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The Cox Proportional Hazard Model on Life Insurance Premium Payments Analysis

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Abstract
Insurance premiums are a sum of money that must be paid by participants of life insurance programs to insurance companies to compensate for losses suffered by participants. The amount of the premium must be in accordance with the sum insured to be received, so that the insurance company has enough money to replace the losses suffered by its customers. In determining the premiums also should not be too large, because it can burden the insurance program customers. Therefore it is necessary to do an analysis to find out the factors (gender, age, amount of coverage, occupation, method of payment of premiums, amount of premium, and type of insurance product) that affect the term of payment ability by the customer. The analysis conducted is using the Cox Proportional Hazard Model. The results obtained in this study are factors that have a significant effect on the period of ability to pay premiums, namely the amount of sum insured, profession and types of insurance products.

Keywords: Cox Proportional Hazard Model, Premium, Life Insurance.

Abstrak
Premi asuransi merupakan sejumlah uang yang harus dibayarkan oleh peserta program asuransi jiwa kepada perusahanan asuransi untuk menggantikan kerugian yang dialami oleh peserta. Besar nilai premi harus sesuai dengan uang pertanggungan yang akan diterima, agar perusahaan asuransi mempunyai cukup uang untuk menggantikan kerugian yang dialami oleh nasabahnya. Dalam penentuan premi juga tidak boleh terlalu besar, karena dapat membebani nasabah program asuransi. Oleh karena itu perlu dilakukan analisis untuk mengetahui faktor-faktor (jenis kelamin, usia, jumlah uang pertanggungan, pekerjaan, cara pembayaran premi, besar premi, dan jenis produk asuransi) yang berpengaruh terhadap jangka waktu kemampuan pembayaran oleh nasabah. Analisis yang dilakukan adalah dengan menggunakan Model *Cox Proportional Hazard.* Adapun hasil yang diperoleh pada penelitian adalah faktor-faktor yang berpengaruh signifikan terhadap jangka waktu kemampuan pembayaran premi, yaitu jumlah uang pertanggungan, profesi dan jenis produk asuransi.

Kata kunci: Model *Cox Proportional Hazard*, Premi, Asuransi Jiwa

1. INTRODUCTION AND PRELIMINARIES

Introduction

Insurance is an agreement between the insurer and the insured, where the insurer binds itself to an insured by accepting a premium to provide risk compensation due to a loss, damage, or loss

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of expected profits that the insured may suffer due to an unspecified event. Insurance is a system of protection for the insured party if they experience risk in the future, by paying an initial amount of money or premium by the insured party to the insurer [1]. Insurance is an agreement between the insured and the insurer, where the insured must pay a premium to the insurer in order to obtain compensation for damage or loss that occurs in the future [2].

Insurance can be divided into two, namely loss insurance and life insurance. Loss insurance consists of fire insurance, loss and damage, marine insurance, transportation insurance, and credit insurance [3]. Life insurance is insurance related to a person's life, consisting of accident, health, death and old age insurance [4]. According to Sembiring [5] there are various kinds of life insurance products, including whole life insurance, term life insurance, and endowment life insurance. Life insurance is based on the chance that a person of a certain age will die within a certain period of time, the interest rate earned by the invested funds, as well as other administrative costs [6].

Insurance program participants have an obligation to pay the insurance premiums they will participate in. Premiums are fees charged by insurance companies to insurance program participants for a certain amount of insurance money [5]. Premium is an amount of money that must be paid by the insured within a certain period of time for their participation in insurance [7]. An insurance company needs to consider many factors when making calculations to determine the amount of the premium. The premium must be sufficient so that the insurance company has sufficient funds to pay insurance benefits. According to Sula [8]. Premiums must also be reasonable so that each insurance program participant is charged a premium that reflects the level of risk borne by the insurance company in providing coverage. Factors that influence insurance premium payments will be analyzed using the Cox Proportional Hazard Model.

Research related to the application of the Cox Proportional Hazard Model was carried out to analyze the survival of stroke patients, and it is known that what influences the survival of stroke patients is age, diabetes mellitus status, and type of stroke [9]. Research on premium calculations was carried out using the Gomperzt assumption to produce larger premiums compared to general calculations carried out by insurance companies [10]. Research on life insurance premium insurance was carried out with the aim of analyzing the factors that influence the period of life insurance premium payment ability at an insurance company. Based on this research, it is known that the period of ability to pay premiums is influenced by the amount of insurance money, the method of premium payment, the amount of premiums and the type of insurance product [11]. In this study, researchers will analyze the period of premium payment ability using the Cox Proportional Hazard Model. The analysis was carried out to determine the factors that can influence the period of ability to pay insurance premiums.

