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SURVIVAL ANALYSIS WITH EXTENDED COX MODEL ABOUT DURABILITY DEBTOR EFFORTS ON CREDIT RISK

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ABSTRACT

The application of survival analysis on the data of credit motorcycle financing experiencing bad loans after the credit starts early, with sixteen covariates were considered. The model used in survival analysis is the Cox proportional hazard models. Cox models have the assumption that the proportional hazard assumption. Extended Cox models selected to improve cox proportional hazard models when one or more covariates did not meet the assumption of proportional hazards. Extended cox models is an extension of cox models that involve time-dependent variables. Covariates that do not meet the proportional hazards assumption in the Cox models diinteraksikan extended with functions appropriate time, in order to obtain time-dependent covariates. So on the model covariates that are not dependent on time and time dependent covariates. The parameters of these covariates estimated using partial maximum likelihood method. To determine whether the extended Cox model is a suitable model for the data in a particular case, likelihood ratio test was used. The results indicate that extended Cox models with functions time appropriate, provide the best model.

Keywords : Credit Risk, Survival Analysis, Cox Proportional Hazard , Extended Cox Model

INTRODUCTION

The vehicles are the most needed tool as a transportation medium. The motor is a means of personal transportation that is often used by the people. The effectiveness and efficiency of the motor makes a special attraction for people to have it. Motor is choosen because the price that could be reached by all societies. Giving of easy credit also makes some people take the decision to credit the motor.

Credit finance companies generally called leasing is a business entity outside the bank and non-bank financial institutions specially set up to conduct business activities such as: leasing, factoring of loan, or consumer financing (Oktaputra 2014). The leasing companies provide credit facilities motors have the business risks arising from the provision of this credit. The risks referred to are credit risk that occurs due to the failure of the debtor to do a obligations to repay the loan to the lender or creditor. The debtor is an individual, company or entity that received one or more facilities for provision of funds.

Credit risk can be minimized by selectively against the debtor that would do credit. The use of models is one of the alternatives to determine the factors that affect the debtor fails to meet its obligations to make payments. According Prasetya (2006) factors are estimated to affect the debtor's failure to fulfill its obligations is the demographic characteristics and loan debtors.

Factors that influence the failure of the debtor to fulfill its obligations can be modeled using survival analysis. Survival analysis is a standard method often used to analyze the credit assessment and estimation of chances debtor fails to take into account the length of time the extent to which the debtor can fulfill its obligations. Survival analysis was first developed by the British astronomer, namely Edmund Halley (1656-1742) (Armitage 1973, Johnson & Johnson, 1980, Miller 1981, Kuzma 1984). As the development of the science of statistics, survival analysis be one important tool in statistics, health, actuarial and other sciences that some of them nonparametric Kaplan-

Meier method, parametric and semiparametric Cox.

Survival methods are often used in survival analysis is a method semiparametric Cox regression. Some of the reasons Cox regression was used include: can estimated hazard ratio without the need to know the baseline hazard function; can estimated the baseline hazard function, hazard function, survival and function of baseline hazard function although not specific; Cox models are "robust" similar to the results of parametric models (Kleinbaum and Klein 2005). Cox regression model is affected by the proportional hazards assumption is proportional hazard for one individual with another individual hazard with proportional is constant, is not affected by time. If the proportional hazards assumption is not met then the resulting model is said nonproporsional hazard and the resulting model is not appropriate. Proportional hazard assumptions are intimately associated with a hazard ratio as measured by the ratio of two different individuals who are constant. But sometimes there are some cases that not all the explanatory variables meet the assumption of proportional hazards that led to the explanatory variables would not be significant to the Cox proportional hazards regression models.

Based the limitations of this assumption, there are alternatives to the Cox regression modeling is some of them; stratification and extended Cox models with variable time known extended Cox (Kleinbaum and Klein, 2005).

The aim of this research is to model credit risk with extended proportional hazards regression model of Cox and identify the factors that affect the timing of a debtor until the loan becomes jammed.

MATERIALS AND METHODS

Data

The data used is secondary data obtained from one of the credit motorcycle financing company in Indonesia. Data consisted of 22737 customer loans motorcycle on one of the branches were observed from the period January 2008 to June 2011 (42 months). A debtor is said to be jammed credit if they do not pay the installments within 30 days after the due date.

The data in this study have status of complete data and data censored. Complete data status if the debtor defaulted in the observation period. Data status censored (right sensor) when the debtor is able to repay the debt before the end of the observation period or the debtor still current loan until the end of the observation period.

The data consists of 16 explanatory variables and the response variable. Response variable used is the survival time of a debtor to become jammed credit (months). List of explanatory variables used are seen in Table 1.

