the selection set is provided or derived following a set of rules based on the selections' actual meaning to the user. The set of all choices that the tourist is aware of individually is referred to as the mode choice set. This indicates that tourists consider a variety of factors, including contextual factors, alternative options, and the subjective value of activity trips (Al-Salih and Esztergár-Kiss, 2021).

Previous studies (Can, 2013; Siraj, et al., 2021) have discussed violations of the independently identically distributed (IID) assumption, and their application ignores the similarity between alternatives within the choice set, thus leading to the limited application of MNL. To partially overcome this limitation, the use of Nested MNL (NMNL) models had been proposed. The utility function's random elements in the NMNL model were correlated within each clustering. However, NMLM models cannot be used for panel data without situations with observed heterogeneity or random preference changes. These studies also demonstrated that the MNP model was capable of solving some of the aforementioned issues. According to this model, the utility function's random component has a multinomial normal distribution with a mean of 0 and covariance between alternatives. This assumption allows for more flexible error correlation patterns that do not require the specification of nested structures, making them more realistic. Also, with the advancement of information technology, there are several applications on the market to implement his MNP model. Although MNL has been widely used in modal selection, using the MNP analysis in this study helped overcome its drawbacks because it allows the IID properties to be relaxed. Therefore, this study uses both MNL and MNP to model domestic tourist choices in Bali.

2. MULTINOMIAL PROBIT AND MULTINOMIAL LOGIT MODELS

A utility function with two components can be used to describe the process by which a domestic tourist chooses their travel mode from a choice set (Can, 2013). The first element is the alternative's observed utility, which depends on both the mode's unique characteristics and the characteristics of the tourists. The utility-related effects of the unobserved attributes and

characteristics are represented by the second component, a seemingly random term. Suppose the options set have j modes (j = 1,..., m), and tourist i (i = 1,..., n) receives the following utility from mode j in the set:

$$U_{ij} = \beta X_{ij} + \gamma_j' Z_i + \varepsilon_{ij} \quad (1)$$

where,

U_{ij} : The utility of tourist i for travel mode j.
X_{ij} : The vector of observed attributes associated with travel mode j perceived by tourist i.
Z_i : The traits vector of tourist i.

The prime denotes transposition, and the coefficients of b and c_j are vectors of fixed parameters for the variables X_{ij} and Z_i, respectively. The last element, i_j, is an undefined term. The mode that offers the most utility will be chosen by tourists. The likelihood that tourist i will select mode m is the likelihood that mode m's utility outweighs the utility of every other mode in the set. Therefore,

$$p_{im} = P(U_{im} > U_{i1,} U_{im} > U_{i2,\ldots,} U_{im} > U_{ip}) \quad (2)$$

$$p_{im} = P\{(\varepsilon_{im} - \varepsilon_{ij}) > [\beta'(X_{ij} - X_{im}) + Z_i(\gamma_j' - \gamma_m')], j \neq m\} \quad (3)$$

Assuming that errors have a multivariate normal distribution with mean zero and a covariance matrix Σ where Σ is not only a diagonal matrix yields the MNP model (Can, 2013). Let $\varepsilon_{i1}^* = \varepsilon_{im} - \varepsilon_{ij}$, and $v_{i1}^* = \beta'(X_{ij} - X_{im}) + Z_i(\gamma_j' - \gamma_m')$ with $\forall j \neq m$, then the probability in MNP is determined as follows:

$$\text{P(mode=m} \mid \beta,\gamma,X, Z) = \int_{v_{i1}^*}^{\infty} \int_{v_{i2}^*}^{\infty} \ldots\ldots \int_{v_{ip}^*}^{\infty} f(\varepsilon_{i1}^*\, \varepsilon_{i2}^* \ldots\ldots \varepsilon_{ip}^*) \partial\varepsilon_{i1,}^* \partial\varepsilon_{i2,}^* \ldots\ldots \partial\varepsilon_{ip,}^*\, j \neq m \quad (4)$$

where f(.) is the probability density function of the multivariate normal distribution.