Literature Review

Survival Analysis

Survival analysis is a statistical method that studies survival. According to Collet [12] survival analysis begins by presenting summary data in numerical or graphical form for each individual. The Kaplan-Meier estimator is a nonparametric estimator for estimating survival function curves. Suppose there are n individuals being studied over a long period of time $t_{(1)}, t_{(2)}, \dots, t_{(n)}$ and there is a jth individual who experiences the event $(j \leq n)$ in time order $t_{(1)} \leq t_{(2)} \leq \cdots \leq t_{(j)}$ meanwhile n_j is the number of individuals who are at risk of experiencing the event at time $t_{(j)}$ and d_j is the individual who experiences the event at time $t_{(j)}$. A Kaplan-Meier estimate of $S(t)$ is formulated,

$$\hat{S}(t) = \prod_{t(j) \leq t} \left(1 - \frac{d_j}{n_j}\right) \quad 1.1$$

Estimate the hazard function of survival time using the ratio of the number of failures to the number of individuals at risk of failure. If d_j is the number of individuals at $t_{(j)}$, the j[th] survival time and n_j is the individual at risk of failure at time $t_{(j)}$, then the estimated hazard function is,

$$\hat{h}(t) = \frac{d_j}{n_j} \quad 1.2$$

the relationship between the estimated survival value and the estimated cumulative hazard value is obtained as follows.

$$\hat{H}(t) = -\log S(t) \quad 1.3$$

Proportional Hazard Assumption Test

The Proportional Hazard Assumption is an assumption in the Cox Proportional Hazard model that must be met. Each independent variable must be proportional so that an assumption test is carried out using the Cox Proportional Hazard model. The assumption test was carried out using the Goodness Of Fit (GOF) statistical test. The Proportional Hazard assumption on a covariate is considered fulfilled if the Schoenfeld residual on that covariate does not depend on the survival time. The steps for testing the Proportional Hazard assumption are [13],

a. used the Cox Proportional Hazard model to obtain Schoenfeld residuals for each predictor variable. Schoenfeld residuals exist for every predictor variable in the model and every object that experiences an event, with the formula,

$$\widehat{r_{\iota J}} = \delta_i\left(x_{ji} - \widehat{a_{J\iota}}\right) \quad 1.4$$

with,

$$\widehat{a_{J\iota}} = \frac{\sum_{l\epsilon R(t_j)} x_{jl}\, e^{\beta_{xl}}}{\sum_{l\epsilon R(t_j)} e^{\beta_{xl}}} \quad 1.5$$

Note:
$\widehat{r_{\iota J}}$: Schoenfeld residual estimate of variable *j* for individual *i*
x_{ji}: value of variable *j* for individual *i* with *j* = 1,2,3,..., *p*
δ_i: sensoring indicator for the *i*[th] individual
$\widehat{a_{J\iota}}$: weighted average of covariate scores

b. create a survival time rank variable which has been sorted based on survival time starting from the individual who experienced the event for the first time,

c. test the correlation between the Schoenfeld residual variable and the survival time rank with the hypothesis,
$H_0 = r = 0$ (proportional hazard assumption is met)
$H_1 = x, r \neq 0$ (proportional hazard assumption not met)
Level of significance: $a = 0.05$
Test statistics:

$$r = \frac{\sum_{i=1}^{n}(X_i - \overline{X_l})(Y_i - \overline{Y_l})}{\sqrt{\sum_{i=1}^{n}(X_i - \overline{X_l})^2 \sum_{i=1}^{n}(Y_i - \overline{Y_l})^2}} \quad 1.6$$

Note:
X: Schoenfeld residuals for each variable
Y: endurance time rank

Test criteria:
H_0 accepted if $-r_{tabel} \leq\ r_{hitung} \leq +r_{tabel}$ or $p - value\ > a$

Cox Proportional Hazard Model

The Cox Proportional Hazard model is a semiparametric distribution model because it does not require information about the underlying distribution of survival times and to estimate the regression parameters of the Cox Proportional Hazard model you do not have to determine a baseline hazard function. The Cox model is [13],

$$h(t,x) = h_0(t)\exp\left(\beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_p x_p\right) \qquad 1.7$$

Note:
$h_0(t)$: baseline hazard function
$\beta_1, \beta_2, \dots, \beta_p$: covariate coefficient
$x_1, x_2, \dots, x_p$: value of the independent variable $X_1, X_2, \dots, X_p$

The hazard ratio is the level of risk that can be seen from the comparison between individuals with the condition of the independent variable X in the success category and the failure category. The hazard ratio for an individual with $X = 0$ compared to $X = 1$ is written,

$$\widehat{HR} = \frac{h(t|X_1^*)}{h(t|X_1)} = \frac{h_0(t)\exp(\beta_1 X_1^*)}{h_0(t)\exp(\beta_1 X_1)} = exp[\beta_1(X_1^* - X_1] \qquad 1.8$$

Note:
$h(t|X_1^*)$: individual hazard value in the failure category
$h(t|X_1)$: individual hazard value in the success category
X_1^* : vector of individual covariates failed category
X_1 : success category individual covariate vector

Ties

A ties or joint event is an event where two or more individuals experience an event at the same time. If there are co-occurrences in the data, then problems will arise in forming partial likelihoods, namely when determining the members of the risk set [14]. There are three methods that can be used to deal with co-occurrences in survival analysis. These methods are the Breslow method, Efron method, and Exact method. The Efron method has more accurate calculations compared to the Breslow method, especially when the size of the risk set for joint events or ties is large. In the Efron Method approach, the risk set is completed by subtracting the average of the function value of the jth variable, because it is not known which variable will experience the event first. The partial likelihood function of Efron's method is written,

$$L(\beta)_{efron} = \prod_{i=1}^{r} \frac{e^{\left(\sum_{j=1}^{p}\beta_j S_k\right)}}{\prod_{k=1}^{d_i}\left[\sum_{i\in R(t_j)} e^{\left(\sum_{j=1}^{p}\beta_j X_{ij}\right)} - \frac{(k-1)}{d_i}\sum_{i\in D(d_i)} e^{\left(\sum_{j=1}^{p}\beta_j X_{ij}\right)}\right]} \qquad 1.9$$

where S_k is the number of covariates x in the co-occurrence and d_i is the number of co-occurrences at time t_i [15].