Table 1 Explanatory Variables

No	Variable	Explain	No	Variable	Explain
1	X1	Motor Type	9	X9	Instalment Paymment
2	X2	Fixed Phone	10	X10	Home Ownership
3	X3	Phone Ownership	11	X11	Marital Status
4	X4	A Down Payment/Advance	12	X12	Amenability
5	X5	Loan Period	13	X13	Graduate Education Final
6	X6	Gender	14	X14	Occupation
7	X7	Income	15	X15	Type of Income
8	X8	Total Income	16	X16	Age

Procedure in the Extended Cox Model

In general, the stages of extended Cox model are as follows:

1) Data Management
Before exploration of the data, the next step is setting data. Setting the data in terms of the results obtained data exploration is the presence of data outliers and missing data. To overcome these outliers the data, variables made into categorical and will be used for the missing data imputation method.

2) Exploration Data
Preparing the data before to analysis, which explores each variable, check for the presence of data outliers and missing data. Furthermore, overcoming the data outliers and data is lost if any.
3) Using the Cox proportional hazard

Models built with existing data using survival analysis. Stages include:

a. Data survival analysis durability with semiparametric method, which uses Cox proportional hazard regression. The formula for the Cox PH model is

$$h(t, \mathbf{X}) = h_0(t).\exp(\sum_{j=1}^{p} \beta_j X_{ij})$$

where,
t = survival time
$h_0(t)$ = baseline hazard function
β_j = Cox regression model coefficients variable j-th
x_{ij} = explanatory variables j-th for individual i-th.
b = vector coefficients of explanatory variables
x = vector of explanatory variables
This analysis is used to see the effect of the explanatory variables on the response variable simultaneously.

b. Examination proportional hazard assumption.

$$\frac{h(t \mid x_i)}{h(t \mid x_{i'})} = \frac{h_0(t).\exp(\beta' x_i)}{h_0(t).\exp(\beta' x_{i'})} = \frac{\exp(\beta' x_i)}{\exp(\beta' x_{i'})}$$

Proportional hazard regression has a pretty strong assumptions which have to be proportional hazard between one individual and another individual. In other words, the ratio of hazard levels between the two groups of individuals (eg, individual i and i ') should be constant over time (Therneau & Grambsch 2000).

4) Estimation of the extended Cox models with partial likelihood function, is done by adding a dependent time variables on variables not significant in the research,

$$h(t, X(t)) = h_0(t)\exp[\sum_{i=1}^{p_1} \beta_i X_i + \sum_{j=1}^{p_2} \delta_j X_j(t)]$$

5) Testing parameters simultaneously or partially. The aim of this parameter testing to see whether the explanatory variables with the addition of a dependent time variables have a significant effect or not on the model. If the testing parameters are explanatory variables that proved significant effect on the response variable explanatory variables can be inserted into the extended Cox models.

6) Interpretation of coefficients in proportional hazard regression can be seen through the hazard rate ratio. If two individuals with the variables X and X *, then the ratio hazardnya levels are:

$$\frac{h(t, X)}{h(t, X^*)} = \frac{h_0(t)\exp[\sum_{j=1}^{p} \beta_j X_{ij}]}{h_0(t)\exp[\sum_{j=1}^{p} \beta_j X_{ij}^*]}$$

$$= \exp[\sum_{j=1}^{p} \beta_j (X_{ij} - X_{ij}^*)]$$

The above equation is the relative risk of an individual with risk factors X experienced events than other individuals with risk factors X* (Klein & Moeschberger 2003).

RESULTS AND DISCUSSION

Exploration Data

Overall the percentage of the debtor's credit data of motorcycle that is able to pay off its debt by 34%, then there is 41% of the debtor until the end of the observation period is still current credit and 25% of debtors failure to pay.

