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# *The impact of the age of the driver of freight transport on the probability of being involved in a traffic accident (case study on the Krian – Taman Sidoarjo Road)*

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**Abstract**. A traffic accident is one of the traffic problems that cause deaths, injuries, and material loss. The high number of traffic accidents indicates the low level of road traffic safety. Krian – Taman Sidoarjo road has become one of the black site areas. According to data from the Sidoarjo Resort Police, there have been 66 traffic accidents from 2015 to 2020. The majority of accidents involve freight transport compared to passenger transport. Therefore, it is necessary to research the factors of freight transport drivers that affect the possibility of traffic accidents on the Krian – Taman Sidoarjo road. Methods of data collection using questionnaires to drivers of freight transportation. While the analytical method used is descriptive analysis and logistic regression using data from questionnaires. The research shows that the older the driver, the higher the probability of being involved in a traffic accident.

Keywords: freight transport, age, probability of traffic accident

## 1. Introduction

Traffic accidents have become a global issue, where almost 1,35 million people die yearly, and 50 million people are seriously injured [1]. Most victims who died from traffic accidents were in their teens and productive ages, that is, the age of 5 – 29 years [1]. Of the number of victims of traffic accidents, 90% occur in developing countries, including Indonesia. Traffic accidents are the third biggest killer in Indonesia after coronary heart disease and tuberculosis (TBC) [2]. According to data from the Indonesian National Police in 2017, an average of 3 people die every hour due to traffic accidents in Indonesia. The data also states that a large number of accidents is caused by several factors, including 61% by the human factor (related to the ability and character of the driver), 9% by vehicle factors (related to meeting technical requirements and roadworthiness) and 30% by infrastructure factors and environment [3]. The human factor is the most dominant cause of traffic accidents. One of the causes that often occur is traffic violations, such as: violating road signs and markings, speeding, overloading and over-dimension, and so on.

Traffic accidents are events that are difficult to predict when and where they will occur. Accidents do not only result in trauma, injury, or disability but also death [4]. The impacts caused by traffic accidents include deaths and injuries, material losses [5], and traffic jams. In addition, traffic jams can cause a loss of time value and waste fuel and the environment on the road [6].

Efforts made by the Government to reduce the number of traffic accidents in Indonesia by launching the Decade of Action for Road Safety 2011 – 2020 and the National General Plan for Road Safety 2011 – 2035. This program is the result of joint work between relevant agencies (Ministry of Transportation, Ministry of Public Works, Indonesian National Police, Ministry of Health, Ministry of National Education, Ministry of Home Affairs, Ministry of Industry, Ministry of Finance, and National Planning and Development Agency). The National General Plan for Road Safety is structured as government responsibility to ensure road traffic safety [7-8].

Sidoarjo regency is one of the regencies located in East Java Province, which is directly connected to Surabaya city, Gresik regency, Pasuruan regency, and Mojokerto regency. Sidoarjo is one of the main supports for Surabaya city and is included in the Gerbangkertosusila area. Based on the Sidoarjo Resort Police, in 2019, the fatality of the victim dying was 219 people [9]. One of the recent traffic accidents is on the Krian – Taman Sidoarjo road, a national road connecting Mojokerto regency and Surabaya City, East Java. Traffic conditions on this road are quite congested, dominated by motorbikes and freight transport. This road is a route for trucks to transport goods from Krian to Surabaya and its surroundings because the land use around Krian and Trosobo is an industrial and warehousing area.

Based on data from the Sidoarjo Resort Police, from 2015 to 2020, there were 66 traffic accidents on the Krian – Taman road, which resulted in 33 deaths, 19 serious injuries, and 30 minor injuries. Of the 66 accidents involving freight transport, about 68 vehicles and passenger transport, 28 vehicles [10]. The high number of traffic accidents on the Krian – Taman road has resulted in this road being known as “The Black Site Area”.