Parameter Significance Test

The parameter significance test is used to determine whether there is a relationship between parameters in the regression model. Significance tests are carried out simultaneously or partially [16]. Simultaneous tests were carried out for the significance of the regression model parameters together. The parameter testing procedure carried out simultaneously is as follows.

a. Make a hypothesis
   H_0 : Variable $X_1, X_2, \dots, X_n$ has no effect on the model
   H_1 : There are variables $X_1, X_2, \dots, X_n$ which influence the model
b. Level of significance: $a = 0.05$
c. Determining test statistics is using the likelihood ratio test:

$$G^2 = -2\ln\frac{L(\widehat{\omega})}{L(\widehat{\Omega})} = -2\left[\ln L(\widehat{\omega}) - \ln L(\widehat{\Omega})\right] \qquad 1.10$$

   Note:
   $L(\widehat{\omega})$: likelihood value for the model without includes covariates
   $L(\widehat{\Omega})$: likelihood value for the model with includes all covariates

d. Determining the critical area (rejection of H_0)
   Reject H_0 if $G^2_{count} > X^2_{p,\alpha}$ or $p - value < \alpha$
e. Conclusion

The partial significance test is used to determine the covariates that influence the regression model. The partial parameter testing procedure is as follows.

a. Make a hypothesis
   $H_0 :\ \beta_p = 0$ (The p independent variable has no effect to the model)
   $H_1 :\ \beta_p \neq 0$ (The p independent variable has an effect on model for $p = 1,2, \dots, n$)
b. Level of significance: $\alpha = 0{,}05$
c. Determining test statistics is using the Wald ratio test:

$$W^2 = \left(\frac{\widehat{\beta_p}}{SE(\widehat{\beta_p})}\right)^2 \qquad 1.11$$

   Note:
   W^2 : Wald ratio
   $\widehat{\beta_p}$: p^{th} covariate coeficient
   $SE(\widehat{\beta_p})$: standard error for $\widehat{\beta_p}$
d. Determining the critical area (rejection of H_0)
   Reject H_0 if $W^2 > X^2_{\alpha,1}$ for $p - value < \alpha$
e. Conclusion

2. METHOD

The data used in this research is data from life insurance program participants at an insurance company with a total of 150 customers from 2014-2019. The variables used in this research are,

1. The dependent variable (Y) is the period of ability to pay insurance premiums.
2. Independent variable (X),
   a. Gender (X_1)
   b. Age (X_2)
   c. Amount of Sum Insured (X_3)
   d. Profession (X_4)
   e. Premium Payment Period (X_5)
   f. Premium Amount (X_6)
   g. Types of Insurance Products (X_7)

The steps taken in this research are as follows:

1. Literature Study
2. Data Retrieval
3. Descriptive analysis of each independent variable
4. Calculate the survival value and hazard value
5. Test the proportional hazard assumption
6. Establishment of the initial Cox Proportional Hazard model
7. Test the significance of parameters
8. Determine the final Cox Proportional Hazard model

3. MAIN RESULTS

The incident observed was that the customer was unable to pay the premium according to the time specified in the insurance policy. The results of the descriptive analysis carried out on the research variables are shown in Table 3.1

Table 3.1 Descriptive Analysis of Variables

Variables (Categories)	Number of Customers	Status		%
		No event occurred	An event occurs	
Gender (X_1)				
Perempuan (Female)	103	61	42	40.8
Laki-laki (Male)	**47**	**26**	**21**	**44.7**
Age (X_2) (Years)				
$17 \leq X_2 < 25$	23	14	9	39.1
$\mathbf{25 \leq X_2 < 35}$	**35**	**17**	**18**	**51.4**
$35 \leq X_2 < 50$	68	43	25	36.8
$X_2 \geq 50$	24	13	11	45.8
Amount of Sum Insured (X_3) (Million IDR)				
$5 \leq X_3 < 10$	6	4	2	33.3
$10 \leq X_3 < 50$	113	70	43	38.1
$50 \leq X_3 < 100$	16	9	9	56.3
$\mathbf{X_3 \geq 100}$	**15**	**6**	**9**	**60**
Profession (X_4)				
Petani (Farmers)	2	1	1	50
Karyawan Swasta (Private Employed)	47	33	14	29.8
PNS/TNI/Polri	14	8	6	42.9
Wiraswasta (Self-employed)	52	30	22	42.3
Lainnya (other)	**35**	**15**	**20**	**57.1**
Premium Payment Period (X_5)				
Bulanan (monthly)	73	39	34	46.6
Triwulan (quarterly)	26	18	8	30.8
Semester	5	3	2	40
Tahunan (annual)	**15**	**4**	**11**	**73.3**
Sekaligus (at a time)	31	23	8	25.8
Premium Amount (X_6) (Million IDR)				
$0,1 \leq X_6 < 1$	94	53	41	43.6
$\mathbf{1 \leq X_6 < 5}$	**13**	**6**	**7**	**53.9**
$5 \leq X_6 < 10$	8	4	4	50
$10 \leq X_6 < 50$	25	17	8	32
$X_6 \geq 50$	10	7	3	30
Types of Insurance Products (X_7)				
Solusi Abadi Plus	49	26	23	46.9
Plan Multipro	**29**	**11**	**18**	**62.1**
Hy-End Pro	16	12	4	25
Cash Pro	23	16	7	30.4
Term Pro	17	10	7	41.2
Optima Saving	3	2	1	33.3
B-life Maksima	13	10	3	23.1

