A USER PERCEPTION MODEL CONCERNING SAFETY AND SECURITY OF PARATRANSIT SERVICES IN BANDUNG, INDONESIA

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Abstract

Safety and security in public transportation, Angkutan Kota or paratransit included, are among the commonly poor aspects in Indonesia. The objective of this research is to describe user perception of safety and security aspects in paratransit operation and to develop a model to predict and explain user choice in the future when there is an improvement. Users stated that the conditions of safety and security could be categorized as fair to dangerous. Realizing the condition, users still want to use paratransit because they have no other mode and paratransit can easily be found. The main reason for safety problems was the low degree of awareness of the driver in operating the car, while the main reason for security problems was the low degree of law enforcement and limited number of policemen (security officers). Users stated that the most responsible stakeholder in safety and security was the operator (driver and owner) and the police. Each aspect has two models using binomial logistic regression, namely a model with and without experience of accidents or criminal incidents. All models seem quite appropriate ones, as shown by their statistical measurement. Incorporating user experience improved the model fitness and improved the model in describing traveler characteristics.

Keywords: paratransit, safety, security, perception, model.

INTRODUCTION

Indonesia is a developing country with a GDP growth rate of 5% per year. This growth is followed by an increasing number of cars (5% per year) and motorcycles (73%) (Dephub, 2004). This growing number of cars, as well as the development in many sectors, is related to the growing number of road accidents. The total number of casualties as a result of road accidents in Indonesia over 2002 was estimated at 178,746 casualties based on records from the Ministry of Health. These consisted of 30,464 fatal casualties and 148,282 injured casualties (Dephub, 2004). Transport Research Laboratory (TRL) UK reported that the number of people killed in road crashes in 1999 was between 750,000 and 880,000 and that, perhaps surprisingly, approximately 85 percent of these deaths occurred in the developing and transitional countries of Africa, Asia, Latin America, and the Middle East. Estimates also suggest that between 23 and 34 million people are injured worldwide in road crashes (Jacobs and Aeron-Thomas, 2000).

The number of road accidents consists of many types of mode. An important mode in road transportation is public transportation such as buses, paratransit, or non-motorized vehicles.

Research into public transport safety undertaken by TRL has shown that public transport vehicles in African and Asian countries are frequently poorly maintained and often overloaded, whilst the drivers themselves receive inadequate training. Public transport in many African cities is provided not only by the conventional bus but also by paratransit vehicles such as mammy wagons (converted trucks) and Matatu (converted vans and the like). Such forms of public transport are poorly regulated and controlled with many operating illegally. These vehicles currently have a reputation of being particularly dangerous (Jacobs and Aeron-Thomas, 2000). The research result from TRL also reflects the reality about public transportation conditions in many Indonesian cities.

There are many aspects involved in measuring the quality of service of public transportation. The quality of service of public transportation is a reflection of its performance. A good example of public transportation measures can be found in Europe, which shows many aspects of quality, where safety and security is one of them (European Commission, 1998 in TRB, 2003). Safety and security measures evaluate the likelihood that passengers will be involved in an accident be it vehicular or otherwise (safety) or become the victim of a crime (security). They can also measure various aspects of workplace safety. In many instances, customer perceptions of safety and security are as important to understand as the actual conditions; a customer satisfaction survey can assist in uncovering these perceptions. Most safety and security measures can be calculated straight away and require little more than careful record keeping. Measures reflecting actual incidents should be reported more frequently (e.g. monthly), while indirect measures reflecting potential levels of safety and security, such as the ratio of transit police officers to transit vehicles, can be reported annually (TRB, 2003).

The provision of public transportation also faces a challenge to maintain the passenger and to attract the potential user. It is important to provide good service of public transportation, where safety and security are two of the important aspects. Valuable lessons learned from Western European and Canadian experience show that ensuring the safety of public transport riders and maintaining the perception that riding on transit is safe are of particular importance to transit operators in Western Europe and Canada (TRB, 2001). The hypothesis is that safe and secure public transportation will maintain current users and attract potential users. People’s choice of mode was influenced strongly by their perception of the mode. It will be useful to explore current users’ as well as potential users’ perception of public transportation services, which can be used to improve the services, forecast the future, and plan steps to improve matters.

This research aims to explore the user perception of the conditions of paratransit’s safety and security and develop a preference model for using paratransit in the future when there is an improvement. The perception of paratransit users in Bandung, Indonesia has been collected using questionnaires. This research is useful to explore the users’ perception of safety and security in paratransit, explore its impact on user choice in using paratransit, and forecast the users’ choice of paratransit.