In the meantime, the Multinomial Logit (MNL) model is to estimate a function that determines outcome probabilities. The range of a domestic tourist's mode of travel is limited to zero and one. The reference category is typically the first, last, or value with the lowest or highest frequency. One mode category is selected as the reference category. Each category's probability is contrasted with the reference category's probability. The likelihood of the categories is as follows for categories where i = 2…..K (Al-Salih and Esztergár-Kiss, 2021):

$$\Pr(Y = i) = \frac{\exp(Z_i)}{1 + \sum_{h=2}^{K} \exp(Z_{hi})} \quad (5)$$

where $\alpha_i + \sum_{h=1}^{H} \beta_{ih} x_{ih} = Z_{i.}$ and for the reference category,

$$\Pr(Y = 1) = \frac{1}{1 + \sum_{h=2}^{K} \exp(Z_{hi})} \quad (6)$$

After rearranging equations (1) and (2), the MNL model can be written as follows:

$$\text{Ln}\left(\frac{P(Y = i)}{P(Y = 1)}\right) = \alpha_i + \sum_{h=1}^{H} \beta_{ih} x_{ih} = Z_i \quad (7)$$

where,

i : the number of categories
β_{ih}, X_{ih} : vectors of the estimated parameters and predictors respectively

$\frac{P(Y=i)}{P(Y=1)}$: the probability of each category with the first category as a reference.

The logit (log odds) was shown to be a linear function of the independent variables (X_s) in the equation above. The logit weights for variables can therefore be interpreted using equation (7) like that of linear regressions.

3. METHODS AND PRELIMINARY DATA ANALYSIS

The survey's results were correlated with the goal of the study thanks to the design of the questionnaire. However, the length of the survey and the respondents' answers' degree of accuracy were also taken into account. Face-to-face interviews with two phases were used as the method for gathering data. The questionnaire's content, effectiveness, and clarity were improved during the first phase, which was a pilot study. 40 tourists were given questionnaires during this stage. The questionnaire's final iteration was used in the following stage of the investigation after receiving feedback.

Table 1. Study variables

No	Variable	Description	Variable Category and its Proportion
1	Moda_choice	Mode of transport dominantly used in Bali	1. Bus/Van (7.33%) 2. Car (70.33%) 3. Motorcycle (22.33%)
2	Length_stay	Length of stay in Bali	1. 1 day (0.67%) 2. 2 days (10.33%) 3. 3 days (23.33%) 4. 4 days (24.33%) 5.5 days (17%) 6. 6 days (6.33%) 7. 7 days (12.33%) 8. > 7 days (5.67%)
3	Gender	Gender	1.Male (47.33%) 2. Female (52.67%)
4	Age	Age	Mean = 33 years old, Standard deviation = 11 years, Max age = 61 years old, Min age = 11 years old
5	Education	Education qualification of tourist	1. Junior high school (4%) 2. Senior high school (39.33%) 3. Vocational (6.67%) 4. Bachelor's degree (44%) 5. Master's degree (4.67%) 6. Doctoral degree (0.67%)
6	Income	Income of domestic tourists per month	1. < Rp. 10 million (57.67%) 2. Rp. 10-20 million (32.33%) 3. Rp. 20-30 million (6%) 4. > Rp. 30 million (3.67%)
7	Trip_freq	Trip frequency to Bali	1. One (34.67%) 2. Twice (25.67%) 3. 3 times (18.33%) 4. 4 times (5.67%) 5.5 times (3.67%) 6. 6 times (2%) 7. 7 times (2.67%) 8. > 7 times (7%)
8	Trip_prpose	Trip purpose visiting Bali	1. Holiday (63.33%) 2. Seminar/meeting (34.33%) 3. Business (2%) 4. Visiting friends (0.33%)
9	No_person	Number of people in the group travel/group size	1. 1 person (3%) 2. 2 persons (26%) 3. 3 persons (16.67%) 4. 4 persons (23.33%) 5.5 persons (11.67%) 6. 6 persons (4%) 7. 7 persons (3.67%) 8. > 7 persons (11.67%)
10	Reason_mode	Reason to choose a mode	1. Trip distance (13.33%) 2. Travel time (19.67%) 3. Cost (22%) 4. Comfort (29%) 5. Secure (11.67%) 6. Available (2.67%) 7. Others (1.67%)
11	Mode_operator	Type of operator	1. Travel agent (9.67%) 2. Rental (74.33%) 3. Public transport (3%) 4. Online transport (2%) 5. Others (11%)
12	Reason_accom	Reason to choose an accommodation	1. Location (prime/famous) (50%) 2. Facilities (23.67%) 3. Distance (4%) 4. Cost (16%) 5. Travel agent (16%) 6. Others (4%)
13	Tourism_act	Main (place) of activity during the trip to Bali	1. Beach (21%) 2. Nature (47.33%) 3. Eco-tourism (4.33%) 4. Adventure (1.33%) 5. Cultural heritage (18%) 6. Shopping & Culinary (5%) 7. City tour (2.67%) 8. MICE & event (0.33%)
14	Tourism_dest	Initiator to choose a tourist destination	1. The tourist (71.33%) 2. Friend (19%) 3. Travel agent (6.33%) 4. Others (3%)
15	Criteria_tourism	Criteria to choose a tourist destination	1. Distance (13.67%) 2. Travel time (17%) 3. Cost (12.67%) 4. Activity (2%) 5. Sightseeing (43%) 6. Local culture (10.67%) 6. Others (1%)