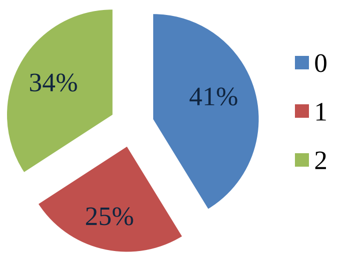

Figure 2 Overall the percentage of the debtor's credit data

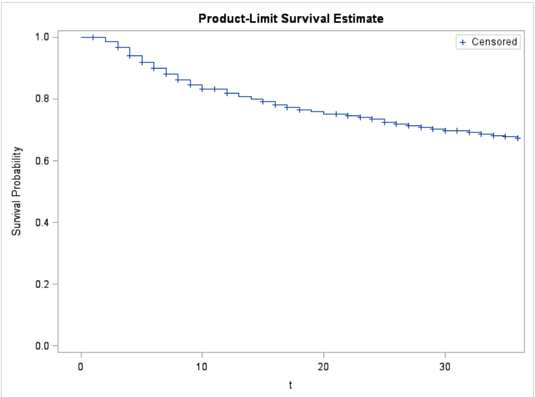

Figure 3 Graph survival function with Kaplan-Meier method

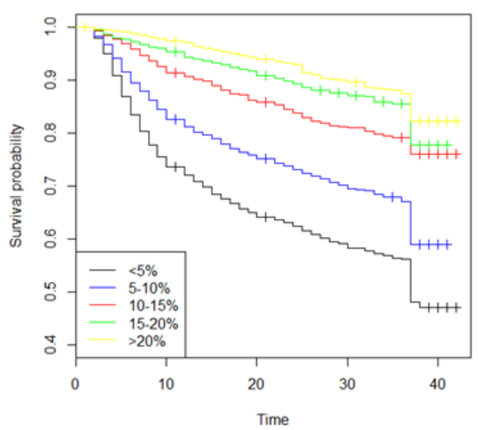

Figure 4 Graph survival function Kaplan-Meier method for a down payment variable

Graph survival function using the Kaplan-Meier method showed that the largest decrease chances of resistance occurs around the first 10 months, after which it declines more slowly. This shows that in the first 10 months there are many debtors who have bad credit than the subsequent months.

Kaplan-Meier method also can produce patterns of survival to any explanatory variables. Graph function durability at the variable advance indicates that debtors who make a down payment of less than 5% has the lowest survival function, or the fastest to become jammed credit. Figure 3 shows that the larger the percentage of advances paid the higher functions of durability or risk to become jammed smaller debtors. In addition, the function of resistance to the advance payment category is less than 5% and 5-10% looks steeper than a category other advances.

Regression Proportional Hazard and Asumption

Proportional hazard regression can explain the influence of the characteristics of the debtor to the survival time simultaneously. Before performing the analysis must first create a dummy variable for all categorical variables. If a variable has k categories the dummy variable that is formed as much as k-1 variable.

Results of analysis with proportional hazard regression method in Table 2. This analysis is done by inserting entire explanatory variables into the model. Testing parameters simultaneously with the test-G obtained the value of chi-square test statistic of 2303.7 and a p-value <0.0001, meaning that at least one explanatory variables that influence the duration of the durability of the debtor. Testing parameters partially performed with Wald test. The variables that significantly affect the survival time of the debtor at alpha 5% among other variables, the type of motor(2 vs 1, 3 vs 1), fixed, phone ownership, a down payment, loan period(4 vs 1), gender, number of installments, home ownership(3 vs 1), marital status, amenability (7 vs 1), graduate education final(4 vs 1), occupation, and age(4 vs 1).

Table 2 Estimation and Testing Parameter of Cox Model

Model Fit Statistics		
Criterion	**Without Covariates**	**With Covariates**
-2 LOG L	109206.17	106220.60
AIC	109206.17	106314.60

Testing Global Null Hypothesis: BETA=0			
Test	**Chi-Square**	**DF**	**Pr > ChiSq**
Likelihood Ratio	2985.5743	47	<.0001