Based on Table 3.1, the proportion of events occurring for each variable is known. 44.7% of male customers are unable to pay insurance premiums. Customers in the age category between 25 years and 35 years have the largest proportion unable to pay insurance premiums among other categories, namely 51.4%. Customers in the category of insurance amount of more than 100,000,000 IDR have the largest proportion unable to pay insurance premiums among other categories, namely 60%. Customers with other job categories (not included in the 4 specified categories) have the largest proportion unable to pay insurance premiums, namely 57.1%. Customers who pay premiums annually have the largest proportion unable to pay insurance premiums among other premium payment methods, namely 73.3%. Customers with large premium categories between 1,000,000 IDR up to 5,000,000 IDR have the largest proportion unable to pay insurance premiums among other categories, namely 53.9%. Customers who choose the B-Life Plan Multipro insurance product have the largest proportion unable to pay insurance premiums among other insurance products, namely 62.1%.

The estimated survival function value $(\hat{S}_t)$ and hazard function value $(\hat{h}_t)$ using the Kaplan-Meier method for the gender category are shown in Table 3.2. The survival value is the value of the customer's chance of being able to pay insurance premiums for 5 years, while the hazard value is the risk value customers experience failure to pay premiums within a period of 5 years.

Table 3.2 Value of the Survival Function and Hazard Function

t_j	n_j	d_j	$\frac{(n_j - d_j)}{n_j}$	$\hat{S}_t$	$\hat{h}_t$	$\hat{H}_t$
Female						
1	103	18	0.83	0.83	0.18	0.08
2	61	10	0.84	0.69	0.16	0.16
3	48	8	0.83	0.58	0.17	0.24
4	36	4	0.89	0.51	0.11	0.29
5	32	2	0.94	0.48	0.06	0.32
Male						
1	47	12	0.75	0.75	0.26	0.13
2	25	4	0.84	0.63	0.16	0.2
3	15	3	0.8	0.5	0.2	0.3
5	12	2	0.83	0.42	0.17	0.38

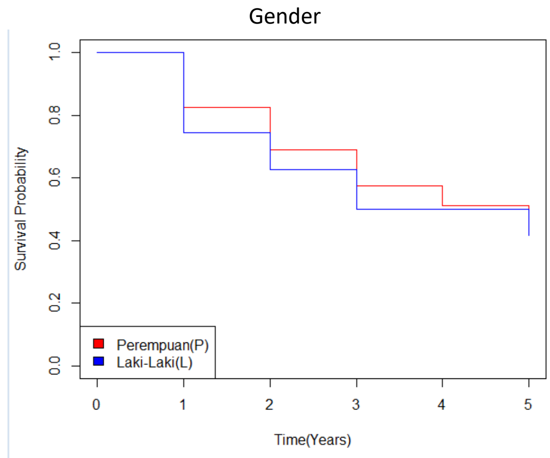

Figure 3.1 Survival function of the gender variable

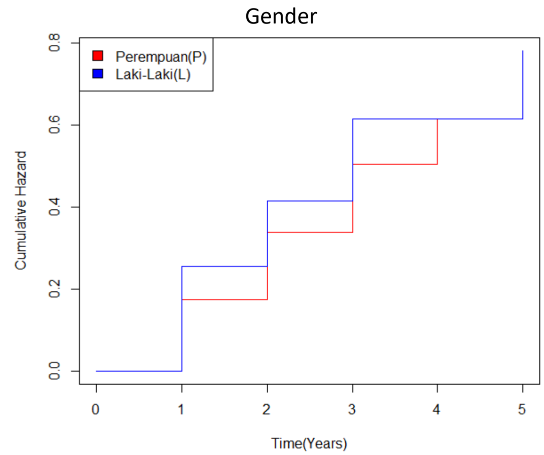

Figure 3.2 Hazard function of the gender variable

Based on Figure 3.1, the survival value for the category of female customers is relatively higher than that of male customers. Figure 3.2 shows that the hazard value for female customers is lower than for male customers. This means that the risk of female customers being unable to pay premiums is lower than male customers.