The central limit theorem states that by repeatedly sampling a population, regardless of the shape of the population distribution, as the sample size increases, the sampling distribution

of the mean of those samples will be approximately normal. In particular, the normalized sample mean approaches a standardized normal distribution as the sample size increases, regardless of the distribution of these variables within the population (Ancheta, et.al, 2023). Additionally, Z-scores are defined based on a standard normal distribution with a mean of 0 and a standard deviation of 1. According to these concepts, the target sample size is determined by specifying the degree of accuracy, the level of confidence or risk, and the degree of dispersion of attributes measured by the population proportion estimation method. Using the formula that defines the sampling error (Ancheta, et.al, 2023):

$$e = z\,x\,\sqrt{\frac{N-n}{N-1}}\,x\,\frac{q(1-q)}{n} \tag{8}$$

where

z : z-score ; n : target sample size
N : total population; q : degree of maximum variability

The target sample size is determined by sampling error, e = ±10%; z-score for 95% confidence level, z = 1.96; and degree of maximum variability, q = 0.50, while $(N - n)/(N - 1)$ is set to 1 because the actual population is much larger than the target sample size. Using the specified criteria, the resulting target sample size is n = 96. In addition, cross-validation of the results against published sample size tables using the same criteria of sampling error, confidence level, and variability yielded a sample size of n=100 for the population > 100,000 (Ancheta, et.al, 2023)

Direct interviews with domestic visitors to Bali led to the collection of individual records. Interviews were limited to individuals. For tourists going as a family or in a group, only one traveler was interviewed and only asked about the tourist's monthly income (not the travel group). From December 2019 to January 2020, samples of 300 domestic tourists were collected in famous tourist spots in Bali such as Kuta, Sanur, Nusa Dua, Jimbaran, and Denpasar. Tourists visiting these destinations were asked to complete survey questionnaires, keeping in mind the balance between gender and age groups. The tourist was informed of the subject and time of the interview. They were also informed that they could stop the interview at any time. Those who consented to the interview were recorded.

Given that it was assumed that all tourists would have to make the same decision, the dependent variable was the set of modal choices made by domestic tourists. It had three options and was coded as follows. 1. a bus or van; 2. a car; and 3. a motorcycle. Each traveler is only required to select one of the three transportation options under this model. The study contrasts the use of buses, vans, and motorcycles with the use of cars. Since the percentage of tourists using cars is the highest (70.33%) among the three modes of transportation, the car is chosen as the reference alternative. The car has the highest ratio and the most expensive mode, so it has a cost disadvantage.

As independent variables, the demographic profile of tourists such as length of stay, gender, age, education, monthly personal income, and trip characteristics such as trip frequency, trip purpose, group size, the reason to choose a mode, mode operator, the reason to choose accommodation, main (place) of activity, initiator and criteria to choose tourist destination. Age was represented as a continuous variable, while other variables were expressed with nominal variables. The age range of the tourists ranged from 11 to 61 years old, and the average age of the sample was approximately 33 years old. Of the 300 tourists, 142 (about 47.33%) were male and 158 (52%) were female. The monthly personal income of the sampled tourists is also shown in Table 1. Income varied widely among tourists with the highest and lowest proportion of income less than Rp. 10 million and more than Rp. 30 million respectively.

Table 1 provides descriptive statistics on tourist demographics and travel characteristics. Of the 300 cases collected, a block of 4 cases was rejected due to missing values, outliers, and other reasons. As a result, the number of use cases in this study is 296, giving a sample rate of 98.67%. Table 1 also shows each variable and its categories and the relationships between them. All these variables and their categories were used to construct the MNP and MNL modes. In this study, STATA 14.0 was used to perform both MNP and MNL regressions.