SAFETY AND SECURITY IN PUBLIC TRANSPORTATION

There are at least three data sources in Indonesia concerning road accidents, namely the Police, the Ministry of Health (hospitals and the like), and Insurance companies. The impact of that situation creates a variety of data and causes difficulties in evaluation, analysis, and decision-making. An illustration of different numbers of recorded accidents by different institutions is shown in Figure 1. The Police of the Republic of Indonesia stated that number of accidents over the last 20 years has decreased by 69%, while the number of cars has increased by 225%. The reduced number of accidents has reduced the fatality rate to 4% (Dephub, 2004). This statement should be observed carefully by comparing it with other sources of data.

Another problem with road accidents is under-reporting of data, which creates under-estimation of victims and impacts. The predicted number of accidents in Indonesia is shown in Table 1. The formal record by the Police showed that the number of reported road accidents and deaths has decreased, while in reality there were many under-reported accidents. Recent research by TRL has highlighted the extent of under-reporting of road deaths in the developing world. However, it is also appreciated that the extent of under-reporting of serious and slight injuries from road crashes is even greater and that fatalities represent only the top of the injury pyramid (Jacobs and Aeron-Thomas, 2000).

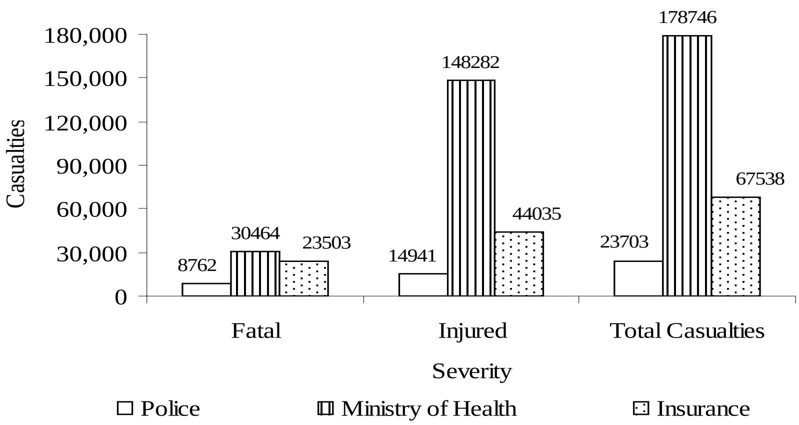

Figure 1 Number of Road Accident Casualties in Indonesia (Dephub, 2004)

Table 1 Profile of Predicted Number of Road Accidents in Indonesia (Dephub, 2004)

	Fatal *	Accident	Total Cases	Total Accident
Reported	8.762	14.944	23.703	12.267
Predicted	30.464	1.083.577	1.114.041	918.471

* The predicted number of fatalities was reported from a pamphlet by WHO/MOH World Health and the predicted number of accidents came from exploration by a hospital survey in Yogyakarta, Indonesia.

Roads accident involved many types of motorized cars, which were dominated by motorcycles (47%), passenger cars (24%), trucks (22%), and other cars (7%). The distribution of actors in road accidents by age was 0-15 years (4%), 16-21 years (26%), 22-30 years (42%), and 31-40 years old (28%) (Dephub, 2004). The distribution of the type of car involved in accident in Bandung is shown in Table 2, which also describes the number of public transportation. The cost of accidents involving public transportation in 2003 is shown in Table 3.

Table 2 Type of Car Involved in Accidents in Bandung, 2003 (Polwiltabes Bandung, 2003)

Area	Type of Car						
	Passenger Car		Freight Car		Bus		Motor-cycle
	Public	Private	Public	Private	Public	Private	
The Metropolitan Police of Bandung City	7	37	-	8	1	3	27
The Resort Police of West Bandung	15	44	2	6	-	-	29
The Resort Police of Central Bandung	2	19	3	-	-	-	4
The Resort Police of East Bandung	6	16	-	2	2	-	17

Table 3 Accidents Involving Public Transportation in Bandung (Polwiltabes Bandung, 2003)

Area	Number of Accident	Number of Victims			Cost (Rupiah)
		Death	Serious	Slight	
The Metropolitan Police of Bandung	47	-	3	2	79,550,000
The Resort Police of West Bandung	52	2	3	2	76,300,000
The Resort Police of Central Bandung	18	4	1	-	38,000,000
The Resort Police of East Bandung	31	9	5	4	18,650,000
					212,500,000