Parameter		**DF**	**Parameter Estimate**	**Standard Error**	**Chi-Square**	**Pr > ChiSq**	**Hazard Ratio**
X1	**2**	1	-0.36309	0.04239	73.3617	<.0001	0.696
X1	**3**	1	-0.32078	0.03976	65.0778	<.0001	0.726
X1	**4**	1	0.08665	0.06737	1.6540	0.1984	1.091
X2	**2**	1	-0.14200	0.06073	5.4664	0.0194	0.868
X3	**2**	1	0.26168	0.03027	74.7113	<.0001	1.299
X4	**2**	1	-0.42169	0.03561	140.2686	<.0001	0.656
X4	**3**	1	-1.00364	0.05441	340.2418	<.0001	0.367
X4	**4**	1	-1.43545	0.08251	302.6644	<.0001	0.238
X4	**5**	1	-1.80043	0.07378	595.4820	<.0001	0.165
X5	**2**	1	0.06654	0.13082	0.2587	0.6110	1.069
X5	**3**	1	0.26523	0.14066	3.5554	0.0594	1.304
X5	**4**	1	1.11030	0.16513	45.2081	<.0001	3.035
X6	**2**	1	-0.15994	0.03810	17.6196	<.0001	0.852
X7	**2**	1	-0.00686	0.03617	0.0359	0.8497	0.993
X7	**3**	1	-0.06783	0.06921	0.9606	0.3270	0.934
X8	**2**	1	0.02082	0.04030	0.2668	0.6055	1.021
X8	**3**	1	-0.02539	0.05629	0.2034	0.6520	0.975
X9	**2**	1	0.22607	0.03435	43.3217	<.0001	1.254
X9	**3**	1	0.34653	0.07810	19.6894	<.0001	1.414
X9	**4**	1	0.57363	0.17928	10.2374	0.0014	1.775
X10	**2**	1	0.06870	0.04158	2.7303	0.0985	1.071
X10	**3**	1	0.12589	0.04303	8.5580	0.0034	1.134
X10	**4**	1	0.03936	0.05331	0.5452	0.4603	1.040
X11	**2**	1	-0.24298	0.07019	11.9833	0.0005	0.784
X11	**3**	1	0.43241	0.08170	28.0094	<.0001	1.541
X12	**2**	1	-0.16878	0.06223	7.3553	0.0067	0.845
X12	**3**	1	-0.12569	0.06094	4.2541	0.0392	0.882
X12	**4**	1	-0.06390	0.06473	0.9746	0.3235	0.938
X12	**5**	1	-0.00570	0.07423	0.0059	0.9387	0.994
X12	**6**	1	0.16519	0.09623	2.9466	0.0861	1.180
X12	**7**	1	0.37073	0.12150	9.3102	0.0023	1.449
X13	**2**	1	-0.00452	0.04090	0.0122	0.9120	0.995
X13	**3**	1	-0.03961	0.03730	1.1280	0.2882	0.961
X13	**4**	1	-0.23584	0.06948	11.5229	0.0007	0.790
X13	**5**	1	-0.06066	0.07123	0.7252	0.3945	0.941
X13	**6**	1	-0.17446	0.19525	0.7983	0.3716	0.840
X14	**2**	1	0.25289	0.10291	6.0382	0.0140	1.288
X14	**3**	1	0.37508	0.10212	13.4906	0.0002	1.455
X14	**4**	1	-0.29423	0.06645	19.6028	<.0001	0.745
X14	**5**	1	-0.23475	0.07362	10.1684	0.0014	0.791
X14	**6**	1	0.28889	0.10902	7.0224	0.0080	1.335
X14	**7**	1	0.21299	0.09008	5.5908	0.0181	1.237
X15	**2**	1	0.11161	0.09418	1.4044	0.2360	1.118
X16	**2**	1	-0.01909	0.16486	0.0134	0.9078	0.981
X16	**3**	1	-0.23491	0.16666	1.9866	0.1587	0.791
X16	**4**	1	-0.38679	0.16868	5.2581	0.0218	0.679
X16	**5**	1	-0.38576	0.17263	4.9933	0.0254	0.680

Table 3 Residual Schoenfeld

Pearson Correlation Coefficients, N = 5611 Prob > |r| under H0: Rho=0																
	RX 1	**RX 2**	**RX 3**	**RX 4**	**RX 5**	**RX 6**	**RX 7**	**RX 8**	**RX 9**	**RX 10**	**RX 11**	**RX 12**	**RX 13**	**RX 14**	**RX 15**	**RX 16**
timerank	0.02322	0.01251	0.01410	0.14415	-0.06838	0.05445	0.02621	0.05819	0.00008	-0.00940	-0.02001	0.02283	0.06490	0.01570	0.03030	0.02024
Rank for Variable t	0.08220	0.34887	0.29911	<.0001	<.0001	<.0001	0.04996	<.0001	0.99950	0.4815	0.1340	0.08872	<.0001	0.23396	0.02332	0.12296