Demographics and travel patterns of tourists were validated using the 2018 Domestic Tourism Market Analysis Book (Cultural and Tourism Research Centre Udayana University, 2019). The book report explores the demographics and travel patterns of domestic tourists during high and low seasons at three major ports of entry and exit in Bali: Gilimanuk Port, Ngurah Rai Airport, and Padangbai Port. Published trends in domestic tourists` mode of transportation choice and type of work show similar trends to the results of a survey of 300 respondents in this study, shown in Table 1. In other words, the demographics and travel characteristics of domestic tourists identified from the results are consistent with the overall demographics and travel characteristics of domestic tourists**.**

4. MODEL DEVELOPMENT AND ANALYSIS

Multinomial Probit (MNP) and Multinomial Logit (MNL) models were used to estimate the coefficients used in the utility function and to identify the influence of different person and travel characteristics on mode choice. In other words, the estimation of MNL and MNP models as a suitable technique was used to study correlated decision-making (Masiero and Zoltan, 2013). Mode selection can be explained by demographics, but travel patterns are influenced by trip characteristics. Furthermore, by introducing activity participation and motivation into the model, the investigated variables concerning tourist behavior can be better understood.

The model estimations are statistically significant, and multi-collinearity is not present in the model as the standard errors of the regression coefficient have a value of less than 4 (Al-Salih and Esztergár-Kiss, 2021). The models are analyzed by discussing and focusing on independent variables related to dependent variables, which have a statistical significance of less than 5% based on the model results as shown in Table 2. Interestingly, despite fundamental differences between MNL and MNP, these two models show similar results of significant variables that influence domestic tourist mode choices in Bali. Consequently, model interpretation will only focus on these variables.

The MNP model of the estimated coefficients, the significant level, and the t-test of the variables are shown in Table 2. For domestic tourist mode choice, the Log likelihood of the MNP model is -150.505. Wald χ^2 value is significant (0.000) and the value is 82.79. From the analysis, the t-score of the age of the tourist (2.10), number of people in the group trip (2.92), and reasons to choose accommodation are positively related and statistically significant with riding a bus/van. This shows that elderly domestic tourists, group travelers, and tourists staying at popular locations prefer buses/vans over other means of transport. This is consistent with a previous study conducted in Japan (Wu, et.al., 2012), which found that domestic tourists are more likely to choose buses as they get older. In contrast, domestic tourists traveling with others in Japan were observed to be more likely to use a car. This is probably because it reduces overall travel costs or because it can provide a private space for communication (Wu, et. al., 2012). The number of travel companions, however, remains unclear.

Table 2. Model estimation results

Multinomial Probit (MNP)	Multinomial Logit (MNL)

Independent Variables	Parameter	Std. error	t score	Parameter	Std. error	t score	Exp. Parameter
Constant (Car)	-	-	-	0	--	--	
Constant (Bus/Van)	-3.125	1.787	-1.75	-5.683***	2.819	-2.02	
Constant (Motorcycle)	4.830***	1.191	4.05	5.952***	1.477	4.03	
Length_stay (Bus/Van)	-0.586***	0.203	-2.89	-0.895***	0.304	-2.94	0.409
Length_stay (Motorcycle)	0.079	0.090	0.88	0.087	0.111	0.78	
Gender (Bus/Van)	-0.034	0.438	-0.08	-0.039	0.619	-0.06	
Gender (Motorcycle)	-0.172	0.279	-0.62	-0.268	0.350	-0.77	
Age (Bus/Van)	0.039***	0.018	2.10	0.073***	0.028	2.56	1.076
Age (Motorcycle)	-0.039***	0.016	-2.43	-0.050***	0.020	-2.49	0.951
Education (Bus/Van)	-0.491***	0.242	-2.03	-0.589	0.350	-1.68	
Education (Motorcycle)	-0.329***	0.139	-2.36	-0.429***	0.175	-2.45	0.651
Income (Bus/Van)	0.658	0.381	1.73	1.068***	0.533	2.00	2.910
Income (Motorcycle)	-0.144	0.229	-0.63	-0.176	0.285	-0.62	
Trip_freq (Bus/Van)	0.122	0.122	1.00	0.131	0.183	0.72	
Trip_freq (Motorcycle)	0.063	0.073	0.86	0.079	0.093	0.86	
Trip_prpose (Bus/Van)	-1.031	0.543	-1.90	-1.477	0.802	-1.84	
Trip_prpose (Motorcycle)	-0.640***	0.271	-2.36	-0.712***	0.328	-2.17	0.491
No_person (Bus/Van)	0.365***	0.125	2.92	0.579***	0.184	3.15	1.784
No_person (Motorcycle)	-0.670***	0.123	-5.47	-0.835***	0.155	-5.39	0.434
Reason_mode (Bus/Van)	0.057	0.181	0.31	0.019	0.257	0.07	
Reason_mode (Motorcycle)	-0.190	0.111	-1.71	-0.239	0.139	-1.71	
Mode_operator (Bus/Van)	-0.536***	0.240	-2.23	-0.793***	0.389	-2.04	0.452
Mode_operator (Motorcycle)	-0.107	0.157	-0.68	-0.104	0.189	-0.55	
Reason_accom (Bus/Van)	0.621***	0.169	3.66	0.926***	0.266	3.48	2.524
Reason_accom (Motorcycle)	-0.048	0.101	-0.48	-0.071	0.127	-0.56	
Tourism_act (Bus/Van)	0.131	0.135	0.97	0.150	0.183	0.82	
Tourism_act (Motorcycle)	0.057	0.089	0.64	0.079	0.109	0.72	
Tourism_dest (Bus/Van)	0.016	0.177	0.09	0.034	0.227	0.15	
Tourism_dest (Motorcycle)	0.009	0.183	0.05	0.037	0.212	0.18	
Criteria_tourism (Bus/Van)	0.171	0.151	1.13	0.301	0.228	1.32	
Criteria_tourism (Motorcycle)	0.052	0.084	0.62	0.093	0.107	0.87	
Observations	296			Observations	296		
Log-likelihood	-150.505			Log-likelihood	-148.449		
Wald χ^2	82.79			LR χ^2	162.34		
Prob > χ^2	0.000			Prob > χ^2	0.00		
				Pseudo R^2	0.35		

