

Pure Premium Estimation Towards Zero Inflated Claim Data of Accident Insurance Through the Generalized Linear Model

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Abstract— This thesis aims to estimate pure premium towards zero inflated claim data of accident insurance through the Generalized Linear Model (GLM). This study focuses on modeling the claim frequency data with excess zeros through the Zero Inflated Poisson (ZIP) regression to bridge the gap between previous studies where it is generally assumed to be distributed in Poisson. Gamma regression is used to estimate the parameter of severity. Pure premiums are estimated by multiplying the frequency and severity in assumption of independence. The data is obtained from accident insurance company PT ABC. 1000 data samples of year 2017, including the claim frequency and severity as dependent variable, as well as age, sex, occupational environment, and the active period of the insurance policy (exposure) as independent variables. The results indicate that ZIP regression model is suitable for estimating the claim frequency. The Gamma regression model also shows conformity in estimating the severity. The estimation of pure premiums shows that gender does not have a significant effect on its amount, while age and occupational environment is the most significant variable. The severity is not always in line with pure premium so it can be concluded that the frequency of claims is a component that has more influence on the movement of pure premiums. Pure premiums produced by a work environment with a low risk are greater than those in a medium-risk work environment. The highest amount of pure premium is on 18 years insureds. Pure premium decline on age, both for the insured women and men, and increased on the end of 50 years to 56 years in the insured man.

Index Terms— Generalized Linear Model (GLM), regression models, Zero Inflated Poisson (ZIP), Gamma, claim frequency, severity, Overdispersion, pure premium.

1 INTRODUCTION

Premium determination is a classic actuarial problem in general insurance, where risk classification techniques are used to determine premiums in different risk categories. To calculate contract value adequately, general insurance companies rely on the accuracy of estimates of all future costs related to insurance protection provided. Until now, insurance companies generally counted the number of claims and large claims separately. The Generalized Linear Model (GLM) is very useful in this context because the mean of frequency and severity can be determined through linear combinations of rating variables such as age and gender (Antonio & Beirlant, 2007). The GLM approach implicitly assumes that the number of claims (frequency) and severity are independent.

The product of two estimates of the mean frequency of claims and the amount of claims is pure premium. Many pure premiums are modeled directly by using the Tweedie distribution. This approach, first developed by Jørgensen (2002) and recently reviewed by Quijano Xacur & Garrido (2015) which states that the number of modeling aggregate claims is a number of Poisson-Gamma compounds. In line with the research, this method also implicitly assumes independence between the number of claims and the size of individual claims.

The frequency of claims is a major component of the calculation of premiums, in this section specifically the frequency of the incidence of workplace accidents, so an appropriate actuarial structure is needed to model expectations. The purpose of frequency modeling is to create a prospective model that gives the probability of a work accident occurring during a certain period in the future. Frequency modeling that can be used to explain the relationship between the dependent variable in the form of discrete data such as the

level of workplace accidents with independent variables in the form of discrete and categorical data is a Poisson regression model. However Poisson regression is limited to equidispersion basic assumptions, where variance and mean must have the same value (Parodi, 2015). According to (Yau & Lee, 2001), equidispersion is a certain form of unobserved heterogeneity. One example of heterogeneity that is not observed in the data count analysis is Overdispersion, where the value of variance is greater than the mean value. The factor that causes Overdispersion is the excess zeros in the data.

One of the problems associated with analyzing work accident rate data is that sometimes there are certain variables (work environment, age, and sex) which are recorded to have no accident rate at all. For example, it was found that more than 70% of women recorded zero accidents over a period of one year, although some of these women had a frequency of workplace accidents greater than zero in other periods of time (Cruz Rios, Chong, & Grau, 2017). This situation can lead to inaccurate conclusions that the variable that has zero work accident data is a safe variable, whereas in reality only a portion of this variable is truly safe (not having a work accident) while the other variables are actually not safe, but happens to have zero workplace accidents during the observation period. The use of the Poisson regression model does not take into account the difference between truly safe variables and variables that happen to be in a zero work accident condition, so the resulting model becomes biased because of over representation of zero accident observations in the sample. This is what is called excess zeros. The estimation of the model gives an impression of Overdispersion in the data, so the use of Poisson regression models can cause error Standardds to be lower than they

should be, and produce inflated p-values and narrower confidence intervals (McCullagh, 1989).

Brisard (2014) highlighted the importance of claim frequency modeling that can accommodate the presence of excess zeros that cause Overdispersion, because in general the frequency distribution of claims used in GLM is Poisson with the limitations of equidispersion assumptions. A popular approach to overcome data cases with excess zeros like this is the Zero Inflated Poisson (ZIP) model. This model was first developed by Lambert (1992) to deal with zero-increase, by calculating data by combining two sources of zero values, namely real zero and zero excess.

This study focuses on modeling claim frequency data with zero inflated through ZIP regression to bridge existing gaps. Because based on previous studies, the frequency of claims is often assumed to be Poisson distribution in pure premium calculation with GLM without paying attention to the presence of excess zeros. While the estimated parameter severity is determined through gamma regression. Furthermore, pure premiums are estimated by multiplying the frequency and severity.

2 LITERATURE REVIEW

2.1 Generalized Linear Model

The general technique for calculating insurance premiums is to combine conditional expectations of the frequency of claims with the expected number of claims. Kafková & Krivánková (2014) and David (2015) present an overview of the Generalized Linear Model (GLM) to calculate pure premiums on vehicle insurance based on the characteristics of policyholders. Pure premium is calculated by multiplying the estimated frequency of claims which is Poisson distribution and estimated severity of gamma distribution, based on the assumption that both distributions are independent (independent).

Based on Brisard (2014), the estimated accuracy of pure premiums with GLM is better than the Tweedie Model. This research also highlights the importance of claim frequency modeling which can accommodate the presence of excess zeros that cause Overdispersion, because in general the frequency distribution of claims used in GLM is Poisson with limitations on equidispersion assumptions. estimation of pure premium with GLM is still better than GLMM. GLM is also more applicable than GLMM where the determination of parameter estimates is more complicated and takes a lot of time (Ha, 2017)

David (2015) modeled motor vehicle insurance premiums using GLM with an assumption of independence where the frequency of claims was analyzed by Poisson regression models and the severity was analyzed by the Gamma regression model. Garrido et al. (2016) made a comparison of assumptions between independence and dependency on frequency of claims and severity to calculate pure premiums within the GLM framework for motor vehicle insurance.

GLM became popular after being developed by McCullagh & Nelder (1989) which is represented as follows.

$$f_Y(y; \theta, \phi) = \exp \left[\frac{y\theta - \kappa(\theta)}{\phi} + C(y, \phi) \right].$$

In the GLM framework it is assumed that the dependent variable Y is a member of the exponential dispersion family $DE(\mu, \phi)$. Both classical linear models and GLM aim to model the mean response, conditional on covariates known that px1 is a vector of covariates $X = (x_1, \dots, x_p)^T$. The model is defined as $E[Y|X]$ in a linear predictor dalam bentuk prediktor linear η so that:

$$\eta = X^T \beta = \sum_{k=1}^p x_k \beta_k$$

where β is a vector $p \times 1$ of unknown regression parameters.

The classical linear model assumes normal observation and modeling the mean response as $E[Y|X] = \mu = \eta = X^T \beta$. GLM no longer limits the response to associate linearly with the predictor η , but allows the function of the mean to be modeled in the form of a linear predictor. For a connecting function g , GLM is formulated as $g\{E[Y|X]\} = g\{\mu\} = \eta = X^T \beta$. This adds flexibility that allows GLM to fit in various types of data, especially insurance data.

The GLM framework as discussed in McCullagh & Nelder (1989) assumes independent observations y_1, \dots, y_n and $y_i \sim ED(\mu_i, \phi)$, so the mean varies with each observation, while dispersion is assumed to be the same for all observations but not yet known. This model denotes the conditional mean of the Y response, it is known the vector of covariate X through a connection function g as:

$$g\{E[X]\} = g\{\mu\} = \eta = X^T \beta = \sum_{k=1}^p x_k \beta_k.$$

Where the connecting function g is a monotonous function. So, the mean is a function of linear predictors:

$$\mu = E[Y|X] = g^{-1}(\eta) = g^{-1}(X^T \beta).$$

The aim of the GLM approach is to estimate the regression parameter β to predict the dependent variable Y.

2.2 Zero Inflated Poisson Regression

The Zero Inflated Poisson (ZIP) was developed by Lambert (1992) to handle zero increases, calculating data by combining two sources of zero values, namely "real zero" and "zero excess". Various types of mixed distributions for Poisson distributions have been proposed as mentioned by Lambert (1992) in his research entitled Zero Inflation Regression, with an application to defects in manufacturing. In the study it was stated that the model from ZIP is a combination of Poisson distribution and logit distribution.

The general form of the ZIP regression model allows for a set of covariates for each parameter in the two models. Important risk factors related to the behavior of claims from policyholders are identified by the significance of the regression parameters. Having an understanding of the causality underlying the frequency of claims for unreported claims and claims that follow the Poisson process, insurance practitioners can develop different premium schemes for policyholders with different levels of risk.

There are many zero values on the frequency data of claims, usually the model leads to a zero inflated model (Greene, 1994).

Previous researchers applied the chi-square test and likelihood ratio test to test the goodness-of-fit of the model. In recent years a zero inflated score test has been provided by Van den Broek (1995) to test whether the number of zeros is too large for a Poisson distribution to model data properly. Test the comparison score between ordinary Poisson and ZIP assumes that the proportion of excess zeros in the ZIP model does not depend on the covariate. One of the advantages of this test is that it is not necessary to test the ZIP model if the number of zeros owned by the number is not excessive.

Jansakul and Hinde (2002) add the disadvantages of Van den Broek's research with the existence of a test for a more general situation where the proportion of zeros in the data is left to depend on the covariate / with this score test, it can be determined whether the Poisson model is less precise compared to the zero inflated model. Yip and Yau (2005) compared several zero inflated parametric distributions, including ZIP, Zero Inflated Negative Binomial, Zero Inflated Generalized Poisson, and Zero Inflated Double Poisson, to accommodate excess zeros in motor vehicle insurance claim count data. Based on Mouatassim and Ezzahid (2012), ZIP is more suitable than Poisson distribution for modeling operational risk frequencies. According to Schawrtz (2016), the EM algorithm is a better parameter estimator for ZIP regression. The latest related research was conducted by Kusuma (2018), namely the application of ZIP regression on the frequency of health insurance claims.

2.3 Gamma Regression

Gamma distribution is a continuous distribution function that has two positive parameters, namely α and θ (de Jong & Heller, 2008). Gamma distribution occurs in positive data such as time data between engine damage, meteorological data such as daily rainfall, large data on insurance claims, and other data that is positive. The parameter α is known as the shape parameter. These parameters affect the shape of the Gamma distribution density function curve; different α values will produce different curves. While the parameter θ is a scale parameter because multiplication between random variables that have Gamma distribution with positive constants produces random variables which also have Gamma distribution with the same value α but with different θ (de Jong & Heller, 2008).

Gamma regression is a regression form that is used to model the relationship between one or several predictor variables with one response variable (Y) that has Gamma distribution (de Jong & Heller, 2008). Thus, the response variable is a continuous random variable which has a positive value and a constant coefficient of variation. The model used in this study is a linear log model so that the expected value (μ) is positive.

3 RESEARCH METHODS

This study refers to the Quijano Xacur & Garrido (2015) study which states that the number of modeling claims is aggregated as the combined number of Poisson-Gamma. This study focuses on modeling the frequency of claims data with zero inflated through ZIP regression as an important part of the

estimation of pure premiums. This research has a quantitative type that estimates the frequency of claims by applying the ZIP Regression Model, estimating the severity by applying the Gamma Regression Model, and estimating pure premiums on zero inflated data. The approach that will be taken to estimate pure premium is the multiplication of two parts. First, the frequency of claims, where the estimated parameters are determined by ZIP regression. Second, severity, where the estimated parameters are determined by Gamma regression

3.1 Data and Variables

The data used in the study is secondary data obtained from PT. ABC as a work accident insurance. 1000 data samples consist of 2017, covering the frequency of claims and the amount of claims which are the dependent variables and the insured data which include age, gender, work environment group, and the duration of the insured working in the related work environment (exposure) as an independent variable. A more detailed explanation of the research variables is explained in Table 3.1.

3.2 Overdispersion Test

The method that can be used to detect Overdispersion or underdispersion is by using deviance and Pearson chi-square values. Deviance value can be used for dispersion test by dividing the deviance value in the model with its free degree, if the result is more than 1, oversdispersion occurs and if less than 1 occurs underdispersion. Other statistical values that can be used for dispersion tests are using the Pearson chi-square statistical value. Pearson chi-square is a test that can be used as a test of goodness-of-fit, in determining the distribution that best fits the data. The following is the formula for detecting Overdispersion (Cameron & Trivedi, 2013) :

- a. Deviance:

$$D = 2 \sum_{i=1}^n \left\{ y_i \ln \left(\frac{y_i}{\hat{\mu}_i} \right) - (y_i - \hat{\mu}_i) \right\}$$

Pearson chi-square:

$$\theta_2 = \frac{x^2}{db} > 1; x^2 = \sum_{i=1}^n \frac{(y_i - \mu_i)^2}{\sigma_i}$$

Information:

y_i : Value of the response variable from the i observation

λ_i : Average estimator value from the i observation

σ_i : Estimator for the variety of i observations

db : n-k-1 (degree of freedom)

k : Number of parameters including constants

n : Number of observations

A significant p-value indicates that the deviation is greater than expected in the null hypothesis of the model. The hypothesis is:

H_0 = The observed data has equidispersion

H_1 = Data observed did not experience equidispersion with a significance level of $\alpha = 5\%$, and the rejection criteria is H_0 rejected if p-value $<\alpha$.

