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Credit Risk Model for Micro, Small, and Medium Enterprise (MSME) Loan at Bank XYZ

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Abstract: ***This study investigate the determinants of micro, small, and medium enterprises (MSMEs) repayment by employing the cox hazard regression on MSMEs business at Bank Y. The result of this study reveals that loan repayment affected significantly by the characteristics such as gender, age, marital status, education level, business location, business sector, business experience, installment to proit ratio, tenor, and amount of installment. Interestingly the result concludes that business profit do not significantly encourage borrowers to repay. This study also conform the important role of peer-screening process on hindering the credit default using survival curve to minimize adverse selection.***

Keywords: adverse selection, survival analysis, credit default, cox hazard regression, MSMEs

1. Introduction

Micro, Small, and Medium Enterprises (MSMEs) play a vital role in Indonesian economic growth. In addition, MSMEs also play an important role in providing employment and increasing Indonesia's Gross Domestic Product (GDP) (Haron et al., 2013). Strategic actions taken through MSMEs have been implemented by the government of Indonesia in order to foster the level of national development. The policies become a real solution for the success of economic growth, an increased number of entrepreneurs and labors, unemployment reduction, and public welfare enhancement. MSME development policies are included in improving access to financing sources, entrepreneurship development, increasing market penetration of MSME products, and reforming MSME regulations (Annual Report of Ministry of Cooperatives and SMEs, 2015).

Based on Indonesia's MSME growth data, the number of national MSME entrepreneurs increased from 59,250,920 units in 2015 to 60,494,795 units in 2016. This upward trend was followed by an increase in economic growth as measured by GDP for MSMEs, which increased by 5% in 2015 compared to 2014. These increases show that MSMEs are a high potential market for the financial service industry, especially banks to provide access to financing. Accessibility to financing is the major factor affecting the growth and success of MSMEs, thus adequate access to financing is critical to enable MSMEs to contribute to the national economic development (Annual Report of Ministry of Cooperatives and SMEs, 2015; Strategic Plan of KKUKM 2015-2019).

However, 60% -70% of all MSMEs do not have access to financing through banks. This is caused by the inability of banks to reach the hinterlands (Business Profile of MSMEs, 2015). Nevertheless, in recent years there has been a significant increase in credit channeling by banks to MSMEs. Figure 1 shows that there was a growth in loan disbursement by banks to MSMEs from 2011 to 2016. The average increase in MSME loan was approximately 13.52% per year.

Figure 1:MSME credit disbursement by commercial banks, 2011-2016

Credit risk has been a matter of considerable and constant research interest in banking and financial circles. Credit risk is the risk of loss resulting from the failure of a borrower or counterparty to fulfill its financial or contractual obligations to the Bank. Default occurs if the debtor is unable to meet its legal obligation according to the debt contract. Consequently, non-performing loan (NPL) piles up. It is a condition in which the interest and principal repayment of the loans granted by a bank or financial institution is not settled within the stipulated time frame or period (Banking Industry Profile Quarter III Report, 2016).

One of the factors that lead to NPL is internal factors of the MSME debtors. Banks can make a mistake in making a loan decision for the debtor because the banks have a difficulty to separate good quality and the poor quality debtor (Taswan, 2011). These problems are often called asymmetric information experienced by financial institutions (banks) and debtor as borrowers (Bakhtiar and Sugema, 2012). This asymmetric information can lead to adverse selection, which is a problem of asymmetric information that occurred prior to credit disbursement. It happens because the bank does not exactly know the characteristics of the debtor when analyzing the documents proposed by the debtor (Saunder and Cornett, 2006; Stiglitz and Weiss, 1981; Lean and Tucker, 2001; Staten, 2014).

To minimize the risk of NPL, the bank implements a creditworthiness test system called Credit Scoring or also known as Credit Risk Rating. However, in MSME business

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segment, especially micro, the borrowers generally have no adequate capital and collateral so that the risk of default is considered high. Based on these conditions, the bank needs to predict the time that will be experienced by the debtors to have bad credit repayment in the assessment of credit risk. This time prediction will be an input for the bank to be able to provide early warning of bad debt occurrence for debtors after being given a credit.