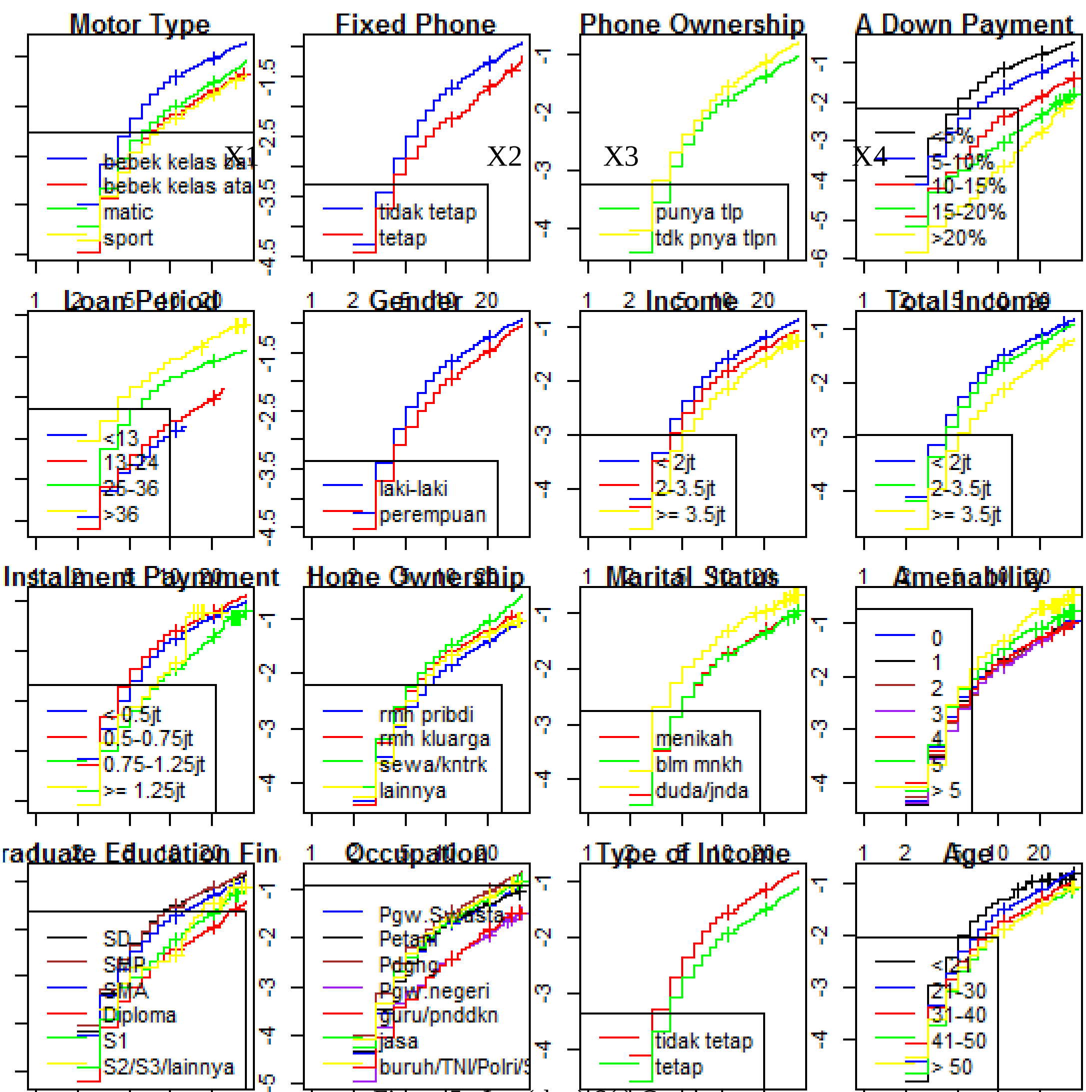

Figure 5 –Log(-log) S(t) Graph

Proportional hazard assumption is the assumption has to be proportional hazard between one individual and other individual. Examination of the assumptions made by making allegations of curve -log(-log) $S(t)$ for all categories of the independent variables and test the Schoenfeld residuals. Curves -log(-log)$S(t)$ for all explanatory variable show that the resulting curve parallel between categories (Figure 5). This is supported also by Schoenfeld residuals. Schoenfeld residuals for all variables can be seen in Table 3. Based on the result curve -log(-log)S(t) and Schoenfeld residual test can be concluded that there explanatory variables that do not meet the assumption of proportional hazards is variable down payment, loan period, gender, income, total income, graduate educaion final, and type of income.

EXTENDED MODEL COX

Extended Cox model is a Cox regression model with the addition of a dependent time variables on variables that do not meet the proportional hazard assumption. Dependent time variables performed of variables that do not meet the assumptions and time function. Time function is used on the addition of variables are dependent time $g(t)=t$. Cox regression models with addition dependent time variables in this study are as follows:

$$h(t,x(t))=h_0(t).\exp(\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4$$
$$+\beta_5X_5+\beta_6X_6+\beta_7X_7+\beta_8X_8$$
$$+\beta_9X_9+\beta_{10}X+\beta_{11}X+\beta_{12}X_{12}$$
$$+\beta_{13}X_{13}+\beta_{14}X_{14}+\beta_{15}X_{15}+\beta_{16}X_{16}$$
$$+\delta_4X_4.g(t)+\delta_5X_5.g(t)+\delta_6X_6.g(t)$$
$$+\delta_8X_8.g(t)+\delta_{13}X_{13}.g(t)+\delta_{15}X_{15}.g(t)$$

with addition time-dependent variables on variables of X_4, X_5, X_6, X_8, X_{13}, and X_{15} that is a down payment, loan period, gender, graduation education final, and type of income.

To calculate the value of the estimation extension of the Cox regression model and the value of likelihood ratio tests are used simultaneously on the extension of the Cox regression model could use help program of SAS 9.3. Testing parameters of the explanatory variables a time-dependent aims to see whether the explanatory variables have a time-dependent or no effect on the dependent variables. Testing is done in two ways simultaneously and partially.