Table 3.1. Variable Description

Variable Type	Variable Name	Type	Description
Age (x_1)	Age	Numeric	The age of the insured in 2017
Gender (x_2)	Gender	Categorical	1 for the insured male 0 for the insured female
Occupational Environment 1 (x_3)	Sector_VH	Categorical	1 for the policy of the level of risk of the work environment is very high 0 for others
Occupational Environment 2 (x_4)	Sector_H	Categorical	1 for policy of the level of risk of high work environment 0 for others
Occupational Environment 3 (x_5)	Sector_M	Categorical	1 for policy of the level of risk of moderate work environment 0 for others
Occupational Environment 4 (x_6)	Sector_L	Categorical	1 for the policy of the level of risk of low work environment 0 for others
Exposure to risk (x_7)	Exp	Numeric	The time period that states the validity period of an insurance policy, as an exposure to the ZIP regression model
Claim Frequency (y_1)	Fclaim	Numeric	Frequency of claims in 2017
Severity (y_2)	Aclaim	Numeric	Claim amount in rupiah

3.3 Estimation of Claim Frequency Through the Zero Inflated Poisson Regression

The probability function for zero values and positive values in Overdispersion data is divided into two models, namely for $y_i = 0$ and $y_i > 0$ which can be written in the following translation (Lambert, 1992).

$$\Pr(Y = y_i) = \begin{cases} \theta_i(z_i) + (1 - \theta_i(z_i)) \text{Pois}(\lambda_i; 0 | x_i), & \text{if } y_i = 0 \\ (1 - \theta_i(z_i)) \text{Pois}(\lambda_i; y_i | x_i), & \text{if } y_i > 0 \end{cases}$$

z_i By being a covariate vector determined the probability of θ_i ; $\text{Poiss}((\lambda_i; 0 | x_i) = \exp(-\lambda_i))$; $\text{Poiss}(\lambda_i; y_i | x_i) = \frac{e^{-\lambda_i} \lambda_i^{y_i}}{y_i!}$, which λ is the mean and variance of the distribution.

The relationship model for and in the ZIP regression model according to (Lambert, 1992) is:

$$\ln(\lambda) = X\beta$$

$$\log it(\theta) = \log\left(\frac{\theta}{1-\theta}\right) = X\gamma$$

Assumed as y_1, y_n independent and θ_i not related to λ_i . Then the possibility function can be configured by:

$$LL_c(\beta_1, \gamma, y, \delta) = LL_c(\gamma, y, \delta) + \sum_{i=1}^n (1 - \delta_i) \log(y_i!)$$

Where,

$$LL_c(\gamma, y, \delta) = f(\delta_i | \gamma) = \sum_{i=1}^n [\delta_i z_i \gamma - \log(1 + \exp(z_i \gamma))]$$

$$LL_c(\beta_1, y, \delta) = f(y_i | \delta_i, \beta_1) = \sum_{i=1}^n (1 - \delta_i) [y_i x_i \beta_1 - \exp(x_i \beta_1)]$$

3.3 Estimation Parameter Regression Gamma

$Y \sim \text{gamma}(\alpha, \beta)$ have a pdf (Garrido et al., 2016):

$$f_Y(y; \alpha, \beta) = \frac{\beta^\alpha}{\Gamma(\alpha)} y^{\alpha-1} e^{-\beta y}$$

$$= \exp\{(\alpha-1)\ln y - \beta y + \alpha \ln(\beta) - \ln \Gamma(\alpha)\}, \quad y > 0$$

The estimation of gamma regression parameters through Maximum likelihood estimation (MLE) will be derived from the equation score for regression parameters on the GLM structure (Garrido et al., 2016):

$$s(\beta_{2j}; \phi, y) = \sum_{i=1}^n \frac{(y_i - \mu_i)}{a_i(\phi)V(\mu_i)} \frac{x_{ij}}{g(\mu_i)} = 0$$

Then, the equation for the Gamma regression parameter, β is

$$s(\beta_{2k}; \phi, y) = \sum_{i=1}^m \sum_{j=1}^{n_i} \frac{(y_{ij} - \mu_i)}{a_i(\phi)V(\mu_i)} \frac{x_{ik}}{g(\mu_i)} = 0, \quad \text{for } k = 1, \dots, p_2$$

For example :

$$Y_{ij} \sim \text{gamma}(\mu_i, \phi)$$

$$a_{ij}(\phi) = \frac{\phi}{w_{ij}}, \quad \text{for weight } w_{i1}, \dots, w_{in_i}$$

the variance function is $V(\mu_i) = \mu_i^2$

Equation score for the claim size parameter, β is

$$s(\beta_{2k}; \phi, y) = \sum_{i=1}^m \sum_{j=1}^{n_i} \frac{(y_{ij} - \mu_i)}{\phi / w_{ij}(\mu_i^2)} \frac{x_{ik}}{g(\mu_i)} = 0, \quad \text{for } k = 1, \dots, p_2$$

Using the log-link function then:

$$g(\mu_i) = \ln(\mu_i) \Rightarrow g(\mu_i) = \frac{1}{\mu_i}$$

Furthermore, the score equation can be simplified to:

$$s(\beta_{2k}; \phi, y) = \sum_{i=1}^m \sum_{j=1}^{n_i} \frac{(y_{ij} - \mu_i)}{\phi / w_{ij}(\mu_i^2)} x_{ik} \mu_i = \sum_{i=1}^m \sum_{j=1}^{n_i} \frac{w_{ij}}{\phi} \frac{x_{ik}}{\mu_i} (y_{ij} - \mu_i) = 0$$

for $k = 1, \dots, p_2$

Note that $j = 1, \dots, N_i$ so that the average claim (severity) is $\bar{Y}_i \sim \text{gamma}\left(\mu_i, \frac{\phi}{N_i}\right)$. Equation score derived for parameter

regression β_2 equivalent both for large individual claims data y_{ij} and average claim size \bar{y}_i . If the weight is assumed to be $w_{ij} = 1$ for all i, j (Garrido et al., 2016), then :

$$s(\beta_{2k}; \phi, y) = \sum_{i=1}^m \sum_{j=1}^{n_i} \frac{w_{ij}}{\phi} \frac{x_{ik}}{\mu_i} (y_{ij} - \mu_i) = \sum_{i=1}^m \sum_{j=1}^{n_i} \frac{1}{\phi} \frac{x_{ik}}{\mu_i} (y_{ij} - \mu_i)$$

$$= \sum_{i=1}^m \frac{1}{\phi} \frac{x_{ik}}{\mu_i} \sum_{j=1}^{n_i} (y_{ij} - \mu_i) = \sum_{i=1}^m \frac{1}{\phi} \frac{x_{ik}}{\mu_i} n_i (\bar{y}_i - \mu_i)$$

3.4 Pure Premium Model

The large expectations of aggregate claims within the GLM framework (Garrido et al., 2016) is

$$\begin{aligned} E[S_i] &= E\left[E(S_i | N_i)\right] = E\left[E\left(\sum_{j=1}^{N_i} Y_{ij} | N_i\right)\right] \\ &= E\left[\sum_{j=1}^{N_i} E(Y_{ij} | N_i)\right] = E\left[\sum_{j=1}^{N_i} E(Y_{ij})\right] \\ &= E[N_i E(Y_i)] = E(N_i)E(Y_i). \end{aligned}$$

$$E[S_i | X_i] = \mu_i = \mu_{i1} \times \mu_{i2} = g_i^{-1}(X_{i1}^T \beta_1) \times g_i^{-1}(X_{i2}^T \beta_2)$$

In the special case both marginal GLM uses log-links, so that it can be simplified as follow.

$$\ln(\mu_{i1}) = X_{i1}^T \beta_1 \Leftrightarrow \mu_{i1} = \exp(X_{i1}^T \beta_1).$$

$$\ln(\mu_{i2}) = X_{i2}^T \beta_2 \Leftrightarrow \mu_{i2} = \exp(X_{i2}^T \beta_2).$$

The total expectation of the total claim becomes:

$$\mu_i = \exp(X_{i1}^T \beta_2) = \exp\{X_{i1}^T \beta_1 + X_{i2}^T \beta_2\}.$$

4 RESULTS AND DISCUSSIONS

The data used in this study consists of many claims made by each policy holder and the amount of claims paid by insurance companies (dependent variable), as well as individual data of policyholders such as age, gender, type of work environment (independent variable). The following are some descriptive statistical values of the available variables.

In Table 4.1 the frequency variable claims has a mode value or the value that most often appears 0, meaning that the majority of the insured has never filed a claim. The minimum and maximum values of the claim frequency variable are 0 and 6. That is, there is an insured who has never filed a claim and most insureds make 6 claims in one period of coverage. For large variable claims, 0 is also the most frequently occurring variable, meaning that most insureds have never applied for the sum insured. The minimum and maximum value of the claim variable is 0 and 33,959,000, meaning that the insured has never applied for the sum insured and the biggest sum insured ever received by an insured is Rp. 33,959,000.00. Whereas for the age variable, the most frequently occurring value is 22, the insured is 22 years old. The minimum and maximum values of age variables are 18 and 56, meaning that policyholders who are the youngest are 18 years old, and the oldest policy holders are 56 years old.

The values in Table 4.2 are descriptive statistics for the exposure variable with a mode equal to 1, meaning that the majority of the insured has a period of coverage for one full year. The minimum and maximum values of the exposure variable are 0.5 and 1. This means that the insured's shortest coverage period is 6 months and the longest period of coverage is one full year.

Table 4.1 Descriptive statistics of numerical variable PT. ABC's data

Variable	Minimum	Maximum	Modus	Mean
Usia	18	56	22	28,70
Frekuensi Klaim	0	6	0	0,47
Besar	0	33.959.000	0	1.320.668,48

Klaim				
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Source: Processed using SPSS software

The values in Table 4.3 are descriptive statistics for categorical observation data. In the sex variable, the percentage of women insured was 31.7%, while men were 68.3% of the total. This shows that the number of male insured is more than that of women. Work environment variable 1 shows the number of insured who work in a work environment with a very high risk of 5.8%. Work environment variable 2 shows the number of insured who work in a high-risk work environment that is as much as 4.1%. Work environment variable 3 shows the number of insured who work in a medium risk work environment that is as much as 26.5%. Work environment variable 4 shows the number of insured who work in a low risk work environment which is as much as 16.5%. While the rest shows the number of insured who work in a work environment with a very low risk of 47%.

Table 4.2 Descriptive statistics of numerical variable PT. ABC's data

Variable	Minimum	Maximum	Modus	Mean
Exposure	0,50	1	1	0,976

Source: Processed using SPSS software

The results of the goodness of fit test presented in table 4.4 show the *p-value* from Pearson Chi-Square less than the level of significance ($p-value(0,000) < 0,05$) so H_0 rejected. H_0 is the data observed experiencing equispersion, while H_1 is the observed data not experiencing equidispersion.

Table 4.3 Descriptive statistics of categorical variable PT. ABC's data

Variable	Category	Information	Freq	Percentage
Sex	1	Male	683	68,3 %
	0	Female	317	31,7 %
Occupational Environment1	1	Very high risk	58	5,8 %
	0	Others	942	94,2 %
Occupational Environment2	1	High risk	41	4,1 %
	0	Others	959	95,9 %
Occupational Environment3	1	Moderate risk	265	26,5 %
	0	Others	735	73,5 %
Occupational Environment4	1	Low risk	165	16,5 %
	0	Others	835	83,5 %
Occupational Environment5	1	Very low risk	470	47 %
	0	Others	530	53 %

Source: Processed using SPSS software

Overdispersion can be analyzed by dividing the deviation value by 1770,9249 and the Pearson value by 1815,5276 each with a *df* (degree of freedom) of 993. The value (1/*df*) deviation is 1,7764 and the value (1/*df*) Pearson is 1,8213, where both are worth more than one. This is an indicator of overdispersion in the Poisson regression model produced.