90% of road accidents were caused by human factors, so user awareness was the best way to reduce the risk (Dephub, 2004). The profession and education of the actors involved in accidents in Bandung in 2003 are shown in Table 4. The main actor causing safety problems in road activity is the driver (Salminen and Lahdeniemi, 2002). The driver of paratransit has been known as the main cause of traffic problems in many cities. Drivers tend to satisfy their motives in traffic as well as in other areas of life (Salminen and Lahdeniemi, 2002). This pushes them to drive faster and more hazardously. Both excitatory and inhibitory motives influence the decision making of a driver. The most hazardous excitatory motives are ‘extrinsic motives’, e.g. those outside of the traffic, such as saving time and effort, which prompt the driver to increase speed. The increased risk of an accident is related to the strength of these extrinsic motives (Näätänen and Summala, 1976). In the case of paratransit drivers, the motive to find as many passengers as possible makes them careless about safety. The working conditions of paratransit operators are very tough, because they have to collect a certain amount of money to pay a rental fee to the car owner. The car owner decides on the amount of the rental fee per day. The driver should find as many passengers as he can to cover this rental fee. After the rental fee has been subtracted from the total amount of money the driver has collected in one day, the rest of the money is the driver’s salary.

Table 4 Actors in Road Accidents in Bandung, 2003 (Polwiltabes Bandung, 2003)

Area	Profession					Education			
	Public officer	Army	Student	Driver	Others	Elementary	Junior	Senior	Univ.
The Metropolitan Police of Bandung	2	1	19	19	39	2	6	40	23
The Resort Police of West Bandung	2	1	10	12	27	-	15	26	7
The Resort Police of Central Bandung	1	1	4	1	7	-	3	12	4
The Resort Police of East Bandung	1	-	11	7	16	-	6	23	1

Drivers, especially public transportation ones, should realize the risk when driving their car. However, in reality car drivers adapt to the risks involved in driving to such a level that they do not generally feel any risk in a given traffic situation, or their subjective risk assessments approach zero. Drivers avoid the feeling of risk just as they avoid pain. This condition is known as the zero risk theory (Näätänen and Summala, 1976; Summala and Näätänen, 1988). The assumption is that there is a risk threshold above which the risk is experienced as aversive. A driver feels the risk of a collision as an emotional and immediate experience, which has been called ostensive risk (Summala, 1988). A risk factor is defined as any factors related to traffic that have been shown to increase the risk of traffic accident or is suspected to increase traffic accident risk. Several risk factors in traffic are saving time, fatigue, using a mobile telephone, and health problems (Salminen and Lahdeniemi, 2002).

DATA COLLECTION

This research has employed questionnaires to collect perception data from the user and driver of paratransit as well as the non-user, including civil servants. However, only the responses from the users are reported in this paper. The questionnaire was distributed directly to the respondents using the simple random sampling method. The data from the users was collected by on-board survey. Each questionnaire contained three sections, namely covering general, safety, and security aspects. The sample size was 85 respondents. The survey was distributed in the third week of February, 2005. General characteristics of the respondents are shown in Table 5.

Table 5 General Characteristics of the Respondents

Characteristics		Value
Mean Age		28.7
Range Age		11-56
Sex	Female	57.6%
	Male	42.4%
Marital Status	Single	54.9%
	Married	45.1%
Education	Elementary	4.7%
	Junior	11.8%
	Senior	42.4%
	Bachelor	36.5%
	Postgraduate	4.7%

The respondents making use of Angkutan Kota have the following occupations: students (33.7%), laborers (6%), private employees (32.5%), civil servants (9.6%), housewives (2.4%), and the rest was not or otherwise employed. 63.8% of the respondents did not own a private car in their family, while 35% owned a motorbike, 10% a bicycle, and 34.2% a passenger car. Car ownership in the family amounted to one (60%), two (18%), and more than two (22%). 89.4% of the respondents rode Angkutan Kota as their major mode. The mean of the number of trips made per day was 2.36 (SD = 1.593), while the mean of trip distance from departure to destination was 2.39 km (SD = 1.046 km). The primary purpose of trips made by Angkutan Kota was study (28.9%), work (42.2%), shopping (15.7%), social activity (4.8%), and others (8.4%). The main reason for using Angkutan Kota was not owning a private car (46.3%), cheapness (15.9%), easy availability everywhere (53.7%), comfort (1.2%), safety and security (3.7%), and others (2.4%).