Notes: 0 in Coef. column indicates a constant term set to zero; *** Significant at 95%; The reference category: car

Meanwhile, length of stay (-2.89) and mode operator (-2.23) are negatively related and statistically significant with bus/van. This implies that tourists who stay longer and rent a

vehicle do not prefer the bus for their travels as they can travel in a car or a motorcycle. Education is negatively related and significant to both bus (-2.03) and motorcycle (-2.36). A motorcycle is statistically significant and negatively related to age (-2.43), trip purpose, (-2.36), and the number of people in the group trip (-5.47).

The education qualification of tourists and income were respectively 34.9 less likely to influence domestic tourists on choosing a motorcycle than a car and 2.9 times more likely to affect domestic tourists on choosing a bus/van than a car. This suggests that domestic tourists with higher education levels are more likely to travel by car than on a motorcycle, and tourists with higher incomes are more likely to travel by bus/van than by car. This, however, indicates that the education qualification of domestic tourists does not necessarily influence them to choose either a bus or a motorcycle. In addition, senior tourists, tourists who mainly travel for holiday, and a group-sized of tourists, are less likely to choose motorcycles for their travels in Bali.

A previous study conducted in Kenya (Wang'ombe, et.al, 2022) explains that education is seen as a way to broaden an individual's horizons and stimulate curiosity. Education is an important indicator of status and preferences in society because people with the same level of education share the same tastes, interests, values, and perceptions. Education broadens horizons and raises awareness. This may explain why highly educated domestic tourists in Bali prefer to ride a car over a motorcycle, as it is safer to ride a car than a motorcycle.

On the one hand, high-income tourists are more likely to travel by bus/van than by car. This is in contrast to previous studies showing that higher-middle-income tourists are less likely to use public transport, are less sensitive to transportation costs, and are more likely to use a car to commute more (Harz and Sommer, 2022; Wang'ombe, et al., 2022). This can be explained by the fact that buses/vans in Bali are not necessarily cheaper than cars. Buses/vans in Bali can also be operated by a private company and the operating costs can be more expensive than renting a car. Future research, therefore, should distinguish between buses/vans operated by private companies and local governments.

Meanwhile, the MNL model of the estimated coefficients, the statistically significant level, and the t-test of the variables obtained from the analysis are also shown in Table 2. Model fit results of mode choice are acceptable. For domestic tourist mode choice, the Log likelihood of the MNL model is -148.449. The likelihood ratio χ^2 value is significant (0.000) and the value is 162.34. The pseudo-R^2 value for travel mode choice is 0.35. The value of Exp(Parameter) for the length of stay of domestic tourists (Length_stay) on choosing a bus/van was 0.409 which implies that the odds decreased by 51.7% (0.409 - 1.0 =-0.591). Hence, the length of stay was 59.1% less likely to influence domestic tourists to choose a bus/van than a car as a transport mode. This result shows that while staying for a longer period, domestic tourists travel more by car than by using a bus/van. This is in line with a past study that found the length of stay influences international tourists to decide trip chain and transportation mode in Bali (Hermawati et.al, 2019).