Table 4.4 Overdispersion Test

Deviance goodness of fit	1770,9249
p-value	0,0000
Pearson goodness of fit	1815,5276

<i>p-value</i>	0,0000
Residual <i>df</i>	993
(1/ <i>df</i>) Deviance	1,7764
(1/ <i>df</i>) Pearson	1,8213

Source: Processed using *software R*

The ZIP regression model in Table 4.5 shows that the frequency of claims (y_1) is influenced by five variables, that is Age, Sector_VH, Sector_H, Sector_M, dan Sector_L with a significance level $\alpha = 5\%$. For the logit model there are six variables that have a significant effect on the level of significance $\alpha = 5\%$, that is Age, Gender, Sector_VH, Sector_H, Sector_M, dan Sector_L. Based on the estimated output from the ZIP regression model above, the model is obtained:

a. Model $\ln(\lambda)$

$$\ln(\lambda) = \beta_1 x_1 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6$$

$$\begin{aligned} \ln(\lambda) = & -0,0291535 x_1 + 0,7762387 x_3 + 0,8890605 x_4 \\ & + 0,623309 x_5 + 0,6203557 x_6 \end{aligned}$$

b. Model $\log it(\theta)$

$$\log it(\theta) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6$$

$$\begin{aligned} \log it(\theta) = & -20,35864 + 0,3198537 x_1 + 5,623129 x_2 \\ & - 2,927232 x_3 - 4,245512 x_4 - 5,296289 x_5 \\ & - 3,69744 x_6 \end{aligned}$$

To determine the prediction value of the claim used between the two models, the probability value for each model is calculated. After the probability value is obtained, the model used as the prediction frequency value is a model that has the highest probability value. *p* variable is formed for each model with (Cameron & Trivedi, 2013) :

- a_1 = Claim frequency prediction value based on the $\ln(\lambda)$ model
- a_2 = Claim frequency prediction value based on the $\log it(\theta)$ model
- $pzero$ is the probability value of the $\ln(\lambda)$ model

$$pzero = \frac{\exp(a_2)}{(1+\exp(a_2))}$$

- $pcount$ is the probability value of the $\log it(\theta)$ model

$$pcount = \exp(a_1) \times (1 - pzero)$$

For example, for a man aged 22 years, working in the mining sector (a very high risk work environment), and having a full one year policy validity period. Then it is analyzed with the ZIP model to be:

- $\ln(\lambda)$ model

$$\ln(\lambda) = \beta_1 x_1 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6$$

$$\begin{aligned} \ln(\lambda) = & -0,0291535(22) + 0,7762387(1) + 0,8890605(0) \\ & + 0,623309(0) + 0,6203557(0) \end{aligned}$$

$$\ln(\lambda) = 1,144378506 = a_1$$

- $\log it(\theta)$ model

$$\begin{aligned} \log it(\theta) &= \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 \\ \log it(\theta) &= -20,35864 + 0,3198537(22) + 5,623129(1) \\ & - 2,927232(1) - 4,245512(0) - 5,296289(0) \\ & - 3,69744(0) \end{aligned}$$

$$\log it(\theta) = 1,242775 = a_2$$

- $pzero = \frac{\exp(a_2)}{(1+\exp(a_2))} = \frac{\exp(1,242775)}{(1+\exp(1,242775))} = 0,776046674$
- $pcount = \exp(a_1) \times (1 - pzero)$
- $= \exp(1,144378506) \times (1 - 0,776046674)$
- $pcount = 0,703322947$

Table 4.5 Estimation of ZIP regression model

		$P(Y > 0)$	<i>Inflate P(Y = 0)</i>
<i>Intercept</i>	Estimation (β_0)	-0,0471594	-20,35864
	Standard Error	0,6481715	7,156484
	<i>P-value</i>	0,942	0,004
Age(x1)	Estimasi (β_1)	-0,0291535	0,3198537
	Standard Error	0,0086182	0,0632243
	<i>P-value</i>	0,001	0,000
Gender (x2)	Estimation (β_2)	-0,0147511	5,623129
	Standard Error	0,1106277	1,562304
	<i>P-value</i>	0,894	0,000
Sector_VH (x3)	Estimation (β_3)	0,7762387	-2,927232
	Standard Error	0,2215465	1,383734
	<i>P-value</i>	0,000	0,034
Sector_H (x4)	Estimation (β_4)	0,8890605	-4,245512
	Standard Error	0,2092377	1,868028
	<i>P-value</i>	0,000	0,023
Sector_M (xs)	Estimation (β_5)	0,623309	-5,296289
	Standard Error	0,1401985	1,452723
	<i>P-value</i>	0,000	0,000
Sector_L (x6)	Estimation (β_6)	0,6203557	-3,69744
	Standard Error	0,1628315	1,006792
	<i>P-value</i>	0,000	0,000
Exposure (x7)	Estimation (β_7)	-0,1202497	6,008227
	Standard Error	0,6093919	6,288516
	<i>P-value</i>	0,844	0,339

Source: Processed using *software R*

The results obtained for $pzero$ are 0,776046674 and $pcount$ is 0,703322947. Then the highest probability value between the two models is the probability value for the $\ln(\lambda)$ model. The prediction value used is the value based on the $\ln(\lambda)$ model with the estimated frequency of claims 1,144378506 and rounded to 1.

The Gamma regression model in Table 4.8 shows that *severity* (

Y_2 is influenced by six variables, namely Age, Sector_VH, Sector_H, Sector_M, Sector_L, and *Exposure* with a significance level $\alpha = 5\%$. *p-value* Gender variable is more significant $\alpha = 5\%$, so it can be concluded that gender does not have a significant effect on *severity*. Based on the estimated output from the Gamma regression model above, the model is obtained:

$$Y_i \sim \text{gamma}(\mu_i, k)$$

$$\mu_i = E[Y_i | x_i] = \exp(x_i \beta)$$

$$\ln(\mu) = \beta_0 + \beta_1 x_1 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7$$

$$\begin{aligned} \ln(\mu) &= \beta_0 + \beta_1 x_1 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 = 10.01372 - 0.0665836 x_1 + 2.545437 x_3 \\ &= 1.519951 x_5 + 1.651012 x_6 + 3.025857 x_7 \end{aligned}$$

Table 4.6 Parameter Estimation through Gamma Regression

Variable	Estimation	Standard Error	P-value
Intercept	$\beta_0 = 10.01372$	1.320855	0.000
Age(x_1)	$\beta_1 = -0.0665836$	0.0142194	0.000
Gender (x_2)	$\beta_2 = -0.2544582$	0.2397927	0.289
Sector_VH (x_3)	$\beta_3 = 2.545437$	0.4934486	0.000
Sector_H (x_4)	$\beta_4 = 2.037454$	0.569526	0.000
Sector_M (x_5)	$\beta_5 = 1.519951$	0.2719054	0.000
Sector_L (x_6)	$\beta_6 = 1.651012$	0.3176886	0.000
Exposure (x_7)	$\beta_7 = 3.025857$	1.296219	0.020

Source: Processed using software Stata

After Gamma regression analysis, then the *goodness of fit* is tested between the frequency of observations originating from sample data and the frequency of expectations obtained from hypothesized distributions.. The null hypothesis is the model obtained in accordance with the observed data with a significance level $\alpha = 5\%$. Rejection criteria is H_0 rejected if $p - value < \alpha$.

Table 4.7 Goodness of Fit Test of Gamma Regression

Deviance goodness of fit	122,45065
p-value	1,0000
Pearson goodness of fit	139,4263
p-value	1,0000
Residual df	992
(1/df) Deviance	0,123503
(1/df) Pearson	0,13652

Source: Processed using software Stata

Based on the results of the *goodness of fit* test presented in table 4.11 the *p-value* from Pearson Chi-Square is more than the significance ($p-value(0,000) > 0,05$) so H_0 not rejected. The conclusion obtained is the Gamma regression model obtained in accordance with the observed data. The deviation value is 122,45065 and the Pearson value is 139,4263 each with *df* (*degree of freedom*) value of 992. The value of (1/df) deviation is 0,123503 and the value of (1/df) Pearson is 0,13652, where both are worth less than one. This is an indicator that the Gamma regression model can model data properly.

Pure $E[S_i]$ premium is the product of multiplication of

estimated frequency claims $E[N_i]$ with estimated *severity* $E[\bar{Y}_i]$ (Garrido et al., 2016).

$$E[S_i] = E[N_i]E[\bar{Y}_i]$$

$$\mu_i = \exp(X_{il}^T \beta_2) = \exp\{X_{il}^T \beta_1 + X_{iz}^T \beta_2\}$$

Based on equations 4.1, 4.2 and 4.3, the pure premium estimation equation can be written as:

a. $\ln(\lambda)$ model

$$E[S_i] = \exp \left\{ -0,0291535 x_1 + 0,7762387 x_3 + 0,8890605 x_4 + 10,01372 - 0,0665836 x_1 + 2,545437 x_3 + 2,037454 x_4 + 1,519951 x_5 + 1,651012 x_6 \right\}$$

$$+ \exp \left\{ +3,025857 x_7 \right\}$$

$$E[S_i] = \exp \left\{ 10,01372 - 0,09574 x_1 + 3,321676 x_3 + 2,926515 x_4 + 2,143260 x_5 + 2,271368 x_6 + 3,025857 x_7 \right\}$$

b. $\log it(\theta)$ model

$$E[S_i] = \exp \left\{ -20,35864 + 0,3198537 x_1 + 5,623129 x_2 - 2,927232 x_3 - 4,245512 x_4 - 5,296289 x_5 - 3,69744 x_6 \right\}$$

$$+ \exp \left\{ 10,01372 - 0,0665836 x_1 + 2,545437 x_3 + 2,037454 x_4 + 1,519951 x_5 + 1,651012 x_6 + 3,025857 x_7 \right\}$$

$$E[S_i] = \exp \left\{ -10,344920 + 0,2532701 x_1 + 5,623129 x_2 - 0,381795 x_3 - 2,208058 x_4 - 3,776338 x_5 - 2,046428 x_6 + 3,025857 x_7 \right\}$$

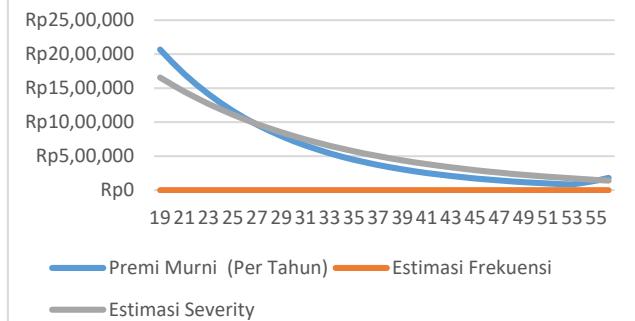


Figure 4.2 Graph of Pure Premium for Male Insured on Very High Risk Occupational Environment

Image 4.2 shows that the highest pure premiums insured by men at the level of work environment risk are very high at the age of 18 years. Pure premiums go down as the insured increases in age, but returns to rise when the insured man is 54 years old. The chart shows that pure premium movements are not in line with the movement of severity. At the insured with ages 18 to 26, pure premiums are higher than severity. This shows that the frequency of claims for the insured at that age is more than 1. In the insured with the age of 27 years up to the age of 54 years, pure premium is lower than the severity. This shows that the frequency of the insured's claim at that age also decreased to less than 1.

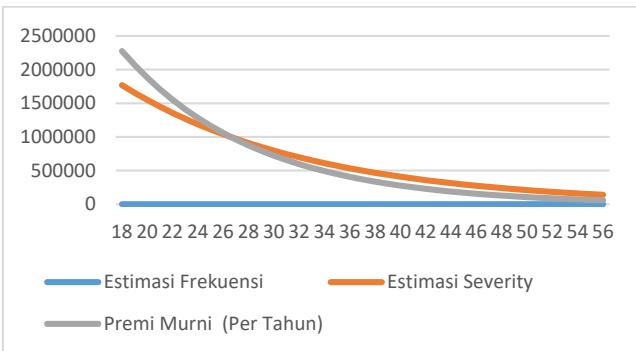


Figure 4.3 Graph of Pure Premium for Female Insured on Very High Risk Occupational Environment

Image 4.3 shows that the highest premium of the highest insured woman at the level of the risk of the work environment is very high at the age of 18 years. Pure premiums go down as the insured increases in age, but returns to rise when the insured man is 54 years old. The chart shows that pure premium movements are not in line with the movement of severity. At the insured with ages 18 to 25 years, pure premiums are higher than severity. This shows that the frequency of claims for the insured at that age is more than 1. In the insured with the age of 26 years until the age of 56 years, pure premium is lower than the severity. This shows that the frequency of the insured's claim at that age also decreased to less than 1.

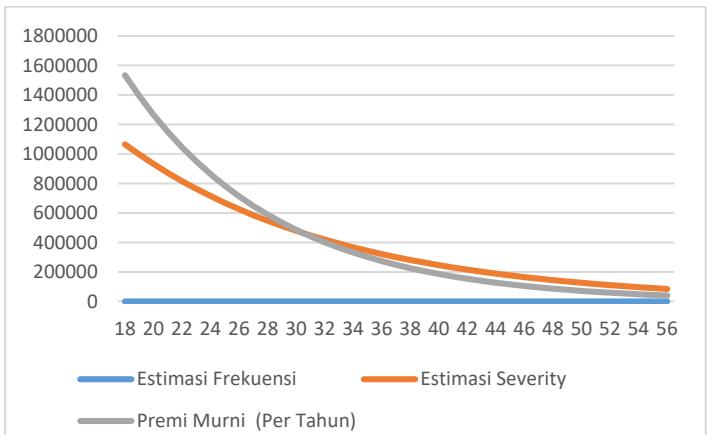


Figure 4.5 Graph of Pure Premium for Female Insured on High Risk Occupational Environment

Image 4.5 shows that the highest pure premiums insured by women at the level of high work environment risk are at the age of 18 years. Pure premiums decrease as the age of the insured increases. The chart shows that pure premium movements are not in line with the movement of severity. At the insured with ages 18 to 30 years, pure premiums are higher than severity. This shows that the frequency of claims for the insured at that age is more than 1. In the insured with the age of 31 years until the age of 56 years, pure premium is lower than the severity. This shows that the frequency of the insured's claim at that age also decreased to less than 1.