The description of the users' experience of accidents and criminal incidents when riding paratransit is presented in Table 6. Users were asked whether they had experienced an accident or criminal incident. If the user had not, then he/she was asked whether he/she heard about any incident from others when riding paratransit. The table describes that criminal incidents reach a higher percentage compared to accidents. The highest percentage in terms of frequency of incidents was once, and the seriousness category of incident was fair.

One important aspect in safety and security problems was the financial scheme to cover the impact of incidents. The present practice was that the victim should cover the cost as an impact of accident/criminal incident, which many times turned out to be very expensive. In this research, the users were asked whether they know about the insurance, also the importance of insurance, and who should pay the insurance premium. The data is described in Table 7. The user generally knows about the insurance and realizes that the insurance was important. However, the user did not agree to pay the insurance premium.

Table 6 Users' Experience of Safety and Security on Angkutan Kota

		Concerning Safety		Concerning Security	
		Own exp.	Other exp.	Own exp.	Other exp.
Have you experienced any involvement in the accident/incident?	Yes	10.7%		63.5%	
	No	89.3%		36.5%	
Have you heard about any accident or criminal incident from others?	Yes		36.5%		57.7%
	No		63.5%		42.3%
Number of accident	Once	44.4%	80.8%	63.6%	68.8%
	2-3	44.4%	19.2%	27.3%	31.3%
	More than 3	11.2%	0%	9.1%	0%
Serious-ness	Very Light	22.2%	8%	4.5%	9.1%
	Light	44.4%	28%	18.2%	33.3%
	Fair	22.2%	16%	40.9%	21.2%
	Serious	0	16%	18.2%	30.3%
	Very Serious	11.2%	32%	18.2%	6.1%
Type of incident		Car collision; Car grazing; Car break down; Car sliding; Falling when the car is moving		Pickpocket; Robbery; Forcing by passenger recruiter; Inflicting pain; Misunderstanding	

Table 7 User Perceptions of Insurance

Aspects		Percentage
Do you know that there is safety insurance?	No	31.8
	Yes	68.2
Do you think that safety and security insurance is important for passengers?	No	10.7
	Yes	89.3
Do you think that the passenger should pay for safety and security insurance?	No	53.6
	Yes	46.4

The user's perceptions of safety and security are described in Table 8. The user was asked about the quality of safety or security conditions in the operation of paratransit. The users stated that the condition of safety and security can be categorized as fair tending to dangerous. Users also stated that they still use paratransit because they have no private car in their family and paratransit was easily found everywhere. The main reason for safety problems was the low degree of awareness of the driver operating the car, while the main reason for security problems was the low degree of law enforcement and the limited number of policemen (security officers). The users stated that the party to be held most responsible for safety and security was the operator (driver and owner), followed by police.

LOGISTIC REGRESSION ANALYSIS

The analysis was conducted by building a model using the logistic regression model. The logistic model is also known as the logit model. One use of logit models is to classify observations. The main competitor in the field of using logit for classification is discriminant analysis (Kennedy, 2003). The logistic regression model overcomes the major disadvantages of the linear regression model for dichotomous dependent variables. Like linear regression, the logistic model relates one or more predictor variables to a dependent variable, and the logistic model yields regression coefficients, predicted values, and residuals. Moreover, the predictors in a logistic model can be continuous or non-continuous. In logistic regression, the relationship between the predictor and the predicted values is assumed to be nonlinear. The logistic curve is S shaped or sigmoidal. The curve never falls below 0 or reaches above 1. Thus, the predicted values obtained using the logistic model can always be interpreted as probabilities (Wright, 1995).

Table 8 User's Perceptions of Safety & Security

	Aspects	Concerning Safety	Concerning Security
How bad is it?	1. Very Safe/Secure	7.6%	8.9%
	2. Safe/Secure	7.6%	5.1%
	3. Fair	58.2%	54.4%
	4. Dangerous	17.7%	22.8%
	5. Very Dangerous	8.9%	8.9%
	Mean (SD)	3.13 (0.952)	3.18(0.984)
What is the reason for still riding it?	Not owning a private car	58.7%	48.1%
	Cheap	24.7%	23.5%
	Available everywhere	44.2%	45%
Why did it happen?	Low education of the driver	27.4%	-
	Low awareness of the driver	72.6%	-
	Low awareness of the passenger	11.9%	-
	Low quality of the car	31.7%	16.3%
	Low law enforcement	20.2%	55%
	Limited number of police	-	35%
	Limited number of communication devices	-	15.2%
	Others	6%	11.3%
Who is the most responsible party?	Driver and owner	75.9%	64.6%
	Police	14.5%	40.2%
	Bureau of Traffic and Road Transport	19.3%	23.2%
	Local government	7.2%	8.5%
	Passenger	1.2%	11%