Testing Simultaneously

Simultaneous test aims to determine the influence of independent variables with the dependent variables simultaneously, or all at once. Simultaneous test is obtained by using test-G and α = 0.05. Based on SAS 9.3 the output results contained in Table 4, the test model was built that has a value likelihood ratio of 3276.04 with a p-value = <.0001. This means that explanatory variables have an influence on the dependent variable(respon).

Table 4 G-test extended Cox model

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	3276.0440	63	<.0001

Table 5 G-test extended Cox model after reducted

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	3244.2799	50	<.0001

Partial Testing

Partial test used is the Wald test with α = 0.05. Testing time-dependent explanatory variables that have no significant effect will be reducted from the model. After reducted, this is differ obtained the value likelihood ratio of 3244.28 with a p-value = <.0001 (see table 5). Extended Cox model can be seen from the p-value of each variable in table 6. There are thirteen explanatory variables that had a p-value less than α. The thirteen explanatory variables was the type of motor, phone, fixed phone ownership, down payment, loan period, gender, number of installments, the ownership of residence, marital status, amenability, graduate education final, occupation, and age. Time-dependent explanatory variables also have a p-value less than α is a down payment, loan period, gender, and education level (see Table6).

Table 6 Testing parameter of Cox Model after reducted

Analysis of Maximum Likelihood Estimates

Parameter		DF	Parameter Estimate	Standard Error	Chi-Square	Pr > ChiSq	Hazard Ratio	Label
X1	**2**	1	-0.36069	0.04230	72.7052	<.0001	0.697	X1 2
X1	**3**	1	-0.32394	0.03956	67.0474	<.0001	0.723	X1 3
X1	**4**	1	0.08478	0.06721	1.5913	0.2071	1.088	X1 4
X2	**2**	1	-0.15413	0.06074	6.4394	0.0112	0.857	X2 2
X3	**2**	1	0.27381	0.03016	82.4183	<.0001	1.315	X3 2
X4	**2**	1	-0.42219	0.03565	140.2575	<.0001	0.656	X4 2
X4	**3**	1	-1.35991	0.09563	202.2356	<.0001	0.257	X4 3
X4	**4**	1	-1.90510	0.14991	161.5008	<.0001	0.149	X4 4
X4	**5**	1	-2.69091	0.13116	420.9289	<.0001	0.068	X4 5
X5	**2**	1	-0.29131	0.13613	4.5796	0.0324	0.747	X5 2
X5	**3**	1	0.38354	0.15206	6.3621	0.0117	1.467	X5 3
X5	**4**	1	0.64397	0.17117	14.1534	0.0002	1.904	X5 4
X6	**2**	1	-0.35371	0.06029	34.4257	<.0001	0.702	X6 2
X9	**2**	1	0.22433	0.03433	42.7040	<.0001	1.251	X9 2
X9	**3**	1	0.35855	0.07819	21.0275	<.0001	1.431	X9 3
X9	**4**	1	0.48089	0.18286	6.9161	0.0085	1.618	X9 4
X10	**2**	1	0.06934	0.04144	2.8000	0.0943	1.072	X10 2
X10	**3**	1	0.12709	0.04294	8.7585	0.0031	1.136	X10 3
X10	**4**	1	0.05389	0.05311	1.0296	0.3102	1.055	X10 4
X11	**2**	1	-0.24082	0.06935	12.0585	0.0005	0.786	X11 2
X11	**3**	1	0.43470	0.08089	28.8777	<.0001	1.544	X11 3
X12	**2**	1	-0.16779	0.06218	7.2820	0.0070	0.846	X12 2
X12	**3**	1	-0.12827	0.06088	4.4399	0.0351	0.880	X12 3
X12	**4**	1	-0.06987	0.06465	1.1679	0.2798	0.933	X12 4
X12	**5**	1	-0.01615	0.07413	0.0475	0.8275	0.984	X12 5
X12	**6**	1	0.15200	0.09615	2.4992	0.1139	1.164	X12 6
X12	**7**	1	0.37036	0.12133	9.3174	0.0023	1.448	X12 7
X13	**2**	1	-0.00495	0.04087	0.0147	0.9035	0.995	X13 2
X13	**3**	1	-0.03586	0.03687	0.9461	0.3307	0.965	X13 3
X13	**4**	1	-0.44658	0.10748	17.2653	<.0001	0.640	X13 4
X13	**5**	1	-0.32561	0.11101	8.6029	0.0034	0.722	X13 5
X13	**6**	1	-0.17023	0.19524	0.7601	0.3833	0.843	X13 6
X14	**2**	1	0.14055	0.04702	8.9340	0.0028	1.151	X14 2
X14	**3**	1	0.26254	0.04430	35.1165	<.0001	1.300	X14 3
X14	**4**	1	-0.30306	0.06627	20.9144	<.0001	0.739	X14 4
X14	**5**	1	-0.24035	0.07335	10.7369	0.0011	0.786	X14 5
X14	**6**	1	0.18196	0.05738	10.0550	0.0015	1.200	X14 6
X14	**7**	1	0.12425	0.04466	7.7389	0.0054	1.132	X14 7
X16	**2**	1	-0.03263	0.16483	0.0392	0.8431	0.968	X16 2
X16	**3**	1	-0.24851	0.16663	2.2242	0.1359	0.780	X16 3
X16	**4**	1	-0.40051	0.16860	5.6429	0.0175	0.670	X16 4
X16	**5**	1	-0.40138	0.17251	5.4134	0.0200	0.669	X16 5
tX4_3		1	0.03103	0.00640	23.5451	<.0001	1.032	
tX4_4		1	0.03937	0.00961	16.7860	<.0001	1.040	
tX4_5		1	0.07160	0.00762	88.2077	<.0001	1.074	
tX5_3		1	-0.04881	0.00561	75.6237	<.0001	0.952	
tX6_2		1	0.01872	0.00444	17.8030	<.0001	1.019	
tX8_3		1	-0.0004574	0.00276	0.0274	0.8686	1.000	
tX13_4		1	0.01851	0.00703	6.9307	0.0085	1.019	
tX13_5		1	0.02323	0.00708	10.7703	0.0010	1.024	