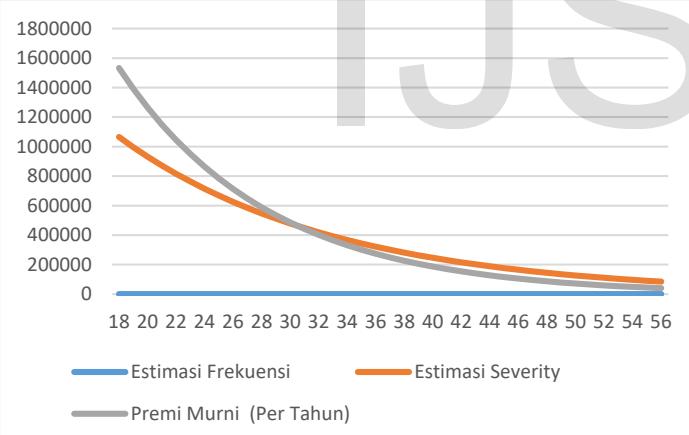


Figure 4.4 Graph of Pure Premium for Male Insured on High Risk Occupational Environment

Image 4.4 shows that the highest pure premiums insured by men at the level of high work environment risk are at the age of 18 years. Pure premiums decrease as the age of the insured increases. The chart shows that pure premium movements are not in line with the movement of severity. At the insured with ages 18 to 30 years, pure premiums are higher than severity. This shows that the frequency of claims for the insured at that age is more than 1. In the insured with the age of 31 years until the age of 56 years, pure premium is lower than the severity. This shows that the frequency of the insured's claim at that age also decreased to less than 1.

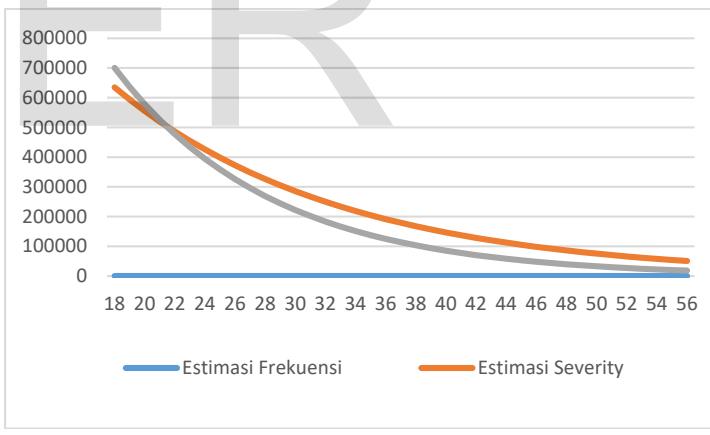


Figure 4.6 Graph of Pure Premium for Male Insured on Moderate Risk Occupational Environment

Image 4.6 shows that the highest pure premiums borne by men at the level of work environment risk are at the age of 18 years. Pure premiums decrease as the age of the insured increases. The chart shows that pure premium movements are not in line with the movement of severity. At the insured with ages 18 to 21, pure premiums are higher than severity. This shows that the frequency of claims for the insured at that age is more than 1. At the insured with the age of 22 years up to the age of 56 years, pure premium is lower than the severity. This shows that the frequency of the insured's claim at that age also decreased to less than 1.

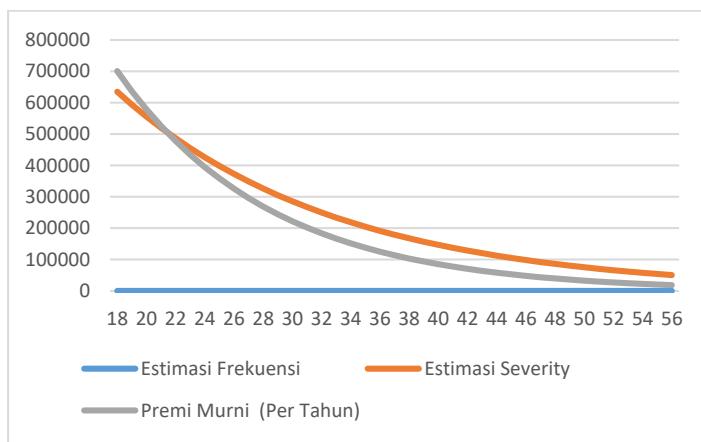


Figure 4.7 Graph of Pure Premium for Female Insured on Moderate Risk Occupational Environment

Image 4.7 shows that the highest pure premiums insured by women at the level of risk of the work environment are at the age of 18 years. Pure premiums decrease as the age of the insured increases. The chart shows that pure premium movements are not in line with the movement of severity. At the insured with ages 18 to 21, pure premiums are higher than severity. This shows that the frequency of claims for the insured at that age is more than 1. At the insured with the age of 22 years up to the age of 56 years, pure premium is lower than the severity. This shows that the frequency of the insured's claim at that age also decreased to less than 1.

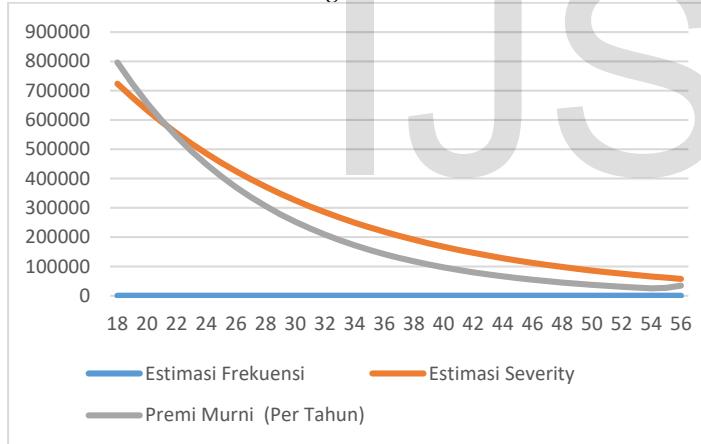


Figure 4.8 Graph of Pure Premium for Male Insured on Low Risk Occupational Environment

Image 4.8 shows that the highest premium for the male insured at the level of risk of a low work environment is at the age of 18 years. Pure premiums decrease as the age of the insured increases. The chart shows that pure premium movements are not in line with the movement of severity. At the insured with ages 18 to 21, pure premiums are higher than severity. This shows that the frequency of claims for the insured at that age is more than 1. At the insured with the age of 22 years up to the age of 56 years, pure premium is lower than the severity. This shows that the frequency of the insured's claim at that age also decreased to less than 1.

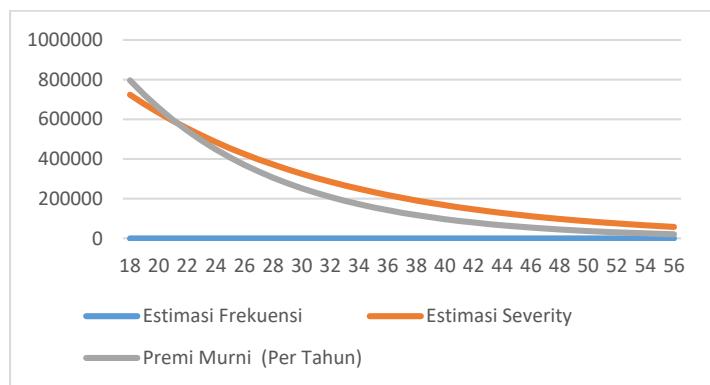


Figure 4.9 Graph of Pure Premium for Female Insured on Low Risk Occupational Environment

Image 4.9 shows that the highest premium of the insured woman at the level of risk of a low work environment is at the age of 18 years. Pure premiums decrease as the age of the insured increases. The chart shows that pure premium movements are not in line with the movement of severity. At the insured with ages 18 to 21, pure premiums are higher than severity. This shows that the frequency of claims for the insured at that age is more than 1. At the insured with the age of 22 years up to the age of 56 years, pure premium is lower than the severity. This shows that the frequency of the insured's claim at that age also decreased to less than 1.

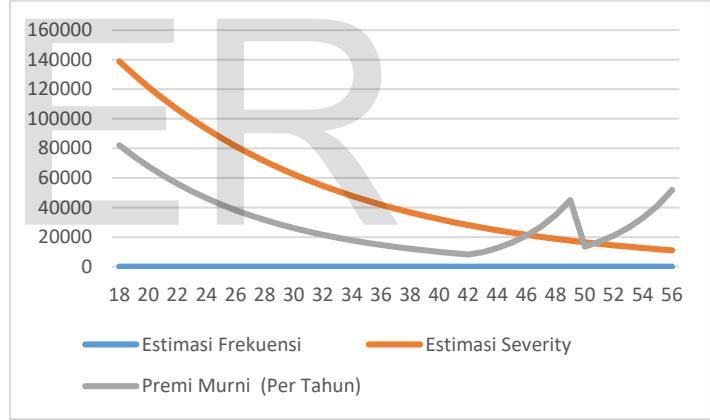


Figure 4.10 Graph of Pure Premium for Male Insured on Very Low Risk Occupational Environment

Image 4.10 shows that the highest pure premiums insured by men at the level of work environment risk are very low at the age of 18 years. Pure premiums decrease as the age of the insured increases. The chart shows that pure premium movements are not in line with the movement of severity. At the insured with ages 18 to 46, pure premiums are lower than severity. This shows that the frequency of claims for the insured at that age is less than 1. In the insured with the age of 47 years until the age of 56 years, pure premium is higher than the severity. This shows that the frequency of the insured's claim at that age also increases to more than 1. The pure premium of the insured aged 18 to 42 years has decreased. Pure premium goes up again to the insured at the age of 43 hing 49 years. Pure premium goes down to the insured at the age of 50 years, and returns to the insured who is 51 to 56 years old.

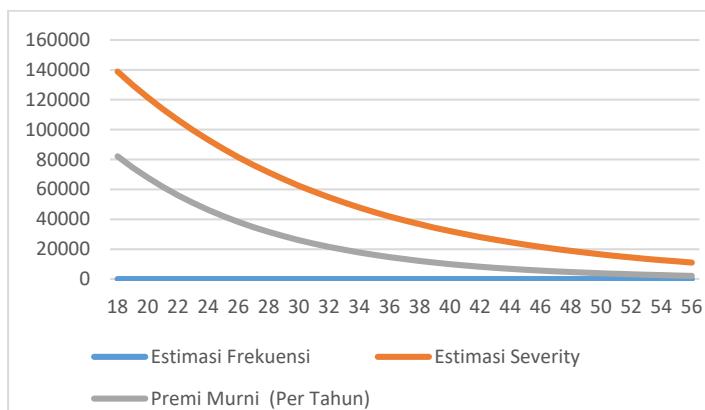


Figure 4.11 Graph of Pure Premium for Female Insured on Very Low Risk Occupational Environment

Image 4.11 shows that the highest pure premiums insured by women at the level of work environment risk are very low at the age of 18 years. Pure premiums decrease as the age of the insured increases. The chart shows that pure premium movements are not in line with the movement of severity. The pure premium insured by women at ages 18 to 56 years is lower than severity. This shows that the frequency of claims for the insured at that age is less than 1.

5 CONCLUSIONS

The Generalized Linear Model (GLM) is applied to data on accident insurance claims that have zero inflation. Based on the analysis carried out in this study, several things can be drawn as conclusions as follows.

1. The deviance and pearson chi-square test results show that the data has zero inflation which results in Overdispersion. The results of the analysis through the ZIP regression indicate that the frequency of claims with the model $\ln(\lambda)$ is influenced by five variables, namely age, the group of work environments with very high, high, medium, and low risk. Whereas gender and exposure have no significant effect on the model with a significance level $\alpha = 5\%$. For model $\log it(\theta)$, the sex variable is influential so that there are six variables that have a significant effect on the level of significance $\alpha = 5\%$ except exposure. The highest frequency of work accident claims is held by the insured at the age of 18 years. The frequency of claims decreased with age, both for the insured women and men, but again increased in the ages of the end of 50 years to 56 years in the insured man.
2. Analysis with the Gamma regression model shows that the model is suitable for modeling the severity of the claim data of PT. ABC after being diagnosed through distribution fitting and residual test, and tested whether the model is in accordance with the data used through residual deviation. The results of the analysis show that severity (Y_2) is influenced by six variables, namely age, a group of work

environments with very high, high, moderate, and low risk and exposure with a level of significance $\alpha = 5\%$, except gender. Great severity is not always in line with pure premiums.