Based on the above problem statements, this study aimed to achieve two main objectives, namely:
1) Analyzing the factors affecting credit default over time.
2) Suggesting a simpler method of determining the credit score of a borrower based on a deterministic value of quantifiable loan applicant characteristics using Hazard Function and Cox regression model.

2. Literature Review

Loanable Funds

Bank as a financial institution has the role of intermediaries to transfer funds from savers or surplus unit to borrowers, which is vital to support the economy. In economics, lending is a theory of market interest rates. Loanable funds are the amount of money available for a loan. The market for loan funds is where there are demand and supply of financial resources. The ease in accessing funds for a loan is influenced by the total income in the economy after consumption and government spending are considered fixed (ceteris paribus). Therefore, the interest rate on the loan is determined by the difference between supply and demand in the economy in general (Anyanwu, 1990).

Credit

According to the Indonesian Law No. 7 The Year 1992 concerning Bank, credit is the provision of money or equivalent claims based on the agreement or loan-borrowing agreement between the banks and other parties, requiring borrowers to repay their debts after a certain period of time with interest or profit sharing. In general, there are three different types of credit:
a) Business Loans: Business loans are credits used to finance business or business turnover so as to produce something productive, such as trading business, home industry business, consulting service business, and others.
b) Consumer Credit: Consumer credit is a credit used to buy something that is consumptive, such as home or private vehicle.
c) Multipurpose Loans: The multipurpose loan is type of credit that can be used for any purpose, whether for consumption or for business.

MSME loan is the loan with the largest number of customers in Indonesia. Micro-enterprises are defined as productive individual-owned enterprises with a maximum credit plafond of 100 million. Small businesses have a credit limit of more than 100 million to a maximum of 500 million and medium-sized businesses have a credit limit of more than 500 million and a maximum of 10 billion rupiahs.

Characteristics of MSME in Indonesia

Characteristics of MSMEs are the natures or factual conditions inherent in the business activities and behavior of the entrepreneurs in running their business. These characteristics are the distinguishing characteristics of business actors according to the scale of their business. In business perspective, MSMEs are classified into four groups, namely (Business Profile of MSMEs, 2015):
- MSMEs of the informal sector, for example cadgers.
- Micro segment are MSMEs with the ability of the "craftsmen" but have less entrepreneurial skill to develop their business.
- Dynamic Small Business is a group of SME that has entrepreneurship capability by establishing cooperation (receiving sub contract work) and export.
- Fast Moving Enterprise is a group of SME that has entrepreneurship capability and is ready to transform into a big business.

3. Methodology

Data

The data used in this study were data of MSME credit customers in a conventional bank in Indonesia which called as Bank XYZ in this study with the loan disbursement period from January 2013 to December 2016. The data consisted of uncensored data (customers who had a status of repayment failure until the end of this study period) and censored data (customers whose credits had been paid off and customers whose credit had not been completed but still had good repayment status until the end of the study period.

Variables

The variables used in this study were obtained from MSME credit borrower database of Bank XYZ. Socioeconomic variableswere used to identify the correlation between the variablesand bad credit behavior. The variables used were based on the previous researches which were added with variables that have not been used. Customer's socioeconomic variables include age, gender, marital status, education, income, business sector, business experience, installment amount, loan size, loan installment to income ratio, loan period, and alsoIndonesian regional variables.

Cox Regression Model

Survival analysis is an analysis of time records of an initial event until the occurrence of failure time (Kleinbaum and Klein, 2005). The important thing of survival analysis is the presence of censored data that makes the commonly used method unsuitable to be used as an analytical tool, for example, logistic regression analysis (Collet, 2003). The credit repayment period in this study is the period when customers do credit repayment until the bad credit occurs (failure event). In general, there are three reasons for the censored data to occur. The first is that the study ends-no event, which occurs when the study period ends and the observed object has not reached a failure (good credit repayment). The second is lost to follow up, which happens when the object moves, dies or refuses to participate. The third is withdrawal from the study that occurs if the observation is stopped by certain causes.The Cox model, commonly referred to as the hazard model function, is a model that can be used to predict the hazard of an individual. This model is a multiplication between two factors. First is $h_0(t)$ which is known as the basic and exponential hazard