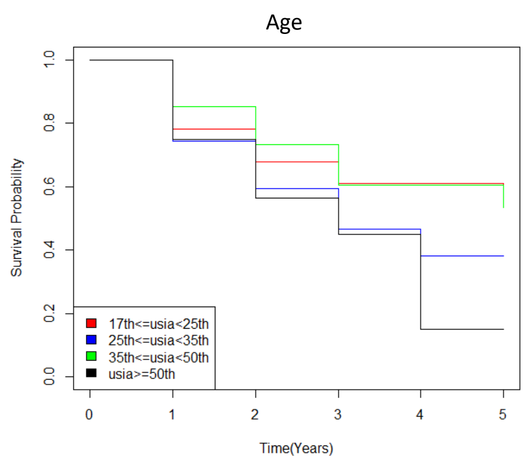

Figure 3.3 Survival function of the age variable

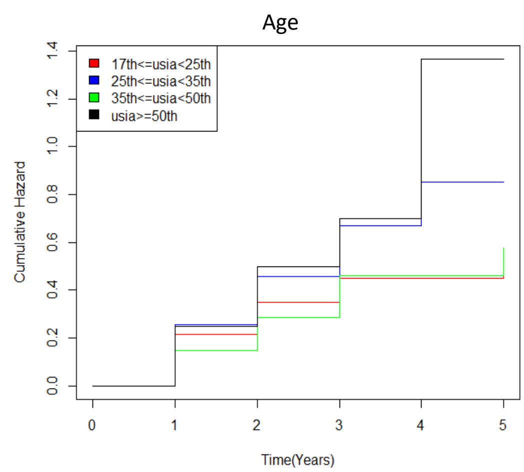

Figure 3.4 Hazard function of the age variable

Based on Figure 3.3, the survival value for customers in the 35 years $\leq$ age $<$ 50 years category is relatively higher compared to other age categories. Figure 3.4 shows that the hazard value for customers in the 35 years $\leq$ age $<$ 50 years category is lower compared to customers in other age categories. This means that the risk of customers in the 35 years $\leq$ age $<$ 50 years category being unable to pay premiums is lower than customers in other age categories.

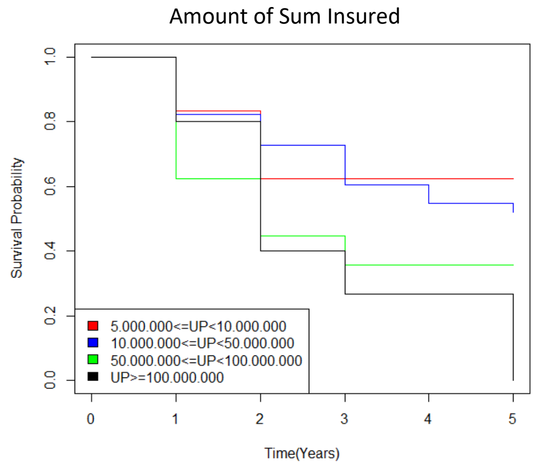

Figure 3.5 Survival function of the Amount of Sum Insured variable

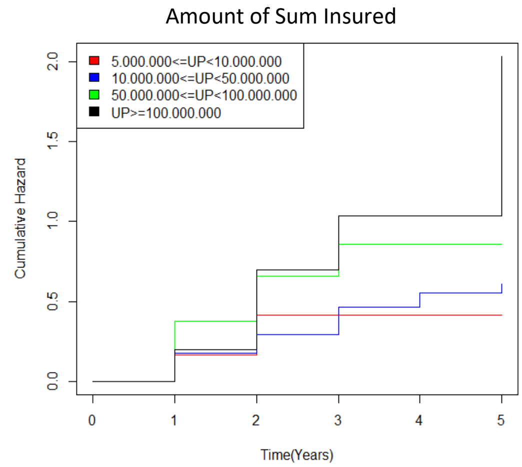

Figure 3.6 Hazard function of the Amount of Sum Insured variable

Based on Figure 3.5, the survival value for customers in the 10,000,000 ≤ amount of sum insured < 50,000,000 category is relatively higher compared to other categories of sum insured amount. Figure 3.6 shows that the hazard value for customers in the 10,000,000 ≤ amount of sum insured < 50,000,000 category is lower compared to customers in other categories. This means that the risk of these customers not being able to pay the premium is lower than other categories of customers.