The main problem in this study is that freight transport contributes more to traffic accidents than passenger transport. So it is necessary to improve the factors that cause it [11]. The human factor plays an important role in reducing the number of traffic accidents on the road. Therefore, this research’s object is the driver of freight transport. The study aims to identify the causative factors and to know the model and the probability of traffic accidents on the Krian – Taman Sidoarjo road.

## 2. Material and Methods

This section includes procedures, procedures, or work stages used to obtain research purposes. This section aims to make research run more smoothly, systematically, and credibly.

### *2.1. Time and Location*

This research is conducted in the Service Unit of Motor Vehicle Weighing Trosobo Sidoarjo. The basis of consideration is that every freight transport crossing Krian – Taman Sidoarjo road must carry out inspections and weigh vehicles according to applicable regulations. Research implementation time for several days (weekdays) during operating hours.

### *2.2. Data Collection Stage*

This stage aims to obtain the information needed to achieve the research purposes. Techniques used to collect data in this study include interviews, questionnaires, and documentation.

*2.2.1. Primary Data.* This data is obtained from interviews or direct questions and answers to respondents and filling out questionnaires through Google forms. Respondents are randomly taken to freight transport drivers passing through Krian – Taman Sidoarjo road. The technique used is to reveal a preference.

- Number of Samples

The population used in the study were all freight drivers who passed on the Krian – Taman Sidoarjo road. While taking the number of samples refers to the average daily traffic of freight transport at the Service Unit of Motor Vehicle Weighing Trosobo Sidoarjo. In calculating the number of samples using the Slovin formula. The average daily traffic of freight transport in 2020 at the Service Unit of Motor Vehicle Weighing Trosobo Sidoarjo (N) is 3.558 [12]. Error tolerance limit or margin of error (e) is 10%. So that the number of samples (n) is obtained:

$$n = \frac{N}{1 + Ne^2} = \frac{3.558}{1 + 3.558\ (0{,}1)^2} = 100\ samples$$

The minimum number of samples required in this study is 100 samples. However, to anticipate incomplete/ invalid respondents' answers, 150 samples are used.

*2.2.2. Secondary Data.* This data is used to support research. These data include:

1. Data on traffic accidents from 2015 to 2020 on the Krian – Taman Sidoarjo road (Police Resort Sidoarjo).
2. Daily traffic freight transport data (Service Unit of Motor Vehicle Weighing Trosobo Sidoarjo).
3. Data of violations freight transport (Service Unit of Motor Vehicle Weighing Trosobo Sidoarjo).
4. Data of Krian – Taman Sidoarjo road.

*2.3. Data Analysis Stage*

Primary and secondary data from the field survey are then processed for further analysis. Secondary data is used to describe the characteristics of traffic accidents on the Krian – Taman Sidoarjo and the causal factors. At the same time, the primary data from the questionnaire results have then analyzed the characteristic of the respondents using descriptive statistics in the form of pie charts. Finally, we are using logistic regression analysis to determine the model and probability of traffic accidents on the Krian – Taman Sidoarjo road.

*2.3.1. Traffic Accidents Data Analysis.* This analysis will describe the causes of traffic accidents and the characteristics of traffic accidents on the Krian – Taman Sidoarjo road.

1. Analysis of Traffic Accidents Causes

The method used in the fishbone diagram. In this study, the causes of traffic accidents are divided into 4 (four), namely: human, vehicle, road, and the environment [13], as shown below:

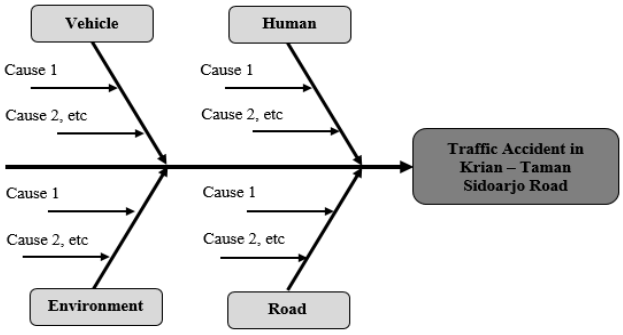


**Figure 1.** Fishbone Diagram of Traffic Accidents on the Krian – Taman Sidoarjo road.

2. Analysis of Traffic Accidents Characteristics

The method used is the "5W + 1H" approach issued by the Department of Settlements and Regional Infrastructure [14], namely: Why (factor of accident), What (type of vehicle), Where (location of accident), Who (involvement of road users), When (time of occurrence) and How (type of vehicle movement).