The odds for the age of tourists (Age) on choosing a bus/van and motorcycle increased by 7.6% (1.076-1.0) and decreased by 4.9% respectively. These indicate that age was 7.6% more likely to influence tourists to choose a bus/van and was 4.9% less likely to choose a motorcycle than a car. This confirms that the age of domestic tourists has a strong statistical influence on domestic tourists riding a bus/van than a car but less influence on riding a motorcycle than a car. This confirms that the increasing age of tourists has least preferred the motorcycle for traveling. As previously mentioned, this is consistent with a previous study conducted in Japan (Wu, et.al., 2012), which found that domestic tourists are more likely to choose buses as they get older. A past study conducted in China, however, demonstrated that tourists aged 26 to 44 prefer traveling by car to their travel destination (Tang et.al, 2020).

The number of people in the travel groups (No_person) was positively and negatively associated with transport mode choice for domestic tourists. They were 78.4% more likely and 56.6% less likely to influence domestic tourists to choose a bus/van and motorcycle than a car. A higher number of people within a group of tourists prefer riding a bus/van and using a car to a motorcycle.

In the meantime, some variables were found negatively connected to transport mode choice for domestic tourists. Main purpose visiting Bali (Trip_prpose) and main operators for local transport mode (Mode_operator) were 50.9% and 54.8% less likely to influence a domestic tourist to choose a motorcycle and bus/van than a car respectively. The main consideration for choosing types of accommodation (Reason_accom) however, was 2.52 times more likely to influence domestic tourists to choose a bus/van than a car. This confirms that car use is mainly affected by domestic tourists whose main travel purpose is vacations and seminars/conferences (professional motives).

Domestic tourists who rent motor vehicles also prefer cars to motorcycles. Interestingly, tourists who choose to stay in famous accommodations prefer to travel by bus/van rather than by car. This can be explained by the fact that preferences for individual transportation choices are more related to the short time at the destination (lower time budget) than to the business traveler's characteristics. Tourists with similar characteristics combining work and other types of motivation tend to exhibit different behaviors (Ramao and Bi, 2021).

As the MNL and MNP produce the same type of outcome, the marginal effects of the three positively significant factors on domestic tourists' choice of bus/van were determined using the log odds ratio for each group in the MNL model. Logarithmic odds are converted to probability numbers using the following formula :

$$P(\text{car})=\frac{1}{e^{bus}+e^{motorcycle}+1};P(\text{motorcycle})=\frac{e^{motorcycle}}{e^{bus}+e^{motorcycle}+1};P(\text{bus/van})=\frac{e^{bus/minibus}}{e^{bus}+e^{motorcycle}+1}$$

Where: $e^{(car)} = e^{(0)} = 1$.

On the assumption that a 1% change in the probability of senior domestic tourists while other variables remain constant, motorcycle = -0.050 * 0.01 = -0.0005 and bus/van = 0.073 * 0.01 = 0, 00073. The rate of change (probability) for each mode selection is P(car) = 33.33%, P(motorcycle) = 33.31%, and P(bus/van) = 33.36%. The probability of each mode selection based on the remaining variables is summarized in Table 3. The table shows that a 1% change in probability among senior domestic tourists, group-size tourists, and well-known accommodations affected mode choice between 33.09% and 33.55%

Table 3. Marginal effects in mode choice

No.		% Change in Mode choice		
		Bus/van	Car	Motorcycle
1.	Change in 1% probability of senior domestic tourists	33.36%	33.31%	33.33%
2.	Change in 1% probability of group-sized tourists	33.55%	33.09%	33.36%
3.	Change in 1% probability of well-known accommodations	33.55%	33.21%	33.24%

Considering these results, local authorities should take into account the positive and important factors promoting the use of buses/vans by domestic tourists to further promote the use of transport public. Public transportation that is supported by the government already travels through the SARBAGITA region of Bali along routes including Denpasar, Badung, Gianyar, and Tabanan. These buses are present to aid in local mobilization and tourist flow to and from well-known tourist destinations. This program aims to increase interest in utilizing public transportation among locals and visitors to reduce the use of private vehicles, which is expected to reduce traffic congestion, accidents, and air pollution in Bali. The findings of this study are consistent with previous studies on the role of bus services in public transport demand (Stylos,

et.al, 2022; Van-Huy, et.al, 2023). Previous studies have concluded that the ideal travel experience is based on the concept of enjoying relaxation, sightseeing, and possibly socializing. Therefore, redirecting daily bus trips towards tourism is a possible solution to increase the number of passengers per bus trip.