Interpretation of extended Cox models are:

1. Type motorcycle variable with the motorcycle category of the low-class as a reference, have a negative regression coefficient with the value of -0.36069 and hazard ratio value 0.697 for high

class motorcycle and value -0.32394 and hazard ratio value 0723 for matic motorcycle. This indicates that individuals who take credit for this kind of motorcycle high class and have the risk of failure to pay 0.697 times and 0.723 times compared to the low class motorcycle.

2. Fixed phone variable with category are not fixed phone as reference, have a negative regression coefficient with the value of -0.15413 and hazard ratio value 0.857. This indicates that the individual has a fixed phone risk failure to pay of 0857 times compared to having a phone that is not fixed.
3. Phone ownership variable with category to have a telephone as a reference, have a positive regression coefficient with a value of 0.27381 and a hazard ratio of 1.315. This indicates that individuals who do not have a telephone have a risk failure to pay 1,315 times compared to having a phone.
4. A down payment variable with the category a advance of less than 5% as a reference, the has a hazard ratio value 0.656 for an advance of 5-10%, hazard ratio 0.257 for a down payment of 10-15%, hazard ratio 0.149 for a down payment of 15-20%, hazard ratio 0.068 to advance more than 20%. This indicates that the individual has a risk of failure to pay 0.656 times who took credit with a down payment of 5-10% compared to the down payment is less than 5%. For an advance of 10-15% of individuals at risk of failing to pay 0257 times less than the down payment of 5%. Individuals who take motor with an advance of 15-20% has 0149 times the risk of default compared to an advance of less than 5%. Individuals who take motor with an advance of more than 20% had a risk of default 0.068 times than the down payment is less than 5%. Thus, individuals who take motor with a down payment of less than 5% have the highest risk of failure to pay.
5. A loan period variable with category of less than 13 months as a reference, has a hazard ratio value 0.747 for a period of 13-24 months, hazard ratio value 1467 for a period of 25-36 months, and 1.904 for a period of more than 36 months. This means that individuals who take motor with a longer loan term, the risk of failure to pay would be higher.
6. Gender variable with male category as a reference, have the hazard ratio 0.702. This means that individuals who are female has the risk of failure to pay of 0.702 times compared to male.
7. Number of installments variable with category 0.5 million as a reference, have the hazard ratio value 1.251 for 0.5-0.75 million, 1.431 for 0.75-1.25 million, and 1.618 for more than 1.25 million. This means that the greater the number of installments, it can cause a higher risk of failure.
8. Home ownership variable with its private home as a reference category, has a hazard ratio value of 1.136. This indicates that individuals who have a house of lease/contract will have a risk of failure to pay motorcycle loans 1.136 times compared to private home.
9. Marital status variable to get married as a reference category, have the hazard ratio value 0.786 and 1.544 for the unmarried and widowers / widows. This means that individuals who are not married will have the risk of failure to pay 0786 times compared to already married and the individual with the status of widower / widow has a risk of failure to pay 1.544 times compared to already married.
10. Amenabiliy variable with no dependents category as a reference, have the hazard ratio of 1,448 for the number of dependents over 5. It shows individuals who have more than 5 dependents will have a default risk amounting to 1,448 compared with no dependents.
11. Graduate education level variable with SD as a reference category, has a hazard ratio value of 0.640 for undergraduate, 0722 for diploma, and 0843 for post graduate and others. It showed hazard ratios of SMA to S2, S3, and others have a default risk higher.
12. Occupation variable with private employees as reference category, have a hazard ratio value of 1,151 for farmers, 1.3 for merchants, 0739 for civil servants, 0786 for teachers / educators, 1.2 for services, and 1,132 for workers and others. This means that individuals who have the job of farmers until teachers / educators have diminished the risk of failure, but unlike the case of individuals who have jobs to workers and other services increased risk of failure and then declined.