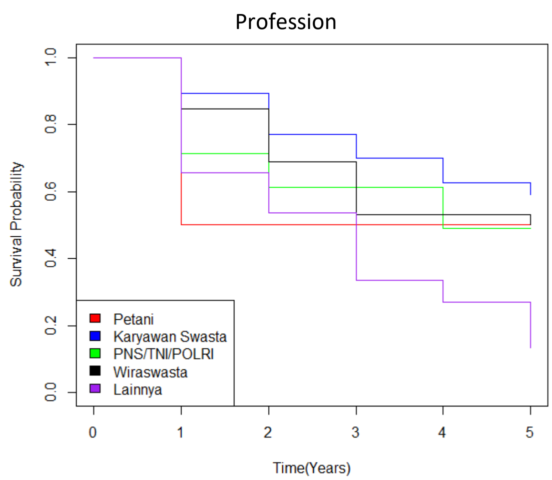

Figure 3.7 Survival function of the Profession variable

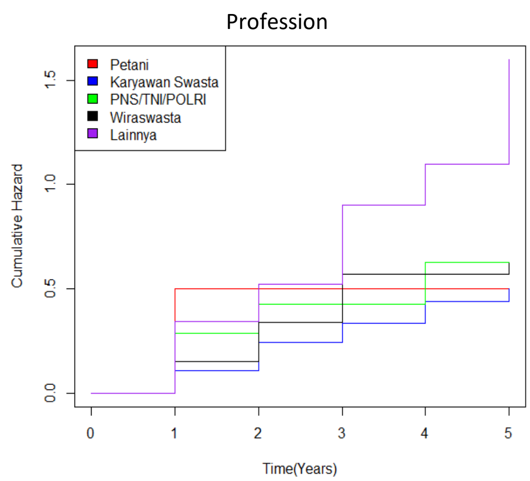

Figure 3.8 Hazard function of the Profession variable

Figure 3.7 shows that the survival value for customers in the private employee profession category is relatively higher compared to other profession categories. Figure 3.8 shows that the hazard value for customers in the private employee profession category is lower compared to customers in other categories. This means that the risk of these customers not being able to pay the premium is lower than other categories of customers.

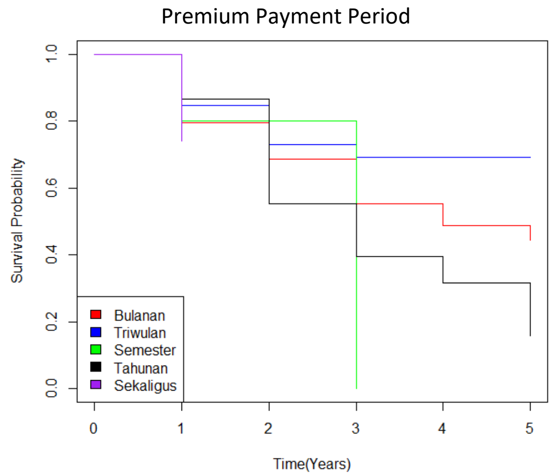

Figure 3.9 Survival function of the Premium Payment Period

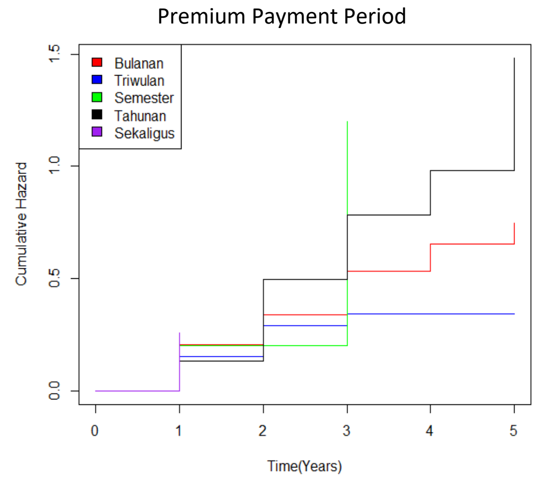

Figure 3.10 Hazard function of the Premium Payment Period

Figure 3.9 shows that the survival value for customers who pay premiums quarterly is relatively higher compared to other payment method categories. Figure 3.10 shows that the hazard value for customers who pay quarterly premiums is lower compared to other categories of customers. This means that the risk of these customers not being able to pay the premium is lower than other categories of customers.

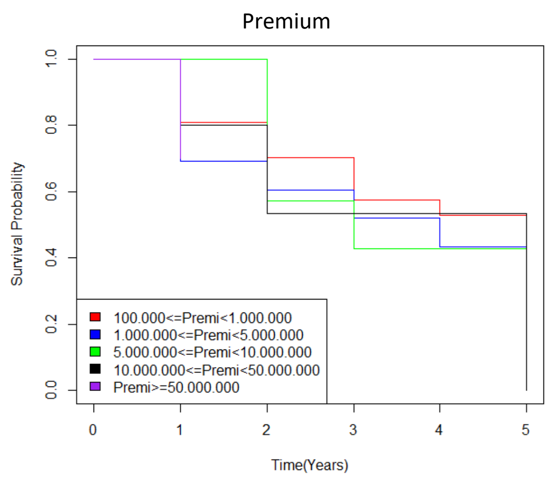

Figure 3.11 Survival function of variable premuium amount

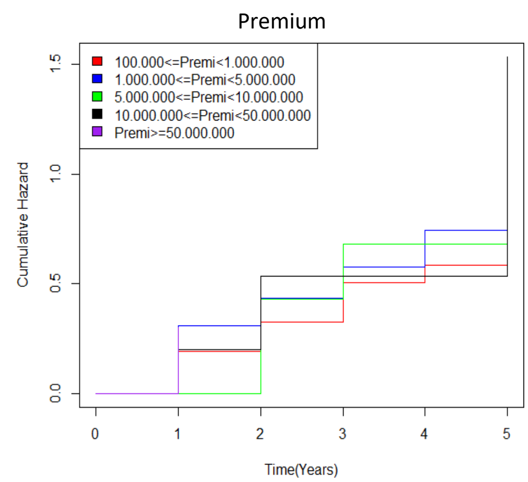

Figure 3.12 Hazard function of variable premium amount

Figure 3.11 shows that the survival value for customers in the $100,000 \leq$ premium $<$ 1,000,000 category is relatively higher compared to other premium categories. Figure 3.12 shows that the hazard value for customers in the $100,000 \leq$ premium $< 1,000,000$ category is lower compared to customers in other categories. This means that the risk of customers in the 100,000 category $\leq$ premium $<$ 1,000,000 not being able to pay the premium is lower than customers in other categories.