Both models show that older travelers, tourists traveling in groups, and tourists staying at popular locations prefer buses/vans over other means of transport. Hotels/properties in popular locations need to increase bus/van accessibility to accommodate customers' travel needs. Alternatively, local authorities can focus specifically on attracting elderly public transport passengers and domestic tourists in groups. Additionally, the results of this study can be used as a guide to study domestic tourist demand for public bus services and to identify the best routes to maximize passenger numbers.

Currently, two types of public bus transport serve Bali's National Tourism Strategic Area and urban/rural areas, but they are not yet integrated. Lack of public transport integration occurs not only in Bali but also elsewhere, such as in the Jakarta metropolitan area (Arif, et.al, 2023). The Bali provincial government, therefore, should consolidate the times between public bus routes to shorten the transfer time for passengers and reduce the overall travel time.

Bali's local government should integrate these public bus services into the same itinerary to avoid queues and ensure affordability and accessibility for residents and tourists. Moreover, the development of innovative and effective cooperation plans between key stakeholders (public and private) is required to achieve seamless transport solutions (Pazzini et al., 2022). Providing accurate real-time travel information on public buses, instead of pre-determined timetables, can reduce waiting times for passengers (Pazzini et al., 2022). New information and communication technologies have made the planning and use of public bus services easier and more flexible (Arif, et.al, 2023). To take into account all forms of coordination, an integrated fare system consisting of contract forms of different public transport operators is required, allowing different means of transportation, different means of transportation, and means of communication to be used with a single ticket. When implementing an integrated system, it is important to integrate infrastructure such as parking lots, stations, and stops.

5. CONCLUSIONS

This study provides a complete picture of travel choices for domestic travelers in Bali. Discrete choice random utility models offer significant advantages in modeling travel demand. In this study, models of both MNL and MNP were constructed. The application of the MNP analysis for this study helped overcome the limitations of MNL analysis as it allows the relaxation of IID properties. The purpose of this analysis was to examine the main factors that influence the modal choice of domestic travelers. A variable of the mode of transport dominantly used in Bali, therefore, is employed to accommodate sightseeing characteristics containing round trips of domestic tourist traffic and a high degree of freedom in choosing a mode of transport.

Despite the fundamental differences between MNL and MNP, these two models show similar results for the key variables that influence local tourist choice in Bali. Probability analysis shows a 1% change in probability among older domestic travelers, group-size tourists, and known accommodation-affected mode selection between 33.09% and 33.55%.

Both models suggest that age (older travelers), traveler group size, and famous/familiar accommodation are important factors explaining travelers' bus/van choices. The study also found that high-income local tourists prefer buses/vans over all other modes of transport. Buses and vans are not necessarily cheaper than other modes of transport in Bali. Buses/vans in Bali are sometimes operated by private companies and operating costs can be higher than renting a

car. Therefore, future studies should distinguish between buses/vans operated by private companies and local governments. In addition, the results of this study can be used as a guide to study domestic tourists' demand for public bus services and determine the best routes to maximize passenger numbers.

Local governments are encouraged to promote hotels/bungalows/accommodations in well-known/prestigious locations to provide access to more buses/vans to meet the travel needs of their customers. Local governments can increase access to public transportation to draw more elders, domestic tourist groups, and guests from well-known/famous lodging facilities.

REFERENCES

Ancheta, D.P., Tani, R., Uchida, K. (2023) The relationship of social vulnerability and travel behavior with COVID-19 in Metro Manila, Philippines. *Asian Transport Studies*, 9, 100093, 10pp.

Al-Salih, W.Q., Esztergár-Kiss, D. (2021) Linking mode choice with travel behavior by using logit model based on utility function. *Sustainability*, 13, 4332, 18pp.

Arif, A.A., Falyani, F.K., Sari, V., Anggraini, R.I. (2023) JakLingko: The Implementation of Integrated Transportation Approach in Jakarta Smart City. *Proceedings of the Business Innovation and Engineering Conference (BIEC 2022)*, 310-316.