13. Age variables of less than 21 years as a reference category, has a hazard ratio value of 0.67 for 41-50 years and 0669 for more than 50 years. This means that individuals who have a lifespan of 41-50 years have an increased risk of default at 0.67 times as compared with less than 21 years and individuals who have a lifespan of more than 50 years had a risk of failure by 0669 times compared with less than 21 years.
14. Advances time-dependent variable tied to the category of 10-15%, has a hazard ratio of 1.032, which signifies the addition of a down payment for a month have a risk of failure to pay 1.032 times that of the previous advance. So it is the same for variable advance a time-dependent advance to the category 15-20% and over 20% had a hazard ratio of 1.04 and the 1.074, which signifies the addition of one-month advance has the risk of default of 1:04 and 1.074 times of advances previously.
15. Loan period time-dependent variable to the category of 25-36 months, has hazard ratios of 0.952, showing the addition of a period of one month has the risk of default of 0.952 times that of the previous loan period.
16. Gender time-dependent variable to the category of female, has a hazard ratio 1.019, which showed the addition of gender for one month had a risk of default amounting to 1,019 times that of gender previously.
17. Graduate education level time-dependent variable for undergraduate and diploma category, has a hazard ratio of 1.019 and 1.024, which suggests the addition of education levels for one month had a risk of failure amounting to 1,019 and 1,024 times the education level previously.

CONCLUSION

Extended Cox models for survival data of credit risk of the motor in one leasing company in Indonesia is:

$$h(t,x(t)) = h_0(t)\exp[-0.36X_{1(hc)} - 0.32X_{1(mt)} - 0.154X_2 + 0.273X_3 - 0.42X_{4(5-10\%)} - 1.36X_{4(10-15\%)} - 1.9X_{4(15-20\%)} - 2.69X_{4(>20\%)} - 0.29X_{5(13-24)} + 0.38X_{5(25-36)} + 0.64X_{5(>36)} - 0.35X_6 + 0.22X_{9(0.5-0.75m)} + 0.36X_{9(0.75-1.25m)} + 0.48X_{9(\geq 1,25)} + 0.127X_{10(rent)} - 0.24X_{11(s)} + 0.43X_{11(w)} - 0.17X_{12(1)} - 0.13X_{12(2)} + 0.37X_{12(>5)} - 0.45X_{13(S1)} - 0.33X_{13(D3)} - 0.17X_{13(etc)} + 0.14X_{14(frm)} + 0.26X_{14(etr)} - 0.3X_{14(pns)} - 0.24X_{14(tcr)} + 0.18X_{14(jas)} + 0.12X_{14(lab)} - 0.4X_{16(41-50)} - 0.4X_{16(>50)} + 0.03X_{4(10-15\%)}g(t) + 0.039X_{4(15-20\%)}g(t) + 0.07X_{4(>20\%)}g(t) - 0.05X_{5(25-36)}g(t) - 0.0004X_{8(>3.5)}g(t) + 0.018X_{13(S1)}g(t) + 0.023X_{13(D3)}g(t)$$

where $h_0(t)$ is baseline hazard need not fixed, X_1 variable is a motor type, X_2 variable is a fixed phone, X_3 variable is a phone ownership, X_4 is a down payment, X_5 variable is a loan period, X_6 is a gender, X_9 variable is an instalment, X_{10} variable is a home ownership, X_{11} variable is a marital status, X_{12} variable is a amenability, X_{13} variable is a graduate education final, X_{14} variable is a occupation, X_{16} variable is a age.

Advances dependent-time variable in the category of 10-15%, 15-20%, and> 20% have a significant effect on the risk of failure to pay. Furthermore, the loan period time-dependent variable in the category 25-36 months and the total income of a time-dependent in the category of more than 3.5 million have a significant effect on the risk of failure to pay. Variables graduate education final dependent-time in the category S1 and diploma significant effect on the risk of failure to pay.

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