*2.3.2. Analysis of Respondents' Characteristics.* This analysis will describe the characteristic of drivers of freight transport passing through the Krian – Taman Sidoarjo road using descriptive statistical methods in the form of pie charts.

*2.3.3. Analysis of Traffic Accident Modeling and Probability.* This analysis used logistic regression with the help of SPSS Software. The first step that must be taken is determining the independent and dependent variable.

**Table 1.** Independent and Dependent Variable in Research.

| | | |
|---|---|---|
| Independent Variable | | |
| *X1* | = | Age |
| Dependent Variable | | |
| *Y* | = | Involvement in Traffic Accident on the Krian – Taman Sidoarjo road |

In determining the model of logistic regression equation using the following formula:

$$\pi\,(x) = \frac{e^{\beta 0 + \beta 1\, x1 + \ldots\ldots + \beta p\, xp}}{1 + e^{\beta 0 + \beta 1\, x1 + \ldots\ldots + \beta p\, xp}} \quad (1)$$

With :

| | | |
|---|---|---|
| *p* | = | number of predictor/ independent variable |
| *x1, x2, ..., xp* | = | independent variable |
| *β* | = | independent variable coefficient |

Furthermore, to determine the estimated probability of traffic accidents using the following formula:

$$g(x) = ln\left(\frac{\pi\,(x)}{1 - \pi\,(x)}\right) = \beta 0 + \beta 1\, x1 + \ldots\ldots + \beta p\, xp \quad (2)$$

$$logit(\pi(x)) = \frac{\pi\,(x)}{1 - \pi\,(x)} = \beta 0 + \beta 1\, x1 + \ldots\ldots + \beta p\, xp \quad (3)$$

After the above calculation, it will produce an exponential value that will be used to calculate the estimated probability value with the following formula:

$$\pi 0\,(x) = \frac{1}{1 + \exp g(x)} \quad (4)$$

$$\pi 1\,(x) = \frac{\exp g(x)}{1 + \exp g(x)} \quad (5)$$

Furthermore, the feasibility test of the logistic regression model was carried out using the Hosmer and Lemeshow test (goodness of fit).

## 3. Result and Discussion

### *3.1. Traffic Accident Data Analysis*

*3.1.1. Analysis of Traffic Accident Causes.* Based on the analysis of traffic accident causes using a fishbone diagram, the following figure is obtained:

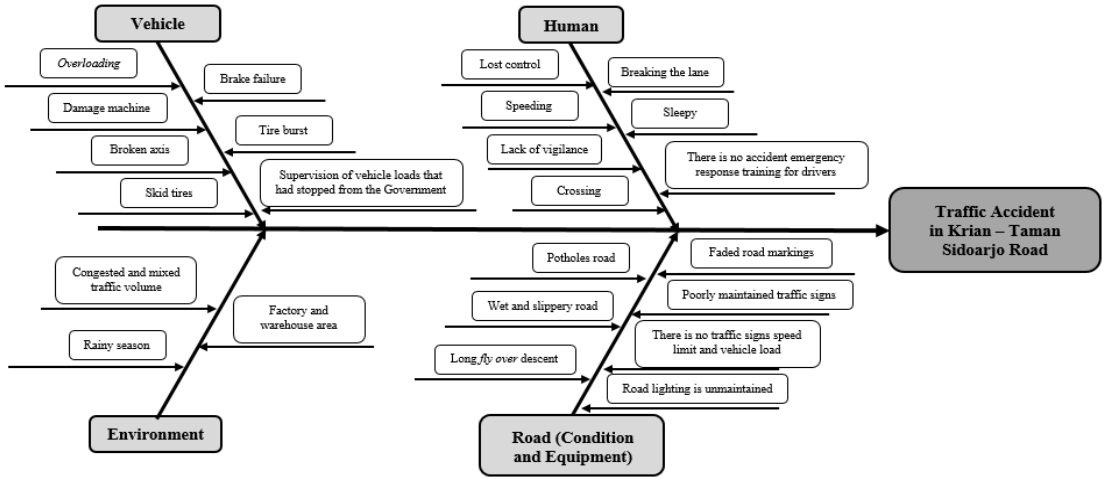


**Figure 2.** Fishbone Diagram Analysis of Traffic Accidents Causes on the Krian – Taman Sidoarjo Road.

*3.1.2. Analysis of Traffic Accident Characteristics.* Based on the analysis of the traffic accidents characteristics on the Krian – Taman Sidoarjo road from 2015 to 2020 with pie charts, the following figure is obtained:

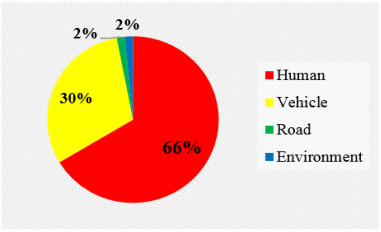


**Figure 3.** Percentage chart of traffic accidents causes ***(Why)***

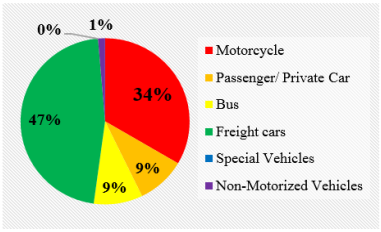


**Figure 4.** Percentage chart of vehicle type involved in traffic accidents ***(What)***

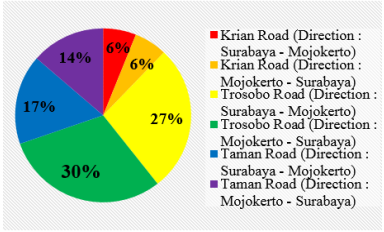


**Figure 5.** Percentage chart of traffic accidents location ***(Where)***

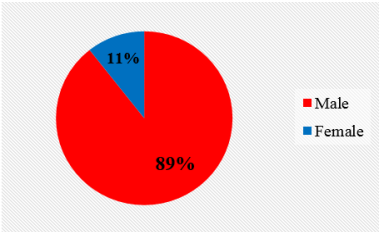


**Figure 6.** Percentage chart of road users' gender in traffic accidents ***(Who)***.

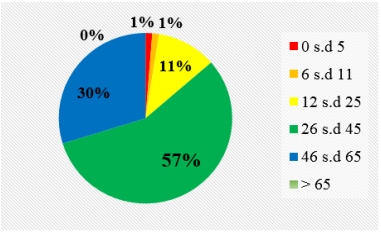


**Figure 7.** Percentage chart of road users' age in traffic accidents ***(Who)***.

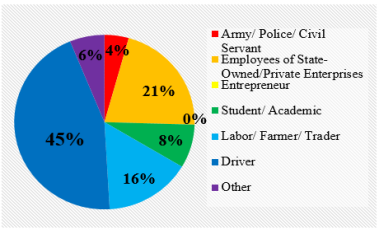


**Figure 8.** Percentage chart of road users' jobs in traffic accidents ***(Who)***.

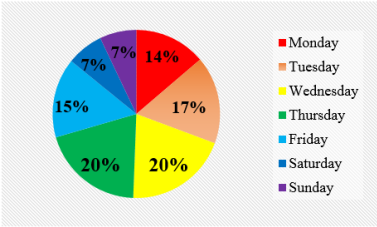


**Figure 9.** Percentage chart of traffic accidents day ***(When)***.

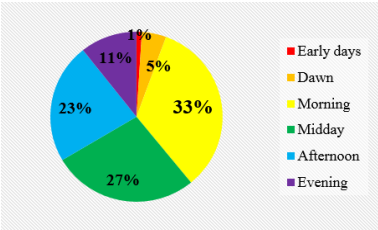


**Figure 10.** Percentage chart of traffic accidents hour ***(When)***.

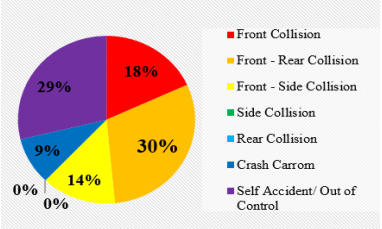


**Figure 11.** Percentage chart of vehicle movement types during traffic accidents ***(How)***.

The majority of traffic accidents caused on the Krian – Taman Sidoarjo road are human factors, with 44 accidents (66%). The main causes of human factors including sleepy, speeding, lack of vigilance, loss of control, and traffic violations [15]. Most vehicle types involved in traffic accidents on the Krian – Taman Sidoarjo road are freight transport, with as many as 68 vehicles (47%); this is because the Krian – Taman road is an industrial area that is the route for freight transport to take and receive goods from the factory to their destination [16]. Most traffic accidents location occurred on Trosobo road (direction Mojokerto – Surabaya) as many as 20 incidents (30%); this is because the geometric condition in Trosobo road flyover often causes loaded trucks and buses to experience brake failure [16]. The majority of road users in traffic accidents in Krian – Taman Sidoarjo are male, as many as 143 people (89%); this is because the average person driving a freight transport vehicle is male [17]. The majority of road users aged in traffic accidents in Krian – Taman Sidoarjo are in the age range of 26 to 45 years (adults), as many as 90 people (56%); this is because this age is a productive age for people to work and carry out daily travel activities [18]. The majority of road users job in traffic accidents on the Krian – Taman Sidoarjo are drivers, as many as 71 people (45%); this is because the driver is a job mostly on the road, so the risk level of having a traffic accidents is higher than in other jobs [19]. Most of traffic accidents day in Krian – Taman Sidoarjo are on Wednesdays and Thursdays, with 13 incidents (20%); this is because the two days are working days where the traffic flow through the Krian – Taman Sidoarjo road is high quite [15]. Most of traffic accidents hour in Krian – Taman Sidoarjo are in the morning (05.00 – 10.00) as many as 22 accidents (33%); this is because these hours are the time for people to carry out activities in the morning (school, work, etc.) [18]. The majority of vehicle movement types during traffic accidents in Krian – Taman Sidoarjo are front-rear collisions with as many as 20 vehicles (30%); this is because the road conditions are quite wide and divided by the median and the low side barriers make road users accelerate at high speed so that the front of the vehicle has a high potential for accidents [20].

### *3.2. Analysis of Respondents' Characteristics*

Based on the results of the questionnaire to 150 respondents obtained the following characteristics:

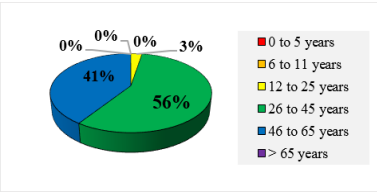


**Figure 12.** Distribution chart of respondents' age.

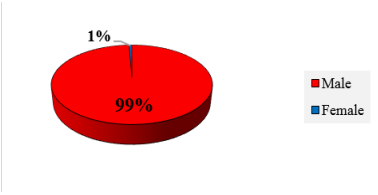


**Figure 13.** Distribution chart of respondents' gender.

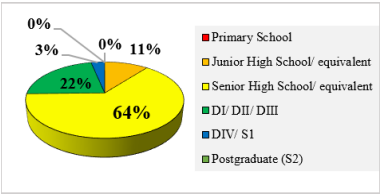


**Figure 14.** Distribution chart of respondents' education.

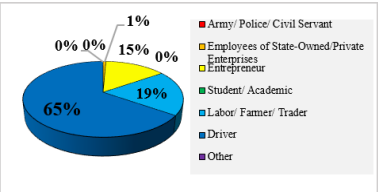


**Figure 15.** Distribution chart of respondents' job.

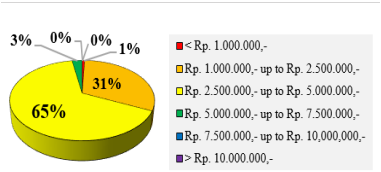


**Figure 16.** Distribution chart of the average respondents' income per month.

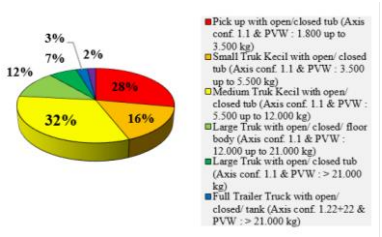


**Figure 17.** Distribution chart of respondents' freight transport vehicle types.

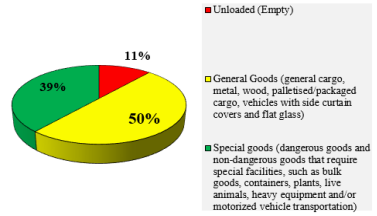


**Figure 18.** Distribution chart of respondents' vehicle load.

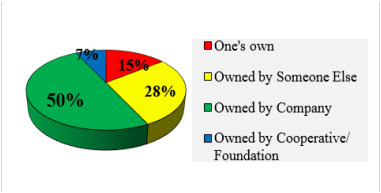


**Figure 19.** Distribution chart of respondents' vehicle ownership.

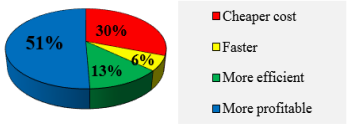


**Figure 20.** Distribution chart of respondents' reasons for using freight transport.

The characteristics of the respondents of freight transport drivers on the Krian – Taman Sidoarjo road are dominated by the age of 26 to 45 years about 85 people (56,7%), with the male respondents about 149 people (99,3%). The last education of respondents is Senior High School/ equivalent about 96 people (64%), and 98 people (65,3%) were jobs as drivers. The respondents' average income is Rp. 2.500.000,- up to Rp. 5.000.000,- per month is about 109 people (72,7%). The most type of freight transport vehicle is medium trucks with open/ closed/ tank (conf. axis 1.2 and Permitted Vehicle Weight: 5.500 to 12.000 kg) about 49 people (32,7%), with vehicle load including general goods (general cargo, metal, wood, palletized/ packaged cargo, vehicles with side curtain covers and flat glass) about 75 people (50%). The vehicle owned by the Company was about 75 people (50%), and the reason for using freight transport is that it was more profitable about 76 people (50,7%).

### *3.3. Analysis of Traffic Accidents Modelling and Probability*

*3.3.1. Testing the Independent Variables on the Dependent Variable of the occurrence of Traffic Accidents.* Based on the test results of the independent variable to dependent variable in SPSS software obtained:

**Table 2.** Variable Test Results.

| Independent Variable | p-value/ Sig. | Explanation |
|---|---|---|
| Age (X1) | .004 | Significant |

Table 2 above shows that the age variable has a significant effect on the occurrence of traffic accidents because it has Sig. < α that is 0,004 < 0,05.

*3.3.2. Model and Probability of each Independent Variable on the occurrence of Traffic Accidents.* The age variable that has a significant effect is then used to determine the model and probability of the results of the logistic regression test.

- Variable of Age (X1)

**Table 3.** The Results of the logistic regression test for the variable of age (X1).

| Variables in the Equation | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | 95.0% C.I. for EXP (B) | |
| | | B | S.E. | Wald | df | Sig. | Exp (B) | Lower | Upper |
| Step 1[a] | X1 | .062 | .021 | 8.498 | 1 | .004 | 1.063 | 1.020 | 1.108 |
| | Constant | -3.127 | .941 | 11.031 | 1 | .001 | .044 | | |
| a. Variable (s) entered on step 1: X1. | | | | | | | | | |

$logit\ (p) = -3{,}127 + 0{,}062$ Age

For respondents aged 20 years, the probability obtained is:

$$p = \frac{e^{-1{,}887}}{1 + e^{-1{,}877}} = 13{,}16\%$$

By using the above formula, table 4 is obtained below.