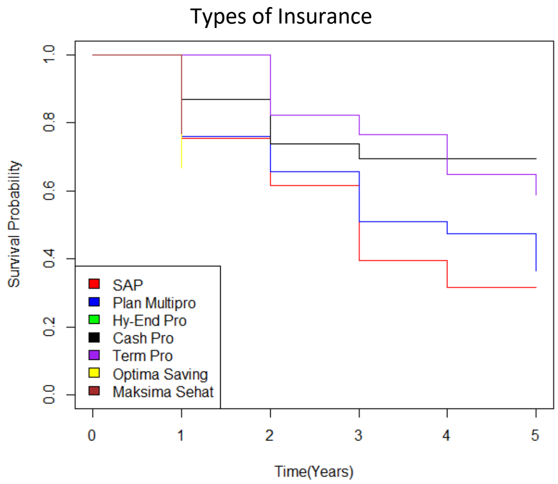

Figure 3.13 Survival function variable Types of Insurance Products

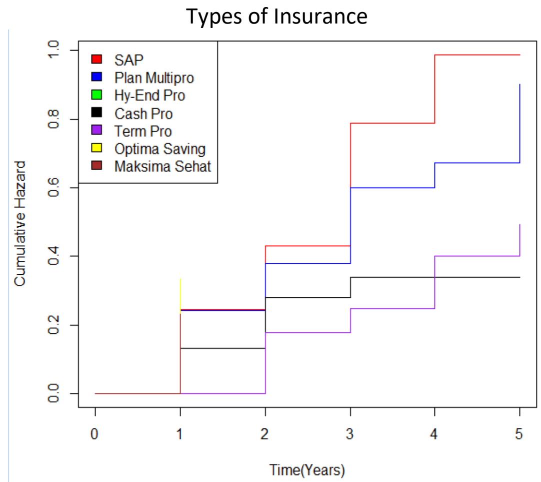

Figure 3.14 Hazard function variable type of Insurance Product

Based on Figure 3.13, the survival value for customers who choose the B-life Term Pro insurance product is relatively higher compared to other product categories. Figure 3.14 shows that the hazard value for customers who choose the B-life Term Pro insurance product is lower compared to customers in other categories. This means that the risk of the customer being unable to pay the premium is lower than customers in other categories of insurance products.

Next, the proportional hazard assumption test is carried out, the assumption test using Goodness of Fit is carried out by carrying out the Schoenfeld residual test, with the initial hypothesis H_0 the variable meets the proportional hazard assumption.

Table 3.3 Goodness of Fit Results for Assumption Test

Variables	Correlation	*p-value*	Decision
Gender	-0.094	0.436	Accept H_0
Age	0.102	0.411	Accept H_0
Amount of Sum Insured	0.106	0.377	Accept H_0
Profession	0.019	0.859	Accept H_0
Premium Payment Period	0.048	0.694	Accept H_0
Premium Amount	-0.086	0.502	Accept H_0
Types of Insurance Products	-0.047	0.936	Accept H_0

Based on Table 3.3, the p-value of each variable is greater than 0.05, so the decision obtained is to accept H_0, meaning that the result of the Schoenfeld residual test is $r = 0$. Thus, it is concluded that the variables gender, age, amount of insurance money, occupation, method of premium payment, premium and type of insurance product meet the proportional hazard assumption.

The initial model was obtained from estimating the parameter β_p using Maximum Partial Likelihood Estimation (MPLE) with the Efron Method. The following are the results of parameter estimation for each variable in insurance customer data using the Efron Method.

Table 3.4 Estimation of Cox Model Parameters using the Efron Method

Variables	β_p	$\exp(\beta_p)$	$SE(\beta_p)$	$Pr(>\lvert z \rvert)$
Gender	0.225	1.25	0.28	0.41
Age	-0.04	0.96	0.16	0.81
Amount of Sum Insured	0.384	1.47	0.21	0.07
Profession	0.328	1.39	0.13	0.01
Premium Payment Period	0.301	1.35	0.21	0.16
Premium Amount	-0.289	0.75	0.28	0.3
Types of Insurance Products	-0.199	0.82	0.09	0.03

Based on Table 3.4, the initial Cox Proportional Hazard Model with the Efron Method obtained is,

$$h(t,X) = h_0(t)\exp(0.225X_1 - 0.04X_2 + 0.384X_3 + 0.328X_4 + 0.301X_5 - 0.289X_6 - 0.199X_7)$$

Simultaneous significance tests were carried out using the likelihood ratio test as follows.