3. Estimated pure premiums on PT ABC zero inflated accident insurance claims data are carried out using the Generalized Linear Model which assumes independence between expected frequency claims and expected severity. Pure premium estimation is calculated by multiplying the claims frequency expectation analyzed through ZIP regression and the expected severity analyzed by Gamma regression. Pure premium estimation results for PT. ABC is presented in table 4.12, table 4.13, table 4.14, table 4.15, and table 4.16. The severity is not always in line with pure premium so it can be concluded that the frequency of claims is a component that has more influence on the movement of pure premiums. Pure premiums produced by a work environment with a low risk are greater than those in a medium-risk work environment

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7 APPENDICES

Appendix 7.1 Pure Premium Table of Accident Insurance for Male on Very High Risk Occupational Environment

Usia	In lambda	logit teta	Pzero	Pcount	Premi Murni (Per Bulan)
18	1,285921652	1,675399484	0,500001688	0,80899437	Rp194.923
19	1,248973732	0,929975316	0,500002325	0,743373278	Rp177.127
20	1,213087424	1,280507476	0,500003201	0,681916372	Rp160.956
21	1,178232224	1,76316E-05	0,500004408	0,624298821	Rp146.261
22	1,144378506	1,242775	0,776046674	0,703322947	Rp132.908
23	1,111497494	1,334282937	0,500008357	0,51942747	Rp120.774
24	1,079561241	1,460282969	0,500011507	0,471660045	Rp109.748
25	1,0485426	0,633775728	0,500015844	0,426699494	Rp99.728
26	1,018415207	0,887266247	0,500021817	0,384341246	Rp90.623
27	0,989153453	0,000120159	0,50003004	0,344397814	Rp82.349
28	0,960732466	0,00016545	0,500041363	0,306696971	Rp74.831
29	0,933128089	0,000227813	0,500056953	0,27108008	Rp67.999
30	0,906316859	0,000313682	0,50007842	0,237400521	Rp61.791
31	0,880275986	0,000431916	0,500107979	0,205522188	Rp56.150
32	0,854983336	0,000594717	0,500148679	0,175318004	Rp51.024
33	0,830417411	0,000818882	0,50020472	0,146668413	Rp46.365
34	0,806557329	0,00112754	0,500281885	0,119459769	Rp42.132
35	0,783382811	0,001552539	0,500388135	0,09358256	Rp38.286
36	0,760874157	0,002137732	0,500534433	0,068929349	Rp34.790
37	0,739012236	0,002943499	0,500735874	0,045392302	Rp31.614
38	0,717778467	0,004052982	0,501013244	0,022860119	Rp28.728
39	0,697154799	0,005580657	0,501395161	0,001214133	Rp26.105
40	0,677123703	0,007684154	0,501921029	0,98032323	Rp23.722
41	0,657668154	0,010580514	0,502645104	0,96003717	Rp21.556
42	0,638771614	0,014568588	0,503642082	0,940177689	Rp19.588
43	0,620418021	0,020059872	0,5050148	0,920526589	Rp17.800
44	0,602591776	0,027620965	0,506904802	0,900809704	Rp16.175
45	0,585277725	0,038032033	0,509506862	0,880675313	Rp14.698
46	0,568461153	0,052367307	0,513088836	0,859665058	Rp13.356
47	0,552127766	0,072105922	0,518018674	0,837175006	Rp12.137
48	0,536263679	0,099284541	0,524800766	0,812404067	Rp11.029
49	0,52085541	0,136707496	0,534123746	0,784287341	Rp10.022
50	0,505889861	0,188236148	0,546920575	0,751414404	Rp9.107
51	0,491354311	0,259187303	0,564436502	0,711940899	Rp8.275
52	0,477236406	0,356881816	0,588285401	0,663525175	Rp7.520
53	0,463524146	0,49139996	0,620436172	0,603379842	Rp7.244
54	0,450205875	0,676621532	0,662984242	0,528654746	Rp9.332
55	0,437270274	0,931657985	0,717411534	0,437581043	Rp12.022
56	0,424706346	1,282824388	0,782930166	0,331930451	Rp15.487

Appendix 7.2 Pure Premium Table of Accident Insurance for Male on High Risk Occupational Environment

Usia	In lambda	logit teta	Pzero	Pcount	Estimasi Frekuensi	Estimasi Severity	Premi Murni (Per Tahun)	Premi Murni (Per Bulan)
18	1,439502	1,807336	0,500000452	0,10929616	1,439502402	Rp1.065.043	Rp1.533.133	Rp131.295
19	1,398142	1,49E+00	0,500000622	0,023833081	1,398141703	Rp996.438	Rp1.393.162	Rp119.308
20	1,357969	1,426576	0,500000857	0,94414154	1,357969406	Rp932.253	Rp1.265.970	Rp108.415
21	1,318951	1,471814	0,50000118	0,869744564	1,318951364	Rp872.201	Rp1.150.391	Rp98.517
22	1,281054	1,496535	0,500001624	0,800211189	1,281054414	Rp816.018	Rp1.045.364	Rp89.523
23	1,244246	0,94525	0,500002236	0,735151432	1,244246343	Rp763.454	Rp949.925	Rp81.350
24	1,208496	1,231695	0,500003079	0,674211865	1,208495866	Rp714.276	Rp863.199	Rp73.923
25	1,173773	0,695953	0,50000424	0,617071719	1,173772593	Rp668.266	Rp784.392	Rp67.174
26	1,140047	0,23352	0,500005838	0,563439427	1,140047012	Rp625.219	Rp712.779	Rp61.041
27	1,10729	0,032154	0,500008039	0,513049571	1,107290455	Rp584.945	Rp647.704	Rp55.468
28	1,075475	0,442737	0,500011068	0,465660162	1,075475081	Rp547.266	Rp588.571	Rp50.404
29	1,044574	0,060962	0,50001524	0,421050213	1,044573847	Rp512.014	Rp534.836	Rp45.802
30	1,01456	0,08394	0,500020985	0,379017563	1,014560486	Rp479.032	Rp486.007	Rp41.621
31	0,985409	0,000116	0,500028895	0,339376915	0,985409488	Rp448.175	Rp441.636	Rp37.821
32	0,957096	0,000159	0,500039786	0,301958046	0,957096076	Rp419.306	Rp401.316	Rp34.368
33	0,929596	0,000219	0,500054782	0,266604162	0,929596182	Rp392.296	Rp364.677	Rp31.230
34	0,902886	0,000302	0,500075431	0,233170356	0,902886433	Rp367.026	Rp331.383	Rp28.379
35	0,876944	0,000415	0,500103863	0,201522133	0,876944125	Rp343.384	Rp301.129	Rp25.788
36	0,851747	0,000572	0,500143012	0,171533956	0,851747208	Rp321.265	Rp273.637	Rp23.434
37	0,827274	0,000788	0,500196917	0,143087774	0,827274265	Rp300.571	Rp248.654	Rp21.294
38	0,803504	0,001085	0,50027114	0,116071453	0,803504495	Rp281.209	Rp225.953	Rp19.350
39	0,780418	0,001493	0,500373339	0,09037705	0,780417692	Rp263.095	Rp205.324	Rp17.584
40	0,757994	0,002056	0,50051406	0,065898818	0,757994234	Rp246.148	Rp186.579	Rp15.978
41	0,736215	0,002831	0,500707823	0,042530814	0,736215061	Rp230.292	Rp169.544	Rp14.519
42	0,715062	0,003898	0,50097462	0,02016394	0,715061662	Rp215.458	Rp154.066	Rp13.194
43	0,694516	0,005368	0,501341978	0,998682179	0,694516055	Rp201.579	Rp140.000	Rp11.989
44	0,674561	0,007391	0,501847801	0,977957711	0,674560777	Rp188.594	Rp127.218	Rp10.895
45	0,655179	0,010177	0,502544275	0,957844479	0,655178868	Rp176.446	Rp115.604	Rp9.900
46	0,636354	0,014013	0,503503252	0,938169639	0,636353852	Rp165.080	Rp105.049	Rp8.996
47	0,61807	0,019295	0,504823649	0,918722107	0,618069728	Rp154.446	Rp95.459	Rp8.175
48	0,600311	0,026568	0,506641625	0,899237149	0,600310955	Rp144.498	Rp86.743	Rp7.429
49	0,583062	0,036582	0,509144547	0,879375618	0,583062438	Rp135.190	Rp78.824	Rp6.750
50	0,56631	0,050371	0,512590109	0,858695993	0,566309517	Rp126.481	Rp71.628	Rp6.134
51	0,550038	0,069357	0,51733237	0,836616876	0,550037952	Rp118.334	Rp65.088	Rp5.574
52	0,534234	0,0955	0,523856834	0,812367229	0,534233911	Rp110.712	Rp59.146	Rp5.065
53	0,518884	0,131496	0,532826776	0,784921788	0,518883962	Rp103.580	Rp53.746	Rp4.603
54	0,503975	0,181061	0,545141907	0,752921178	0,503975058	Rp96.908	Rp48.839	Rp4.183
55	0,489495	0,249307	0,562005966	0,714583471	0,489494526	Rp90.666	Rp44.380	Rp3.801
56	0,47543	0,343278	0,584986473	0,667634703	0,475430058	Rp84.825	Rp40.329	Rp3.454

Appendix 7.3 Pure Premium Table of Accident Insurance for Male on Moderate Risk Occupational Environment

Usia	In lambda	logit teta	Pzero	Pcount	Estimasi Frekuensi	Estimasi Severity	Premi Murni (Per Tahun)	Premi Murni (Per Bulan)
18	1,103565167	6,31964E-07	0,500000158	0,40744727	1,103565	Rp634.773	Rp700.514	Rp59.991
19	1,07185683	8,70168E-07	0,500000218	0,460398312	1,071857	Rp593.884	Rp636.559	Rp54.514
20	1,041059558	1,19816E-06	0,5000003	0,416107312	1,04106	Rp555.629	Rp578.443	Rp49.537
21	1,011147172	1,64977E-06	0,500000412	0,374375116	1,011147	Rp519.838	Rp525.633	Rp45.014
22	0,982094248	2,27162E-06	0,500000568	0,335019544	0,982094	Rp486.352	Rp477.644	Rp40.905
23	0,953876091	3,12785E-06	0,500000782	0,297873747	0,953876	Rp455.024	Rp434.036	Rp37.170
24	0,926468716	4,30682E-06	0,500001077	0,262784725	0,926469	Rp425.713	Rp394.410	Rp33.777
25	0,899848827	5,93017E-06	0,500001483	0,229612011	0,899849	Rp398.291	Rp358.402	Rp30.693
26	0,873993798	8,16541E-06	0,500002041	0,198226485	0,873994	Rp372.635	Rp325.681	Rp27.891
27	0,848881651	1,12432E-05	0,500002811	0,168509318	0,848882	Rp348.632	Rp295.947	Rp25.344
28	0,824491043	1,5481E-05	0,50000387	0,140351014	0,824491	Rp326.174	Rp268.928	Rp23.031
29	0,800801242	2,13162E-05	0,500005329	0,11365055	0,800801	Rp305.164	Rp244.375	Rp20.928
30	0,777792111	2,93509E-05	0,500007338	0,088314593	0,777792	Rp285.506	Rp222.065	Rp19.017
31	0,755444093	4,0414E-05	0,500010103	0,064256789	0,755444	Rp267.115	Rp201.791	Rp17.281
32	0,733738192	5,5647E-05	0,500013912	0,041397111	0,733738	Rp249.909	Rp183.368	Rp15.703
33	0,71265596	7,66219E-05	0,500019155	0,019661253	0,712656	Rp233.811	Rp166.627	Rp14.270
34	0,692179475	0,000105503	0,500026376	0,998980062	0,692179	Rp218.750	Rp151.414	Rp12.967
35	0,672291334	0,000145269	0,500036317	0,979288997	0,672291	Rp204.659	Rp137.591	Rp11.783
36	0,652974631	0,000200025	0,500050006	0,960527595	0,652975	Rp191.476	Rp125.029	Rp10.707
37	0,634212949	0,00027542	0,500068855	0,942638942	0,634213	Rp179.142	Rp113.614	Rp9.730
38	0,615990338	0,000379233	0,500094808	0,92556911	0,61599	Rp167.603	Rp103.242	Rp8.841
39	0,598291312	0,000522176	0,500130544	0,909266552	0,598291	Rp156.806	Rp93.816	Rp8.034
40	0,581100825	0,000718998	0,500179749	0,893681422	0,581101	Rp146.706	Rp85.251	Rp7.301
41	0,564404266	0,000990007	0,500247502	0,878764759	0,564404	Rp137.256	Rp77.468	Rp6.634
42	0,548187444	0,001363167	0,500340792	0,864467514	0,548187	Rp128.414	Rp70.395	Rp6.029
43	0,532436573	0,001876981	0,500469245	0,850739304	0,532437	Rp120.142	Rp63.968	Rp5.478
44	0,517138267	0,002584464	0,500646116	0,837526829	0,517138	Rp112.403	Rp58.128	Rp4.978
45	0,502279521	0,003558616	0,500889653	0,824771789	0,50228	Rp105.163	Rp52.821	Rp4.524
46	0,487847706	0,004899952	0,501224986	0,812408122	0,487848	Rp98.389	Rp47.999	Rp4.111
47	0,473830555	0,006746873	0,501686712	0,80035832	0,473831	Rp92.051	Rp43.617	Rp3.735
48	0,460216154	0,009289947	0,50232247	0,788528453	0,460216	Rp86.122	Rp39.635	Rp3.394
49	0,44699293	0,012791573	0,50319785	0,776801455	0,446993	Rp80.574	Rp36.016	Rp3.084
50	0,434149645	0,017613053	0,504403149	0,765028004	0,43415	Rp75.384	Rp32.728	Rp2.803
51	0,421675381	0,024251876	0,506062672	0,753014154	0,421675	Rp70.528	Rp29.740	Rp2.547
52	0,409559536	0,033393046	0,508347486	0,740504515	0,40956	Rp65.985	Rp27.025	Rp2.314
53	0,39779181	0,045979764	0,511492916	0,727159453	0,397792	Rp61.734	Rp24.557	Rp2.103
54	0,386362203	0,063310746	0,515822402	0,712524274	0,386362	Rp57.758	Rp22.315	Rp1.911
55	0,375260998	0,087174232	0,521779767	0,695987961	0,375261	Rp54.037	Rp20.278	Rp1.737
56	0,36447876	0,120032493	0,529972146	0,676728878	0,364479	Rp50.556	Rp18.427	Rp1.578