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functions of linear combinations of βjxj. In general, this model can be written as:

$$h_i(t_i) = h_0(t_i)exp\left(\sum_{j=1}^{P} \beta_j X_j\right)$$

withβ_j is the parameter estimation and x_j is explanatory variable. The important thing in the Cox model is that it is semi-parametric, since the basic function $h_0(t_i)$ is a non-specified function regardless of certain parametric distribution (Kleinbaum and Klein, 2005).

The estimation of $\beta_j$parameter values in Cox model can be done with partial probability function. Suppose the data consists of n observed time duration with $t_1<t_2<\cdots<t_n$ and (t_i) is the set of all individuals who remain in observation before time (Collet, 2003).

4. Result and Discussion

Cox regression generated the G value of 17564.9 with the p-value of 0.0001 which is less than the alpha of 5%. The meaning of the G value is that there was at least one independent variable that is related to the survival time. Based on the partial test with the Wald test, the independent variables associated with the duration of the bad debt occurrence can be seen in Table 1. The result shows that probability for default influenced by all independent variables except Business Income.

Gender factor had a significant effect with the regression coefficient value of 0.095 and p-value of 0.0001 with a hazard ratio of 1.10. The result shows that male customers had a default risk 1.10 times faster than female customers (WongnaadanVitor, 2013; Setargie, 2013). It was because female customers had a better willingness to repay the MSME loan compared to male customers (Chakravarty, 2013). These results are in line with the research conducted by Rahman (2001) and Goetz and Gupta (1996) which indicated that female customers are easier to be affected by the pressure within a credit group and more sensitive to the intervention done by the creditor. Survivor function curve in Appendix 1 shows that male customers had a possibility of faster default in the 48th month with the percentage of 15%, higher than female survivor with 13.8%.

Age factor had a significant effect with the regression coefficient value of -0.024 and p-value of 0.0001 with a hazard ratio of 0.98. The result shows that when the average age increased, the younger-aged customers would have a 0.98 times faster to have default risk compared to the older-aged ones. Older age person has a better and wiser in making a decision so that the default risk is lower. Survivor function curve shows that in the 48th month, the possibility of default was experienced faster by a young-aged group of <30 years old with the percentage of 16.4%, followed by the age group of 31-40 years old with the percentage of 15% (Appendix 1).

Table 1: Determinants of Loan Repayments Using Cox Regression

Variable	Coefficient	Standard Error	p-value	Hazard Ratio
Gender (X_1)	0.095	0.011	<.0001[a]	1.10
Age (X_2)	-0.024	0.001	<.0001[a]	0.98
Marital Status (X_3)	-0.257	0.014	<.0001[a]	0.77
Education level: Junior High School (X_{42})	-0.666	0.048	<.0001[a]	0.51
Education level: High School (X_{43})	-0.855	0.047	<.0001[a]	0.43
Education level: Diploma (X_{44})	-0.389	0.054	<.0001[a]	0.68
Education level: Bachelor (X_{45})	-0.763	0.047	<.0001[a]	0.47
Region: Palembang (X_{52})	-0.596	0.020	<.0001[a]	0.55
Region: Jakarta Kota (X_{53})	-2.585	0.065	<.0001[a]	0.08
Region: Jakarta Thamrin (X_{54})	-1.457	0.048	<.0001[a]	0.23
Region: Jakarta Sudirman (X_{55})	-2.405	0.061	<.0001[a]	0.09
Region: Bandung (X_{56})	-1.773	0.038	<.0001[a]	0.17
Region: Semarang (X_{57})	-0.218	0.021	<.0001[a]	0.80
Region: Surabaya (X_{58})	-0.896	0.021	<.0001[a]	0.41
Region: Balikpapan (X_{59})	-0.071	0.019	0.0002 [a]	0.93
Region: Makassar (X_{510})	-0.516	0.020	<.0001[a]	0.60
Region: Denpasar (X_{511})	-0.700	0.029	<.0001[a]	0.50
Region: Jayapura (X_{512})	-0.451	0.074	<.0001[a]	0.64
Sector S2 (X_{62})	-0.516	0.024	<.0001[a]	0.60
Sector S3 (X_{63})	-0.203	0.053	0.0001[a]	0.82
Sector S4 (X_{64})	-0.503	0.020	<.0001[a]	0.61
Sector S6 (X_{66})	-0.564	0.029	<.0001[a]	0.57
Sector S7 (X_{67})	-0.528	0.022	<.0001[a]	0.59
Sector S8 (X_{68})	-0.577	0.036	<.0001[a]	0.56
Sector S9(X_{69})	-0.216	0.037	<.0001[a]	0.81
Sector S10 (X_{610})	-0.891	0.045	<.0001[a]	0.41
Business Experience (X_7)	-0.004	0.001	0.0002[a]	1.00
Business Income (X_8)	-0.020	0.021	0.3533	0.98
Loan Installment to Income Ratio (X_9)	0.820	0.086	<.0001[a]	2.27
Loan Period (X_{10})	0.002	0.000	<.0001[a]	1.00
Installment Amount (X_{11})	0.251	0.022	<.0001[a]	1.29