The procedure that calculates the logistic coefficient compares the probability of an event occurring with the probability of its not occurring. This odds ratio can be expressed as (Hair et al., 1998)

$$\frac{\text{Prob}_{(\text{event})}}{\text{Prob}_{(\text{no event})}} = e^{B_0 + B_1 X_1 + \ldots + B_n X_n} \tag{1}$$

The estimated coefficients (B0, B1, B2, . . . Bn) are actually measures of the changes in the ratio of the probabilities, termed the odds ratio. Moreover, they are expressed in logarithms, so they need to be transformed back (the antilog of the value has to be taken) so that their relative effect on the probabilities is assessed more easily. Use of this procedure does not change in any manner the way we interpret the sign of the coefficient. A positive coefficient increases the probability, whereas a negative value decreases the predicted probability.

The overall measure of how well the model fits, similar to the residual or error sums of squares value for multiple regression is given by the likelihood value. A well-fitting model will have a small value for -2LL. The chi-square test for the reduction in the log likelihood value provides one measure of improvement due to the introduction of the independent variable(s). In addition to the statistical chi-square tests, several different "R2-like" measures have been developed to represent the overall model fit (Hair et al., 1998). In logistic regression, there is no true R2 value as there is in OLS regression. However, because deviance is analogous to MSres (or MSE) in regression analysis, one can approximate an R2 based on lack of fit indicated by the deviance (-2LL). Where the null model is the logistic model with just the constant and the k model contains all the predictors in the model (Newsom, 2004).

$$R^2_{\text{logistic}} = 1 - \frac{-2LL_{null} - 2LL_k}{-2LL_{null}} = 1 - \frac{G}{-2LL_k} \quad (2)$$

The R2 of this model is explained by two types of R2, namely Cox and Snell R2 and Nagelkerke R2. Because Cox and Snell R2 value cannot reach 1.0, Nagelkerke modified it. The correction increases the Cox and Snell version to make 1.0 a possible value for R2 (Newsom, 2004).

To analyze and predict the users' preference for using more paratransit in the future, a model was built using binomial logistic regression. The models were built to explain the important variable in predicting user preference. Two aspects were incorporated in the model, namely safety and security experience. Table 9 shows the model that indicates whether the user will use more paratransit in the future, if there was an improvement of the safety aspect. Table 9 contains two models, namely a model that included and one that did not include experience of accidents when using paratransit. Both models seem quite proper ones, as shown by their statistical measurement. It can also be seen from the statistical measurement of the model that there is an improvement after incorporating the experience of the user. Incorporating user experience of accidents improved the goodness of the model in predicting future use of paratransit when there is an improvement in the safety aspect. The positive sign of the variable in the model means an increase in the probability of the user to ride more paratransit. The model explains that females proved more willing to use more paratransit, as did younger users. People who have not married yet show more willingness to use more paratransit. People with an educational background other than senior high school tend to use more paratransit if there is an improvement in the safety aspect. Current users who accepted the paratransit as their main mode tend to continue using paratransit. More frequent users at present show higher probability to use more paratransit. The model also shows that a trip distance between 2 and 5 km was the most appropriate one for using paratransit. The model explains that users who traveled by paratransit to reach the workplace tend to use more paratransit when there is an improvement in safety aspects. The important reason for using paratransit was that paratransit was available everywhere. Users who had experienced an accident tend to decline using more paratransit even though there had been some improvement.