Bursa, B., Mailer, M., Axhausen, K.W. (2022) Travel behavior on vacation: transport mode choice of tourists at destinations. *Transportation Research Part A*, 166, 234-261.

Can, V.V. (2013) Estimation of travel mode choice for domestic tourists to Nha Trang using the multinomial probit model. *Transportation Research Part A*, 49, 149-159.

Choo, H. (2016) Domestic tourism. In: Jafari, J., Xiao, H. (eds.), *Encyclopedia of Tourism*. Springer Cham, Switzerland.

Cultural and Tourism Research Centre Udayana University (2019) Domestic tourism market analysis book 2018. Bali Provincial Tourism Office, 6(1), 92pp.

Harz, J., Sommer, C. (2022) Mode choice of city tourists: Discrete choice modeling based on survey data from a major German city. *Transportation Research Interdisciplinary Perspectives*, 16, 100704.

Hermawati, P., Adisasmita, S.A.,, Ramli, M.I., Hamid, S. (2019) Choices models of trip chain and transportation mode for international tourists in tourism destination island. *International Journal of GEOMATE*, 16(55), 195-203.

Masiero, L., Zoltan, J. (2013) Tourists intra-destination visits and transport mode: a bivariate probit model. *Annals of Tourism Research*, 43, 529–546.

Pazzini, M., Lantieri, C., Vignali, V., Simone, A., Dondi, G., Luppino, G., Grasso, D. (2022) Comparison between different territorial policies to support intermodality of public transport. *Transportation Research Procedia*, 60, 68–75

Qi, C., Zhu, Z., Guo. X., Lu, R., Chen, J. (2020) Examining interrelationships between tourist travel mode and trip chain choices using the nested logit model. *Sustainability,* 12, 7535, 15pp.

Ramao, J., Bi, Y. (2021) Determinants of collective transport mode choice and its impacts on trip satisfaction in urban tourism. *Journal of Transport Geography*, 94, 103094, 9pp.

Schmöcker, J.D. (2021) Estimation of city tourism flows: challenges, new data and COVID. *Transport Reviews*, 41, 137–140.

Siraj, Md.S.B., Hasan, M., Ahmed, Md. T. (2021) Understanding the mode choice behavior for short distance and regular travel in a developing country, Paper presented at the Bangladesh Regional Science Association (BRSA) 3rd Annual Conference on Regional Science (ACRS 3). Dhaka, Bangladesh, October 21-23.

Statistics of Bali Province (2019) *Bali in Figures*. Bali Province Government, Denpasar.

Stylos, N., Bigné, E., Bellou, V. (2022) The affective impact of sightseeing bus tour experiences: using Affective Events Theory (AET) to examine length-of-stay and electronic word-of-mouth. *Tourism Recreation Research,* 17pp.

Subbarao, S.S.V., Swaroop, S.N.V., Shekhar, R.S. (2020) Interrelationships between mode choice and trip-chain choice decisions: a case of Mumbai metropolitan region. *Transportation Research Procedia*, 48, 3049-3061.

Tang, X., Wang, D., Sun, Y., Chen, M., Waygood, E.O.D. (2020) Choice behavior of tourism destination and travel mode: a case study of local residents in Hangzhou. *China Journal of Transport Geography*, 89, 102895, 7pp.

Trinh, T.A., Le, T.P.L. (2017) Mode choice for tourist: a case study in Vietnam. *Journal of the Eastern Asia Society for Transportation Studies*, 12, 724-737.

Van-Huy, V., Kikuchi, M., Kubota, H. (2023) Shaping a new level of bus service under a novel concept of bus interaction: a meta-review. *Journal of Transportation Technologies,* 13, 173-207.

Wang'ombe, L., Njoroge, J., Agufana, P. (2022) Analysis of demographic and travel characteristics of domestic tourists' visiting coast region, Kenya. *Journal of Hospitality and Tourism*, 2(1), 69-85.

Wiradnyana, I.G.N.P., Suthanaya, P.A., Wedagama, D.M.P., Yana, A.A.G.A, Dissanayake, D. (2020) Analysing the choice and pattern of needs of transportation mode for domestic tourists in Bali, Paper presented at the 3rd International Conference on Smart City Innovation., Denpasar, Indonesia, October 27-28.

Wu, L., Zhang, J., Fujiwara, A. (2012) Dynamic analysis of Japanese tourists' three stage choices tourism participation, destination choice, and travel mode choice. *Transportation Research Record: Journal of the Transportation Research Board,* 2322, 91–101.