Appendix 10. Pure Premium Table of Accident Insurance for Male on Low Risk Occupational Environment

Usia	In lambda	logit teta	Pzero	Pcount	Estimasi	Estimasi	Premi Murni	Premi Murni
					Frekuensi	Severity	(Per Tahun)	(Per Bulan)
18	1,100310816	3,12654E-06	0,500000782	0,502547607	1,100310816	Rp723.665	Rp796.257	Rp68.190
19	1,068695985	4,30501E-06	0,500001076	0,455787006	1,068695985	Rp677.050	Rp723.561	Rp61.964
20	1,037989532	5,92768E-06	0,500001482	0,411763155	1,037989532	Rp633.438	Rp657.502	Rp56.307
21	1,008165356	8,16198E-06	0,50000204	0,370278624	1,008165356	Rp592.635	Rp597.474	Rp51.167
22	0,979198107	1,12385E-05	0,50000281	0,331152765	0,979198107	Rp554.460	Rp542.926	Rp46.495
23	0,951063164	1,54745E-05	0,500003869	0,294220064	0,951063164	Rp518.744	Rp493.359	Rp42.250
24	0,923736612	2,13073E-05	0,500005327	0,25932867	0,923736612	Rp485.329	Rp448.316	Rp38.393
25	0,897195224	2,93385E-05	0,500007335	0,22633908	0,897195224	Rp454.067	Rp407.386	Rp34.888
26	0,871416439	4,0397E-05	0,500010099	0,195122942	0,871416439	Rp424.818	Rp370.193	Rp31.703
27	0,846378348	5,56237E-05	0,500013906	0,165561977	0,846378348	Rp397.453	Rp336.396	Rp28.808
28	0,822059666	7,65897E-05	0,500019147	0,137547	0,822059666	Rp371.851	Rp305.684	Rp26.178
29	0,798439725	0,000105458	0,500026365	0,110977006	0,798439725	Rp347.898	Rp277.776	Rp23.788
30	0,775498446	0,000145208	0,500036302	0,085758324	0,775498446	Rp325.488	Rp252.415	Rp21.616
31	0,753216331	0,000199941	0,500049985	0,061803816	0,753216331	Rp304.522	Rp229.371	Rp19.643
32	0,73157444	0,000275305	0,500068826	0,039032091	0,73157444	Rp284.906	Rp208.430	Rp17.850
33	0,710554378	0,000379074	0,500094769	0,01736672	0,710554378	Rp266.553	Rp189.401	Rp16.220
34	0,690138277	0,000521957	0,500130489	0,998980062	0,690138277	Rp249.383	Rp172.109	Rp14.739
35	0,670308785	0,000718696	0,500179674	0,979288997	0,670308785	Rp233.319	Rp156.396	Rp13.393
36	0,651049046	0,000989592	0,500247398	0,960527595	0,651049046	Rp218.290	Rp142.117	Rp12.171
37	0,63234269	0,001362595	0,500340649	0,942638942	0,63234269	Rp204.229	Rp129.143	Rp11.060
38	0,614173818	0,001876193	0,500469048	0,92556911	0,614173818	Rp191.073	Rp117.352	Rp10.050
39	0,596526985	0,00258338	0,500645845	0,909266552	0,596526985	Rp178.765	Rp106.638	Rp9.132
40	0,579387192	0,003557124	0,50088928	0,893681422	0,579387192	Rp167.250	Rp96.903	Rp8.299
41	0,56273987	0,004897897	0,501224472	0,878764759	0,56273987	Rp156.477	Rp88.056	Rp7.541
42	0,54657087	0,006744044	0,501686004	0,864467514	0,54657087	Rp146.397	Rp80.016	Rp6.852
43	0,530866448	0,009286051	0,502321496	0,850739304	0,530866448	Rp136.967	Rp72.711	Rp6.227
44	0,515613255	0,012786208	0,503196508	0,837526829	0,515613255	Rp128.144	Rp66.073	Rp5.658
45	0,500798327	0,017605666	0,504401303	0,824771789	0,500798327	Rp119.890	Rp60.041	Rp5.142
46	0,486409071	0,024241705	0,506060129	0,812408122	0,486409071	Rp112.167	Rp54.559	Rp4.672
47	0,472433256	0,033379041	0,508343985	0,80035832	0,472433256	Rp104.942	Rp49.578	Rp4.246
48	0,458859003	0,045960479	0,511488098	0,788528453	0,458859003	Rp98.182	Rp45.052	Rp3.858
49	0,445674774	0,063284193	0,51581577	0,776801455	0,445674774	Rp91.857	Rp40.939	Rp3.506
50	0,432869362	0,08713767	0,521770644	0,765028004	0,432869362	Rp85.940	Rp37.201	Rp3.186
51	0,420431884	0,11998215	0,529959605	0,753014154	0,420431884	Rp80.404	Rp33.805	Rp2.895
52	0,408351768	0,165206578	0,541207962	0,740504515	0,408351768	Rp75.225	Rp30.718	Rp2.631
53	0,396618745	0,227477283	0,556625354	0,727159453	0,396618745	Rp70.380	Rp27.914	Rp2.390
54	0,385222843	0,313219455	0,577670898	0,712524274	0,385222843	Rp65.846	Rp25.365	Rp2.172
55	0,374154375	0,431280107	0,606179305	0,695987961	0,431280107	Rp61.605	Rp26.569	Rp2.275
56	0,363403933	0,593840924	0,644245946	0,676728878	0,593840924	Rp57.636	Rp34.227	Rp2.931

Appendix 11. Pure Premium Table of Accident Insurance for Male on Very Low Risk Occupational Environment

Usia	In lambda	logit teta	Pzero	Pcount	Estimasi Frekuensi	Estimasi Severity	Premi Murni (Per Tahun)	Premi Murni (Per Bulan)
18	0,59169558	0,000126	0,500032	0,096532	0,591696	Rp138.839	Rp82.151	Rp7.035
19	0,574694606	0,000174	0,500043	0,111783	0,574695	Rp129.896	Rp74.650	Rp6.393
20	0,558182114	0,000239	0,50006	0,126358	0,558182	Rp121.529	Rp67.835	Rp5.809
21	0,542144071	0,000329	0,500082	0,140297	0,542144	Rp113.700	Rp61.642	Rp5.279
22	0,526566842	0,000453	0,500113	0,153637	0,526567	Rp106.376	Rp56.014	Rp4.797
23	0,511437188	0,000624	0,500156	0,166417	0,511437	Rp99.524	Rp50.900	Rp4.359
24	0,49674225	0,00086	0,500215	0,178674	0,496742	Rp93.113	Rp46.253	Rp3.961
25	0,482469535	0,001184	0,500296	0,190444	0,48247	Rp87.115	Rp42.030	Rp3.599
26	0,468606913	0,00163	0,500407	0,201768	0,468607	Rp81.504	Rp38.193	Rp3.271
27	0,455142601	0,002244	0,500561	0,212685	0,455143	Rp76.254	Rp34.706	Rp2.972
28	0,442065154	0,00309	0,500772	0,223243	0,442065	Rp71.342	Rp31.538	Rp2.701
29	0,429363457	0,004255	0,501064	0,233494	0,429363	Rp66.746	Rp28.658	Rp2.454
30	0,417026713	0,005858	0,501465	0,243501	0,417027	Rp62.447	Rp26.042	Rp2.230
31	0,405044436	0,008066	0,502017	0,253339	0,405044	Rp58.424	Rp23.664	Rp2.027
32	0,393406441	0,011107	0,502777	0,263105	0,393406	Rp54.661	Rp21.504	Rp1.842
33	0,382102837	0,015293	0,503823	0,272921	0,382103	Rp51.140	Rp19.541	Rp1.673
34	0,371124015	0,021058	0,505264	0,99898	0,371124	Rp47.846	Rp17.757	Rp1.521
35	0,360460644	0,028995	0,507248	0,979289	0,360461	Rp44.764	Rp16.136	Rp1.382
36	0,350103659	0,039924	0,50998	0,960528	0,350104	Rp41.880	Rp14.662	Rp1.256
37	0,340044258	0,054972	0,51374	0,942639	0,340044	Rp39.182	Rp13.324	Rp1.141
38	0,33027389	0,075693	0,518914	0,925569	0,330274	Rp36.658	Rp12.107	Rp1.037
39	0,32078425	0,104224	0,526032	0,909267	0,320784	Rp34.297	Rp11.002	Rp942
40	0,311567273	0,143508	0,535816	0,893681	0,311567	Rp32.088	Rp9.998	Rp856
41	0,302615124	0,1976	0,54924	0,878765	0,302615	Rp30.021	Rp9.085	Rp778
42	0,293920193	0,272081	0,567604	0,864468	0,29392	Rp28.087	Rp8.255	Rp707
43	0,285475091	0,374635	0,592579	0,850739	0,374635	Rp26.278	Rp9.845	Rp843
44	0,277272639	0,515845	0,626176	0,837527	0,515845	Rp24.585	Rp12.682	Rp1.086
45	0,269305865	0,710281	0,670463	0,824772	0,710281	Rp23.002	Rp16.338	Rp1.399
46	0,261567998	0,978005	0,726712	0,812408	0,978005	Rp21.520	Rp21.047	Rp1.802
47	0,254052459	1,34664	0,79358	0,800358	1,34664	Rp20.134	Rp27.113	Rp2.322
48	0,246752862	1,854225	0,500082	0,788528	1,854225	Rp18.837	Rp34.928	Rp2.991
49	0,239663002	2,553131	0,500113	0,776801	2,553131	Rp17.623	Rp44.995	Rp3.853
50	0,232776852	0,818321	0,500156	0,765028	0,818321	Rp16.488	Rp13.493	Rp1.155
51	0,22608856	1,094392	0,500215	0,753014	1,094392	Rp15.426	Rp16.882	Rp1.446
52	0,219592439	1,4636	0,500296	0,740505	1,4636	Rp14.432	Rp21.123	Rp1.809
53	0,213282969	1,957366	0,500407	0,727159	1,957366	Rp13.503	Rp26.430	Rp2.263
54	0,207154787	2,61771	0,500561	0,712524	2,61771	Rp12.633	Rp33.069	Rp2.832
55	0,201202684	3,50083	0,500772	0,695988	3,50083	Rp11.819	Rp41.377	Rp3.543
56	0,195421601	4,681882	0,501064	0,676729	4,681882	Rp11.058	Rp51.772	Rp4.434

Appendix 12. Pure Premium Table of Accident Insurance for Female on Very High Risk Occupational Environment