*Notes: Sector
S1 Construction
S2 Mining and quarrying
S3 Transportation, warehousing, and communications
S4 Agricultures, plantation, forestry, hunting, and fishery
S6 Trade, restaurant, and accommodation services
S7 Community, social, and other individual services
S8 Financial intermediaries, real estate, business ownership, and business services
S9 Industry
S10 Electricity, gas, and water

The results show that marital status had the regression coefficient value of -0.257 and p-value 0.0001 with the hazard ratio of 0.77. The negative coefficient value means that the relation between marital status and default risk was inversely proportional. Survivor function curve shows that in the 48th month, unmarried customers had a possibility of faster default with the percentage of 19% which is higher than the married customers with 14% (Appendix 1). The similar result was generated from the research carried out by

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Ozdemir and Boran (2004) which stated that married debtors would repay their loan faster than the unmarried ones. It is probably because the married ones will be more responsible and mature as debtors (Agarwal et al., 2011).

By using the level education of elementary school as the control variable, the factor of education level had a significant effect on default level on MSME credit at Bank XYZ. It is shown by all dummy variables of education have a p-value of 0.0001 (less than the significance level of 0.05). The negative coefficient values on education level variable of junior high school, senior high school, diploma, and undergraduate show that customers with lower last education level had a faster default risk than the customers with higher education level. Education level is expected to be one of the factors influencing credit repayment because it affects one's individual character. The higher the education level, the wider the knowledge and insight owned.

Based on the results calculated, the region with the highest percentage of default existed in Medan region with the percentage of 7%. It became the basis why Medan was chosen as the reference region variable in the modeling. The results of Cox regression in Table 1 show that all dummy variables of the region had an effect on the level of default on MSME credit at Bank XYZ. It can be seen from the p-value of 0.0001 (less than the significance level of 0.05). Survivor function curve in Appendix 1 shows that Medan region experienced the possibility of default faster with the percentage of 26%, followed by Banjarmasin region with 25%.

Based on the results calculated, the sector that had the highest percentage of default was construction sector with the percentage of 5.32%. It became the basis why construction sector was the reference sector variable in the modelling. The results of Cox regression in Table 1 show that all dummy variables of sector had an effect on the level of default on MSME credit at Bank XYZ. It is visible from the p-value of 0.0001 (less than the significance level of 0.05). Survivor function curve in Appendix 1 points that construction sector experienced the possibility of faster default with the percentage of 23%, followed by transportation, storage, and communication sector with 19.4% and manufacturing industry sector with 19.2%.