Table 9 Models with and without Incorporating Experience of Accident

Variables	Not including experience		Including experience	
	B	Sig.	B	Sig.
Constant	-2.760	.196	-2.823	.192
Sex (1 if male, 0 otherwise)	-1.839	.027	-1.876	.024
Age	-.033	.646	-.034	.640
Marital status (1 if married, 0 otherwise)	-.852	.548	-1.081	.470
Education (1 if senior high school, 0 otherwise)	-.689	.388	-.682	.395
Primary mode (1 if paratransit, 0 otherwise)	2.500	.056	2.470	.061
Trip Number	1.755	.009	1.876	.010
Distance (1 if between 2-5 km, 0 otherwise)	2.472	.062	2.504	.061
Trip purpose (1 if working, 0 otherwise)	.366	.721	.597	.592
Reason for using paratransit (1 if available everywhere, 0 otherwise)	2.040	.040	2.035	.043
Experience an accident (1 if yes, 0 otherwise)			-.989	.523
Significance of χ^2		.002		.004
-2LL		47.175		46.797
Cox&Snell R^2		.260		.263
Nagelkerke R^2		.451		.457
Percentage Correct		85.9		87.1

Table 10 shows the model whether the user will use more paratransit in the future, if there was an improvement in the security aspect. Table 10 contains two models, namely the model that included and the one that did not include experience of a criminal incident when using paratransit. Both models seem quite proper ones, as shown by their statistical measurement. It can also be seen from the statistical measurement of the model that there is an improvement after incorporating experience of the user. Incorporating the user’s experience of accidents improved the propriety of the model in predicting future use of paratransit when there is an improvement in the security aspect. The model explains that females were more willing to use more paratransit, as were younger users. Married people show more willingness to use more paratransit when there is an improvement in security. The result of marital status was different when compared to the model for safety problems. People with an educational background other than senior high school tend to use more paratransit if there is an improvement in the security aspect. Current users who accepted the paratransit as their main mode tend to continue using paratransit. More frequent users at present show higher probability of using more paratransit. The model also shows that a trip distance between 2 and 5 km was the most appropriate one to use paratransit. The model explains that users who traveled by paratransit to reach another place than their work place tend to use more paratransit when there is an improvement in security aspects. An important reason for using paratransit was that it was available everywhere. Users who have not experienced any criminal incident tend to use more paratransit when there is an improvement.

Table 10 Models with and without Incorporating Experience of Criminal Incidents

Variables	Not including experience		Including experience	
	B	Sig.	B	Sig.
Constant	-3.881	.101	-3.763	.118
Sex (1 if male, 0 otherwise)	-2.116	.011	-2.208	.010
Age	-.034	.647	-.042	.574
Marital status (1 if married, 0 otherwise)	1.482	.300	1.573	.278
Education (1 if senior high school, 0 otherwise)	-1.235	.145	-.885	.355
Primary mode (1 if paratransit, 0 otherwise)	3.510	.010	3.725	.009
Trip Number	1.973	.005	2.017	.005
Distance (1 if between 2-5 km, 0 otherwise)	1.091	.262	1.173	.241
Trip purpose (1 if working, 0 otherwise)	-1.319	.197	-1.429	.170
Reason for using paratransit (1 if available everywhere, 0 otherwise)	2.813	.010	3.011	.010
Experience an incident (1 if once, 0 otherwise)			-.743	.443
Significance of χ^2		.001		.001
-2LL		47.285		46.675
Cox&Snell R^2		.287		.292
Nagelkerke R^2		.486		.494
Percentage Correct		85.9		87.1

CONCLUSION

Based on the analysis conducted in this research, the following conclusions can be drawn:

1) In the discussion about safety and security problems, it should be kept in mind that the variety of data has been derived from different sources of data. It creates a different image of the same facts. Another problem is the under-reporting of data, in which case many accidents and criminal incidents were not reported.
2) This paper has described user perception of safety and security in the operation of paratransit. Users' perceptions described the seriousness of the safety and security conditions. Users stated that the conditions of safety and security could be categorized as fair to dangerous. Users also stated that they would still use paratransit because they have no private car in their family and paratransit can easily be found. The main reason for safety problems was the low degree of awareness of the driver in operating the car, while the main reason for security problems was the low degree of law enforcement and the limited number of policemen (security officers). Users stated that the party to be held most responsible for safety and security was the operator (driver and owner), followed by the police.
3) The model using binomial logistic regression has been built to show whether the user will use more paratransit in the future, if there was an improvement in safety or security aspects. Each aspect has two models, namely a model with and without experience of accidents or criminal incidents when making use of paratransit. All models seem quite proper ones, as shown by their statistical measurement, and there is an improvement after incorporating experience of the user. Incorporating the user's experience of accidents or criminal incidents improved the fitness of the model in predicting future use of paratransit when there is an improvement. Also, incorporating the users' experience improves the model in describing the characteristics of travelers.

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