In lambda	logit teta	Pzero	Pcount	Estimasi Frekuensi	Estimasi Severity	Premi Murni (Per Tahun)	Premi Murni (Per Bulan)
1,285921652	2,44E-08	0,500000006	0,809000457	1,285921652	Rp 1.770.034	Rp 2.276.125	Rp 194.923
1,248973732	3,36E-08	0,500000008	0,743381355	1,248973732	Rp 1.656.017	Rp 2.068.321	Rp 177.127
1,213087424	4,63E-08	0,500000012	0,681927102	1,213087424	Rp 1.549.344	Rp 1.879.489	Rp 160.956
1,178232224	6,37E-08	0,500000016	0,624313089	1,178232224	Rp 1.449.542	Rp 1.707.897	Rp 146.261
1,144378506	8,77E-08	0,500000022	0,570244408	1,144378506	Rp 1.356.170	Rp 1.551.971	Rp 132.908
1,111497494	1,21E-07	0,500000003	0,519452774	1,111497494	Rp 1.268.812	Rp 1.410.281	Rp 120.774
1,079561241	1,66E-07	0,500000042	0,471693792	1,079561241	Rp 1.187.081	Rp 1.281.526	Rp 109.748
1,0485426	2,29E-07	0,500000057	0,426744542	1,0485426	Rp 1.110.614	Rp 1.164.527	Rp 99.728
1,018415207	3,15E-07	0,500000079	0,384401434	1,018415207	Rp 1.039.074	Rp 1.058.209	Rp 90.623
0,989153453	4,34E-07	0,500000109	0,344478298	0,989153453	Rp 972.142	Rp 961.597	Rp 82.349
0,960732466	5,98E-07	0,500000149	0,306804686	0,960732466	Rp 909.521	Rp 873.806	Rp 74.831
0,933128089	8,23E-07	0,500000206	0,271224358	0,933128089	Rp 850.934	Rp 794.030	Rp 67.999
0,906316859	1,13E-06	0,500000283	0,237593925	0,906316859	Rp 796.121	Rp 721.538	Rp 61.791
0,880275986	1,56E-06	0,50000039	0,205781646	0,880275986	Rp 744.838	Rp 655.663	Rp 56.150
0,854983336	2,15E-06	0,500000537	0,175666336	0,854983336	Rp 696.859	Rp 595.803	Rp 51.024
0,830417411	2,96E-06	0,50000074	0,147136401	0,830417411	Rp 651.971	Rp 541.408	Rp 46.365
0,806557329	4,07E-06	0,500001019	0,120088961	0,806557329	Rp 609.974	Rp 491.979	Rp 42.132
0,783382811	5,61E-06	0,500001402	0,094429065	0,783382811	Rp 570.682	Rp 447.063	Rp 38.286
0,760874157	7,72E-06	0,500001931	0,070068981	0,760874157	Rp 533.922	Rp 406.247	Rp 34.790
0,739012236	1,06E-05	0,500002659	0,046927557	0,739012236	Rp 499.529	Rp 369.158	Rp 31.614
0,717778467	1,46E-05	0,500003661	0,024929637	0,717778467	Rp 467.352	Rp 335.455	Rp 28.728
0,697154799	2,02E-05	0,500005041	0,004005537	0,697154799	Rp 437.247	Rp 304.829	Rp 26.105
0,677123703	2,78E-05	0,500006941	0,98032323	0,677123703	Rp 409.082	Rp 276.999	Rp 23.722
0,657668154	3,82E-05	0,500009558	0,96003717	0,657668154	Rp 382.731	Rp 251.710	Rp 21.556
0,638771614	5,26E-05	0,50001316	0,940177689	0,638771614	Rp 358.077	Rp 228.729	Rp 19.588
0,620418021	7,25E-05	0,500018121	0,920526589	0,620418021	Rp 335.011	Rp 207.847	Rp 17.800
0,602591776	9,98E-05	0,500024951	0,900809704	0,602591776	Rp 313.431	Rp 188.871	Rp 16.175
0,585277725	0,000137	0,500034355	0,880675313	0,585277725	Rp 293.242	Rp 171.628	Rp 14.698
0,568461153	0,000189	0,500047305	0,859665058	0,568461153	Rp 274.352	Rp 155.959	Rp 13.356
0,552127766	0,000261	0,500065135	0,837175006	0,552127766	Rp 256.680	Rp 141.720	Rp 12.137
0,536263679	0,000359	0,500089687	0,812404067	0,536263679	Rp 240.146	Rp 128.781	Rp 11.029
0,52085541	0,000494	0,500123492	0,784287341	0,52085541	Rp 224.677	Rp 117.024	Rp 10.022
0,505889861	0,00068	0,500170039	0,751414404	0,505889861	Rp 210.204	Rp 106.340	Rp 9.107
0,491354311	0,000937	0,500234131	0,711940899	0,491354311	Rp 196.664	Rp 96.632	Rp 8.275
0,477236406	0,00129	0,500322382	0,663525175	0,477236406	Rp 183.996	Rp 87.809	Rp 7.520
0,463524146	0,001776	0,500443896	0,603379842	0,463524146	Rp 172.143	Rp 79.793	Rp 6.833
0,450205875	0,002445	0,500611212	0,528654746	0,450205875	Rp 161.055	Rp 72.508	Rp 6.209
0,437270274	0,003366	0,500841593	0,437581043	0,437270274	Rp 150.680	Rp 65.888	Rp 5.643
0,424706346	0,004635	0,501158811	0,331930451	0,424706346	Rp 140.974	Rp 59.873	Rp 5.127

Appendix 13. Pure Premium Table of Accident Insurance for Female on High Risk Occupational Environment

Usia	In lambda	logit teta	Pzero	Pcount	Estimasi Frekuensi	Estimasi Severity	Premi Murni (Per Tahun)	Premi Murni (Per Bulan)
18	1,439502	6,53E-09	0,500000002	0,109298059	1,439502402	Rp 1.065.043	Rp 1.533.133	Rp 131.295
19	1,398142	8,99E-09	0,500000002	0,02383559	1,398141703	Rp 996.438	Rp 1.393.162	Rp 119.308
20	1,357969	1,24E-08	0,500000003	0,465692491	1,357969406	Rp 932.253	Rp 1.265.970	Rp 108.415
21	1,318951	1,7E-08	0,500000004	0,421093372	1,318951364	Rp 872.201	Rp 1.150.391	Rp 98.517
22	1,281054	2,35E-08	0,500000006	0,379075233	1,281054414	Rp 816.018	Rp 1.045.364	Rp 89.523
23	1,244246	3,23E-08	0,500000008	0,339454041	1,244246343	Rp 763.454	Rp 949.925	Rp 81.350
24	1,208496	4,45E-08	0,500000011	0,302061279	1,208495866	Rp 714.276	Rp 863.199	Rp 73.923
25	1,173773	6,13E-08	0,500000015	0,26674245	1,173772593	Rp 668.266	Rp 784.392	Rp 67.174
26	1,140047	8,44E-08	0,500000021	0,233355751	1,140047012	Rp 625.219	Rp 712.779	Rp 61.041
27	1,10729	1,16E-07	0,500000029	0,20177087	1,107290455	Rp 584.945	Rp 647.704	Rp 55.468
28	1,075475	1,6E-07	0,50000004	0,171867927	1,075475081	Rp 547.266	Rp 588.571	Rp 50.404
29	1,044574	2,2E-07	0,500000055	0,421093372	1,044573847	Rp 512.014	Rp 534.836	Rp 45.802
30	1,01456	3,03E-07	0,500000076	0,379075233	1,014560486	Rp 479.032	Rp 486.007	Rp 41.621
31	0,985409	4,18E-07	0,500000104	0,339454041	0,985409488	Rp 448.175	Rp 441.636	Rp 37.821
32	0,957096	5,75E-07	0,500000144	0,302061279	0,957096076	Rp 419.306	Rp 401.316	Rp 34.368
33	0,929596	7,92E-07	0,500000198	0,26674245	0,929596182	Rp 392.296	Rp 364.677	Rp 31.230
34	0,902886	1,09E-06	0,500000273	0,233355751	0,902886433	Rp 367.026	Rp 331.383	Rp 28.379
35	0,876944	1,5E-06	0,500000375	0,20177087	0,876944125	Rp 343.384	Rp 301.129	Rp 25.788
36	0,851747	2,07E-06	0,500000517	0,171867927	0,851747208	Rp 321.265	Rp 273.637	Rp 23.434
37	0,827274	2,85E-06	0,500000712	0,143536509	0,827274265	Rp 300.571	Rp 248.654	Rp 21.294
38	0,803504	3,92E-06	0,50000098	0,116674816	0,803504495	Rp 281.209	Rp 225.953	Rp 19.350
39	0,780418	5,4E-06	0,500001349	0,091188876	0,780417692	Rp 263.095	Rp 205.324	Rp 17.584
40	0,757994	7,43E-06	0,500001857	0,066991855	0,757994234	Rp 246.148	Rp 186.579	Rp 15.978
41	0,736215	1,02E-05	0,500002558	0,04400342	0,736215061	Rp 230.292	Rp 169.544	Rp 14.519
42	0,715062	1,41E-05	0,500003522	0,022149168	0,715061662	Rp 215.458	Rp 154.066	Rp 13.194
43	0,694516	1,94E-05	0,500004849	0,405901125	0,694516055	Rp 201.579	Rp 140.000	Rp 11.989
44	0,674561	2,67E-05	0,500006677	0,29971106	0,674560777	Rp 188.594	Rp 127.218	Rp 10.895
45	0,655179	3,68E-05	0,500009193	0,201060912	0,655178868	Rp 176.446	Rp 115.604	Rp 9.900
46	0,636354	5,06E-05	0,500012659	0,109298059	0,636353852	Rp 165.080	Rp 105.049	Rp 8.996
47	0,61807	6,97E-05	0,50001743	0,02383559	0,618069728	Rp 154.446	Rp 95.459	Rp 8.175
48	0,600311	9,6E-05	0,500024	0,465692491	0,600310955	Rp 144.498	Rp 86.743	Rp 7.429
49	0,583062	0,000132	0,500033046	0,421093372	0,583062438	Rp 135.190	Rp 78.824	Rp 6.750
50	0,56631	0,000182	0,500045502	0,379075233	0,566309517	Rp 126.481	Rp 71.628	Rp 6.134
51	0,550038	0,000251	0,500062652	0,339454041	0,550037952	Rp 118.334	Rp 65.088	Rp 5.574
52	0,534234	0,000345	0,500086268	0,302061279	0,534233911	Rp 110.712	Rp 59.146	Rp 5.065
53	0,518884	0,000475	0,500118784	0,26674245	0,518883962	Rp 103.580	Rp 53.746	Rp 4.603
54	0,503975	0,000654	0,500163557	0,233355751	0,503975058	Rp 96.908	Rp 48.839	Rp 4.183
55	0,489495	0,000901	0,500225206	0,20177087	0,489494526	Rp 90.666	Rp 44.380	Rp 3.801
56	0,47543	0,00124	0,500310093	0,171867927	0,475430058	Rp 84.825	Rp 40.329	Rp 3.454

Appendix 14. Pure Premium Table of Accident Insurance for Female on Moderate Risk Occupational Environment

Usia	In lambda	logit teta	Pzero	Pcount	Estimasi	Estimasi	Premi Murni	Premi Murni
					Frekuensi	Severity	(Per Tahun)	(Per Bulan)
18	1,103565	2,28E-09	0,5000000001	0,407448	1,103565167	Rp 634.773	Rp 700.514	Rp 59.991
19	1,071857	3,14E-09	0,5000000001	0,460399	1,07185683	Rp 593.884	Rp 636.559	Rp 54.514
20	1,04106	4,33E-09	0,5000000001	0,416108	1,041059558	Rp 555.629	Rp 578.443	Rp 49.537
21	1,011147	5,96E-09	0,5000000001	0,374376	1,011147172	Rp 519.838	Rp 525.633	Rp 45.014
22	0,982094	8,21E-09	0,5000000002	0,335021	0,982094248	Rp 486.352	Rp 477.644	Rp 40.905
23	0,953876	1,13E-08	0,5000000003	0,297876	0,953876091	Rp 455.024	Rp 434.036	Rp 37.170
24	0,926469	1,56E-08	0,5000000004	0,262787	0,926468716	Rp 425.713	Rp 394.410	Rp 33.777
25	0,899849	2,14E-08	0,5000000005	0,229616	0,899848827	Rp 398.291	Rp 358.402	Rp 30.693
26	0,873994	2,95E-08	0,5000000007	0,198231	0,873993798	Rp 372.635	Rp 325.681	Rp 27.891
27	0,848882	4,06E-08	0,500000001	0,168516	0,848881651	Rp 348.632	Rp 295.947	Rp 25.344
28	0,824491	5,59E-08	0,5000000014	0,14036	0,824491043	Rp 326.174	Rp 268.928	Rp 23.031
29	0,800801	7,7E-08	0,5000000019	0,113662	0,800801242	Rp 305.164	Rp 244.375	Rp 20.928
30	0,777792	1,06E-07	0,5000000027	0,088331	0,777792111	Rp 285.506	Rp 222.065	Rp 19.017
31	0,755444	1,46E-07	0,5000000037	0,064278	0,755444093	Rp 267.115	Rp 201.791	Rp 17.281
32	0,733738	2,01E-07	0,500000005	0,041426	0,733738192	Rp 249.909	Rp 183.368	Rp 15.703
33	0,712656	2,77E-07	0,5000000069	0,0197	0,71265596	Rp 233.811	Rp 166.627	Rp 14.270
34	0,692179	3,81E-07	0,5000000095	0,460399	0,692179475	Rp 218.750	Rp 151.414	Rp 12.967
35	0,672291	5,25E-07	0,500000131	0,416108	0,672291334	Rp 204.659	Rp 137.591	Rp 11.783
36	0,652975	7,23E-07	0,500000181	0,374376	0,652974631	Rp 191.476	Rp 125.029	Rp 10.707
37	0,634213	9,95E-07	0,500000249	0,335021	0,634212949	Rp 179.142	Rp 113.614	Rp 9.730
38	0,61599	1,37E-06	0,500000343	0,297876	0,615990338	Rp 167.603	Rp 103.242	Rp 8.841
39	0,598291	1,89E-06	0,500000472	0,262787	0,598291312	Rp 156.806	Rp 93.816	Rp 8.034
40	0,581101	2,6E-06	0,500000649	0,229616	0,581100825	Rp 146.706	Rp 85.251	Rp 7.301
41	0,564404	3,58E-06	0,500000894	0,198231	0,564404266	Rp 137.256	Rp 77.468	Rp 6.634
42	0,548187	4,93E-06	0,500001231	0,168516	0,548187444	Rp 128.414	Rp 70.395	Rp 6.029
43	0,532437	6,78E-06	0,500001696	0,14036	0,532436573	Rp 120.142	Rp 63.968	Rp 5.478
44	0,517138	9,34E-06	0,500002335	0,113662	0,517138267	Rp 112.403	Rp 58.128	Rp 4.978
45	0,50228	1,29E-05	0,500003215	0,088331	0,502279521	Rp 105.163	Rp 52.821	Rp 4.524
46	0,487848	1,77E-05	0,500004426	0,064278	0,487847706	Rp 98.389	Rp 47.999	Rp 4.111
47	0,473831	2,44E-05	0,500006095	0,041426	0,473830555	Rp 92.051	Rp 43.617	Rp 3.735
48	0,460216	3,36E-05	0,500008392	0,0197	0,460216154	Rp 86.122	Rp 39.635	Rp 3.394
49	0,446993	4,62E-05	0,500011555	0,335021	0,44699293	Rp 80.574	Rp 36.016	Rp 3.084
50	0,43415	6,36E-05	0,50001591	0,297876	0,434149645	Rp 75.384	Rp 32.728	Rp 2.803
51	0,421675	8,76E-05	0,500021907	0,262787	0,421675381	Rp 70.528	Rp 29.740	Rp 2.547
52	0,40956	0,000121	0,500030165	0,229616	0,409559536	Rp 65.985	Rp 27.025	Rp 2.314
53	0,397792	0,000166	0,500041535	0,198231	0,39779181	Rp 61.734	Rp 24.557	Rp 2.103
54	0,386362	0,000229	0,50005719	0,168516	0,386362203	Rp 57.758	Rp 22.315	Rp 1.911
55	0,375261	0,000315	0,500078747	0,14036	0,375260998	Rp 54.037	Rp 20.278	Rp 1.737
56	0,364479	0,000434	0,500108429	0,113662	0,36447876	Rp 50.556	Rp 18.427	Rp 1.578