**Table 4.** Probability of traffic accident.

| Age | Logit (p) | Probability of being involved in the traffic accident |
|---|---|---|
| 20 | -1.887 | 13.16% |
| 25 | -1.577 | 17.12% |
| 26 | -1.515 | 18.02% |
| 28 | -1.391 | 19.92% |
| 30 | -1.267 | 21.98% |
| 32 | -1.143 | 24.18% |
| 33 | -1.081 | 25.33% |
| 34 | -1.019 | 26.52% |
| 35 | -0.957 | 27.75% |
| 36 | -0.895 | 29.01% |
| 38 | -0.771 | 31.63% |
| 40 | -0.647 | 34.37% |
| 41 | -0.585 | 35.78% |
| 42 | -0.523 | 37.22% |
| 43 | -0.461 | 38.67% |
| 44 | -0.399 | 40.16% |
| 45 | -0.337 | 41.65% |
| 46 | -0.275 | 43.17% |
| 47 | -0.213 | 44.70% |
| 48 | -0.151 | 46.23% |
| 50 | -0.027 | 49.33% |
| 51 | 0.035 | 50.87% |
| 52 | 0.097 | 52.42% |
| 54 | 0.221 | 55.50% |

| Age | Logit (p) | Probability of being involved in the traffic accident |
|---|---|---|
| 55 | 0.283 | 57.03% |
| 56 | 0.345 | 58.54% |
| 58 | 0.469 | 61.51% |
| 60 | 0.593 | 64.41% |

Table 4 shows that the older the driver, the higher the probability of being involved in a traffic accident.

*3.3.3. Logistic Regression Model Testing*. To test the feasibility of the logistic regression model using the Hosmer and Lemeshow test (goodness of fit), assuming:

H0: the model can explain the data
H1: the model is unable to explain the data
Test statistics:

- H0 is accepted if Sig. > 0,05 or H1 is rejected if Sig. < 0,05
- H0 is accepted if Chi-square count < Chi-square table

**Table 5.** Hosmer and Lemeshow test for the logistic regression test for the age variable.

| Hosmer and Lemeshow Test | | | |
|---|---|---|---|
| Step | Chi-square | df | Sig. |
| 1 | 3.641 | 7 | .820 |

In table 5 above, the value of Sig. = 0,820 > 0,05 and chi-square count = 3,641 < chi-square table = 14,06741 so that H0 is accepted. With a 95% confidence level, it can be said that the logistic regression model used can explain data and deserves to be interpreted.

**Table 6.** Model Summary for the logistic regression test for the variable of age.

| Model Summary | | | |
|---|---|---|---|
| Step | -2 Log likelihood | Cox & Snell R Square | Nagelkerke R Square |
| 1 | 190.912[a] | .060 | .081 |

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than ,001.

In table 6 above, the value of Nagelkerke R square = 0,081, so it can be said that the independent variable can explain the dependent variable by 8,1% so that other variables influence the rest by 100% - 8,1% = 91,9%.

## 4. Conclusions

The characteristics of the respondents of freight transport drivers on the Krian – Taman Sidoarjo road are dominated by the age of 26 to 45 years, about 56,7%, gender is male about 99,3%, the last education is Senior High School/ equivalent, about 64%, the drivers' jobs about 65,3%, the average income per month is Rp. 2.500.000,- up to Rp. 5.000.000,- about 72,7%, types of freight transport vehicle is a

medium truck with open/closed/tank about 32,7%, vehicle load is in the form of general goods about 50,0%, vehicle ownership status is the Company about 50% and the reasons for using the land mode to transport goods is more profitable about 50,7%.

From the study results, it is known that the age variable affects the occurrence of traffic accidents by modelling: **Logit (p) = -3,127 + 0,062 Age**. The older the driver, the higher the probability of being involved in a traffic accident.

**Acknowledgments**

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