1. Hypothesis
   $H_0: \beta_1 = \beta_2 = \cdots = \beta_p = 0$ (all variables have no effect on the model)
   H_1: Not all β_p are equal to zero, there is at least one $\beta_p \neq 0$ for $p = 1,2,\ldots,7$ (there are variables that influence the model)
2. Level of significance: $\alpha = 0.05$
3. Test statistics:
   The log likelihood value for the model without including covariates is $lnL(\widehat{\omega}) = -283.452$, while the log likelihood value for the model including covariates is $lnL(\widehat{\Omega}) = -273.153$, with the p-value from the likelihood ratio test being 0.004. Obtained test values:

$$\begin{aligned} G^2 &= -2\ln\frac{L(\widehat{\omega})}{L(\widehat{\Omega})} \\ &= -2\left[\ln L(\widehat{\omega}) - \ln L(\widehat{\Omega})\right] \\ &= -2[-283.452 - (-273.153)] \\ &= -2[-10.299] \\ &= 20.598 \end{aligned}$$

4. Test Criteria:
   Reject H_0 if $G^2_{hitung} > X^2_{p,0.05}$ or $p\text{-}value < 0.05$
5. Conclusion:
   Based on the tests carried out, it was found that $G^2 = 20.598 > X^2 = 14.067$ and the p-*value* $= 0.004 < \alpha = 0.05$, then the decision was obtained to reject H_0 and it was concluded that there were variables $X_1, X_2, \ldots, X_7$ which had an effect on the Cox Model.

A partial significance test was carried out to further analyze variables that were thought to have a significant effect on the initial Cox Proportional Hazard model. The parameter significance test was carried out using the Wald test to find out which variables had an influence on the Cox Model. The results of the partial significance test are written as follows.

Table 3.5 Partial Significance Test Results with the Wald Test

Variables	β_p	$Wald(W^2)$	*p-value*
Gender	0.235	0.77	0.4
Age	0.051	0.13	0.7
Amount of Sum Insured	**0.443**	**7.12**	**0.003**
Profession	**0.316**	**7.26**	**0.007**
Premium Payment Period	0.131	2.08	0.1

Premium Amount	0.134	1.63	0.2
Types of Insurance Products	**-0.163**	**4.14**	**0.04**

Based on table 3.5, the covariate, Wald and p-values of each variable can be seen. There are 3 variables that have a Wald value of more than $X^2_{0.05,1} = 3.841$ or a p-value of less than $\alpha = 0.05$ (written in bold in the table above). These variables are the amount of sum insured (X_3) with a value of $W^2 = 7.12$, profession (X_4) with a value of $W^2 = 7.26$, and the type of insurance product (X_7) with a value of $W^2 = 4.14$. These results are based on a partial parameter significance test procedure with the following test steps.

1. Make a hypothesis
   $H_0 : \beta_p = 0$ (The p independent variable has no effect to the model)
   $H_1 : \beta_p \neq 0$ (The p independent variable has an effect on model for $p = 1,2, \dots, n$)
2. Level of significance: $\alpha = 0.05$
3. Determining the critical area (rejection of H_0)
   Reject H_0 if $W^2 > X^2_{\alpha,1}$ for $p - value < \alpha$
4. Conclusion
   Based on Table 3.5, the variables that meet the test criteria are the amount of insurance money, employment and type of insurance product. So it can be concluded that the variables that have a significant influence on the Cox Proportional Hazard Model are the amount of sum insured, profession and type of insurance product.

To obtain the final Cox Proportional Hazard model, parameter estimates were carried out for 3 variables that had a significant effect on the model. Parameter estimates for the variables of sum insured, profession and type of insurance product are presented in the following table.

Table 3.6 Final Model Parameter Estimates

Variables	β_p	$\exp(\beta_p)$	$SE(\beta_p)$	$Pr(>\lvert z\rvert)$
Amount of Sum Insured	0.349	1.42	0.16	0.03
Profession	0.315	1.37	0.12	0.01
Types of Insurance Products	-0.195	0.82	0.08	0.02

Based on Table 3.6, the final Cox Proportional Hazard Model obtained,

$$h(t, X) = h_0(t)\exp(0.349X_3 + 0.315X_4 - 0.195X_7)$$

The amount of sum insured has a big influence on the premium payment period. The greater the amount of sum insured, the greater the risk that the customer will not be able to pay the premium. On the other hand, if the sum assured is small, the risk of the customer being unable to pay the premium will be small. The customer's occupation also influences the premium payment period. Customers with jobs with irregular income have a greater risk of being unable to pay premiums. The customer's choice of type of insurance product influences the ability to pay premiums, because the insurance product determines the amount of premium that must be paid, the payment period and the amount of insurance money obtained. This is in line with the research results which states that the period of the ability to pay premiums is influenced by the amount of insurance money, the method of premium payment, the amount of premiums and the type of insurance product [11].

4. CONCLUSION

Based on the results and discussion, it was concluded that the factors that influence the customer's ability to pay insurance premiums are the amount of sum insured (X_3), profession (X_4) and type of insurance product (X_7). The Cox Proportional Hazard Model is obtained as follows.

$$h(t, X) = h_0(t)\exp\,(0.349X_3 + 0.315X_4 - 0.195X_7)$$

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