Appendix 15. Pure Premium Table of Accident Insurance for Female on Low Risk Occupational Environment

Usia	In lambda	logit teta	Pzero	Pcount	Estimasi Frekuensi	Estimasi Severity	Premi Murni (Per Tahun)	Premi Murni (Per Bulan)
18	1,100310816	1,12972E-08	0,502549948	0,500000003	1,100310816	Rp 723.665	Rp 796.257	Rp 68.190
19	1,068695985	1,55554E-08	0,500000004	0,455790129	1,068695985	Rp 677.050	Rp 723.561	Rp 61.964
20	1,037989532	2,14186E-08	0,500000005	0,411767324	1,037989532	Rp 633.438	Rp 657.502	Rp 56.307
21	1,008165356	2,94918E-08	0,500000007	0,370284196	1,008165356	Rp 592.635	Rp 597.474	Rp 51.167
22	0,979198107	4,06081E-08	0,500000001	0,331160218	0,979198107	Rp 554.460	Rp 542.926	Rp 46.495
23	0,951063164	5,59143E-08	0,500000014	0,294230041	0,951063164	Rp 518.744	Rp 493.359	Rp 42.250
24	0,923736612	7,69899E-08	0,500000019	0,259342038	0,923736612	Rp 485.329	Rp 448.316	Rp 38.393
25	0,897195224	1,06009E-07	0,500000027	0,226357005	0,897195224	Rp 454.067	Rp 407.386	Rp 34.888
26	0,871416439	1,45967E-07	0,500000036	0,195146995	0,871416439	Rp 424.818	Rp 370.193	Rp 31.703
27	0,846378348	2,00986E-07	0,50000005	0,165594278	0,846378348	Rp 397.453	Rp 336.396	Rp 28.808
28	0,822059666	2,76743E-07	0,500000069	0,137590407	0,822059666	Rp 371.851	Rp 305.684	Rp 26.178
29	0,798439725	3,81055E-07	0,500000095	0,111035378	0,798439725	Rp 347.898	Rp 277.776	Rp 23.788
30	0,775498446	5,24684E-07	0,500000131	0,085836875	0,775498446	Rp 325.488	Rp 252.415	Rp 21.616
31	0,753216331	7,22452E-07	0,500000181	0,061909592	0,753216331	Rp 304.522	Rp 229.371	Rp 19.643
32	0,73157444	9,94763E-07	0,500000249	0,039174619	0,73157444	Rp 284.906	Rp 208.430	Rp 17.850
33	0,710554378	1,36971E-06	0,500000342	0,017558888	0,710554378	Rp 266.553	Rp 189.401	Rp 16.220
34	0,690138277	1,886E-06	0,998980062	0,500000471	0,690138277	Rp 249.383	Rp 172.109	Rp 14.739
35	0,670308785	2,59688E-06	0,979288997	0,500000649	0,670308785	Rp 233.319	Rp 156.396	Rp 13.393
36	0,651049046	3,57571E-06	0,960527595	0,500000894	0,651049046	Rp 218.290	Rp 142.117	Rp 12.171
37	0,63234269	4,92349E-06	0,942638942	0,500001231	0,63234269	Rp 204.229	Rp 129.143	Rp 11.060
38	0,614173818	6,77928E-06	0,92556911	0,500001695	0,614173818	Rp 191.073	Rp 117.352	Rp 10.050
39	0,596526985	9,33457E-06	0,909266552	0,500002334	0,596526985	Rp 178.765	Rp 106.638	Rp 9.132
40	0,579387192	1,2853E-05	0,893681422	0,500003213	0,579387192	Rp 167.250	Rp 96.903	Rp 8.299
41	0,56273987	1,76977E-05	0,878764759	0,500004424	0,56273987	Rp 156.477	Rp 88.056	Rp 7.541
42	0,54657087	2,43684E-05	0,864467514	0,500006092	0,54657087	Rp 146.397	Rp 80.016	Rp 6.852
43	0,530866448	3,35534E-05	0,850739304	0,500008388	0,530866448	Rp 136.967	Rp 72.711	Rp 6.227
44	0,515613255	4,62006E-05	0,837526829	0,50001155	0,515613255	Rp 128.144	Rp 66.073	Rp 5.658
45	0,500798327	6,36149E-05	0,824771789	0,500015904	0,500798327	Rp 119.890	Rp 60.041	Rp 5.142
46	0,486409071	8,7593E-05	0,812408122	0,500021898	0,486409071	Rp 112.167	Rp 54.559	Rp 4.672
47	0,472433256	0,000120609	0,80035832	0,500030152	0,472433256	Rp 104.942	Rp 49.578	Rp 4.246
48	0,458859003	0,00016607	0,788528453	0,500041517	0,458859003	Rp 98.182	Rp 45.052	Rp 3.858
49	0,445674774	0,000228666	0,776801455	0,500057166	0,445674774	Rp 91.857	Rp 40.939	Rp 3.506
50	0,432869362	0,000314856	0,765028004	0,500078714	0,432869362	Rp 85.940	Rp 37.201	Rp 3.186
51	0,420431884	0,000433534	0,753014154	0,500108383	0,420431884	Rp 80.404	Rp 33.805	Rp 2.895
52	0,408351768	0,000596944	0,740504515	0,500149236	0,408351768	Rp 75.225	Rp 30.718	Rp 2.631
53	0,396618745	0,000821948	0,727159453	0,500205487	0,396618745	Rp 70.380	Rp 27.914	Rp 2.390
54	0,385222843	0,001131761	0,712524274	0,50028294	0,385222843	Rp 65.846	Rp 25.365	Rp 2.172
55	0,374154375	0,001558352	0,695987961	0,500389588	0,374154375	Rp 61.605	Rp 23.050	Rp 1.974
56	0,363403933	0,002145736	0,676728878	0,500536434	0,363403933	Rp 57.636	Rp 20.945	Rp 1.794

Appendix 16. Pure Premium Table of Accident Insurance for Female on Very Low Risk Occupational Environment

Usia	In lambda	logit teta	Pzero	Pcount	Estimasi	Estimasi	Premi Murni	Premi Murni
					Frekuensi	Severity	(Per Tahun)	(Per Bulan)
18	0,59169558	4,55772E-07	0,500000114	0,096475298	0,59169558	Rp 138.839	Rp 82.151	Rp 7.035
19	0,574694606	6,27564E-07	0,500000157	0,111706337	0,574694606	Rp 129.896	Rp 74.650	Rp 6.393
20	0,558182114	8,6411E-07	0,500000216	0,126253943	0,558182114	Rp 121.529	Rp 67.835	Rp 5.809
21	0,542144071	1,18982E-06	0,500000297	0,140155487	0,542144071	Rp 113.700	Rp 61.642	Rp 5.279
22	0,526566842	1,63829E-06	0,50000041	0,15344589	0,526566842	Rp 106.376	Rp 56.014	Rp 4.797
23	0,511437188	2,2558E-06	0,500000564	0,166157814	0,511437188	Rp 99.524	Rp 50.900	Rp 4.359
24	0,49674225	3,10607E-06	0,500000777	0,178321832	0,49674225	Rp 93.113	Rp 46.253	Rp 3.961
25	0,482469535	4,27683E-06	0,500001069	0,189966589	0,482469535	Rp 87.115	Rp 42.030	Rp 3.599
26	0,468606913	5,88889E-06	0,500001472	0,201118945	0,468606913	Rp 81.504	Rp 38.193	Rp 3.271
27	0,455142601	8,10856E-06	0,500002027	0,211804114	0,455142601	Rp 76.254	Rp 34.706	Rp 2.972
28	0,442065154	1,11649E-05	0,500002791	0,222045787	0,442065154	Rp 71.342	Rp 31.538	Rp 2.701
29	0,429363457	1,53732E-05	0,500003843	0,231866252	0,429363457	Rp 66.746	Rp 28.658	Rp 2.454
30	0,417026713	2,11678E-05	0,500005292	0,241286507	0,417026713	Rp 62.447	Rp 26.042	Rp 2.230
31	0,405044436	2,91465E-05	0,500007287	0,250326363	0,405044436	Rp 58.424	Rp 23.664	Rp 2.027
32	0,393406441	4,01326E-05	0,500010033	0,259004559	0,393406441	Rp 54.661	Rp 21.504	Rp 1.842
33	0,382102837	5,52596E-05	0,500013815	0,267338858	0,382102837	Rp 51.140	Rp 19.541	Rp 1.673
34	0,371124015	7,60884E-05	0,998980062	0,500019022	0,371124015	Rp 47.846	Rp 17.757	Rp 1.521
35	0,360460644	0,000104768	0,979288997	0,500026192	0,360460644	Rp 44.764	Rp 16.136	Rp 1.382
36	0,350103659	0,000144258	0,960527595	0,500036065	0,350103659	Rp 41.880	Rp 14.662	Rp 1.256
37	0,340044258	0,000198633	0,942638942	0,500049658	0,340044258	Rp 39.182	Rp 13.324	Rp 1.141
38	0,33027389	0,000273503	0,92556911	0,500068376	0,33027389	Rp 36.658	Rp 12.107	Rp 1.037
39	0,32078425	0,000376593	0,909266552	0,500094148	0,32078425	Rp 34.297	Rp 11.002	Rp 942
40	0,311567273	0,000518541	0,893681422	0,500129635	0,311567273	Rp 32.088	Rp 9.998	Rp 856
41	0,302615124	0,000713992	0,878764759	0,500178498	0,302615124	Rp 30.021	Rp 9.085	Rp 778
42	0,293920193	0,000983115	0,864467514	0,500245779	0,293920193	Rp 28.087	Rp 8.255	Rp 707
43	0,285475091	0,001353677	0,850739304	0,500338419	0,285475091	Rp 26.278	Rp 7.502	Rp 642
44	0,277272639	0,001863913	0,837526829	0,500465978	0,277272639	Rp 24.585	Rp 6.817	Rp 584
45	0,269305865	0,002566471	0,824771789	0,500641617	0,269305865	Rp 23.002	Rp 6.194	Rp 530
46	0,261567998	0,003533841	0,812408122	0,500883459	0,261567998	Rp 21.520	Rp 5.629	Rp 482
47	0,254052459	0,004865839	0,80035832	0,501216457	0,254052459	Rp 20.134	Rp 5.115	Rp 438
48	0,246752862	0,006699902	0,788528453	0,501674969	0,246752862	Rp 18.837	Rp 4.648	Rp 398
49	0,239663002	0,009225271	0,776801455	0,502306301	0,239663002	Rp 17.623	Rp 4.224	Rp 362
50	0,232776852	0,012702518	0,765028004	0,503175587	0,232776852	Rp 16.488	Rp 3.838	Rp 329
51	0,22608856	0,017490432	0,753014154	0,504372496	0,22608856	Rp 15.426	Rp 3.488	Rp 299
52	0,219592439	0,024083036	0,740504515	0,506020468	0,219592439	Rp 14.432	Rp 3.169	Rp 271
53	0,213282969	0,033160565	0,727159453	0,508289382	0,213282969	Rp 13.503	Rp 2.880	Rp 247
54	0,207154787	0,045659655	0,712524274	0,511412931	0,207154787	Rp 12.633	Rp 2.617	Rp 224
55	0,201202684	0,06286998	0,695987961	0,51571232	0,201202684	Rp 11.819	Rp 2.378	Rp 204
56	0,195421601	0,086567329	0,676728878	0,521628327	0,195421601	Rp 11.058	Rp 2.161	Rp 185