The results show that business experience had the regression coefficient value of -0.004 and p-value of 0.0001. The longer the experience in the business field, the lower the default risk. It is because the debtors have owned good experience and competence level in managing their business. Experience in managing a business can also strengthen the borrowers' ability in harnessing opportunities necessary for business growth and their repayment ability (PapadakidanChami, 2002; Verheul et al., 2007). The factor of loan installment to income ration had a significant effect with the regression coefficient value of 0.820 and p-value of 0.0001 with the hazard ratio of 2.27. The results show that when the average loan installment to income ratio increased, the customers owning higher ratio would have 2.27 times faster default risk than the ones with a lower ratio. It is related to the customers' financial management in considering the amount of loan according to their ability. The difficulty to repay happens when the need for MSME loan increases as the alternative capital.

The significance value (p-value) of business income variable was 0.5766 (more than the significance level of 0.05). It means that customer income from their business had no significant effect on the default on MSME credit. The loan period factor had a significant effect with the regression coefficient value of 0.002 and p-value of 0.0001 with the hazard ratio of 1.00. The results show that when the average loan period increased, the customers who repay the installment in a long period would have a 1 time faster default risk thank the ones who repay in a short period. Loan period is the due time for the debtors to repay the primary installment along with the interest. Loan period will affect the amount of installment and interest that will be paid every. The longer loan period will relieve the installment and interest paid every month. Besides, it will decrease the fund turnover and bank's liquidity, so that the bank will more consider the loan with long loan period. In addition, long loan period will rise the default risk itself. In terms of installment amount, its regression coefficient value was 0.251 and its p-value was 0.0001 with the hazard ratio of 1.29. The results show that when the installment amount increased, the customers owning high installment amount would have a 1.29 times faster default risk than the ones owning low installment amount. A higher loan will be more difficult to repay if left to accumulate especially if there are a compound interest and sanction (Onyeagocha et al., 2012).

$$
\begin{aligned}
&\hat{h}(t,X) \\
&= h_o(t)\exp\{0.095X_1 \\
&- 0.024\,X_2 - 0.257\,X_3 - 0.666\,X_{42} - 0.855\,X_{43} - 0.389\,X_{44} \\
&- 0.763\,X_{45} - 0.596\,X_{52} - 2.585\,X_{53} - 1.457\,X_{54} - 2.405\,X_{55} \\
&- 1.773\,X_{56} - 0.218\,X_{57} \\
&- 0.896\,X_{58} - 0.071\,X_{59} - 0.516\,X_{510} - 0.700\,X_{511} \\
&- 0.451\,X_{512} - 0.516\,X_{62} - 0.203\,X_{63} \\
&- 0.503\,X_{64} - 0.564\,X_{66} \\
&- 0.528\,X_{67} - 0.577\,X_{68} - 0.216\,X_{69} - 0.891\,X_{610} - 0.004\,X_7 - 0.020\,X_8 \\
&- 0.020\,X_8 + 0.820\,X_9 + 0.002\,X_{10} + 0.251\,X_{11}
\end{aligned}
$$

This study is expected to provide benefits for Bank XYZ in terms of a recommendation of prospective debtor assessment in providing MSME loan. It is needed to address the adverse selection problem where the bank needs to know the debtor's characteristics when analyzing the documents proposed by the prospective debtor. Through the analysis of the documents proposed by the debtors, Bank XYZ can obtain the required information to assess the characteristics of the prospective debtors.

Credit risk modeling using Cox hazard regression in this study is expected to be made an important attention for Bank XYZ in assessing the creditworthiness of the prospective debtors. Bank XYZ can consider the factors that can affect a prospective debtor to experience a credit default. It can also conduct a prediction related to the possibility of the time when customers will experience the default on MSME loan. It is conducted to identify the effective loan period so that the credit risk that will be experienced by the customers will be minimized. It also becomes an early warning for Bank XYZ to reconsider whether to keep providing credit but with a different amount of loan, loan period, or interest rate.

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Conducting re-analysis using Character, Capital, Capability, Collateral dan Condition (5C) principles. The element that is first seen is a character. It is related to the debtor's behavior which is associated with the willingness to repay and fulfill his/her obligation. This character can be associated with the moral hazard, namely one's tendency to deliberately violate the authority and ability for personal interests by sacrificing the interests of others. This character is highly disadvantageous for the bank and the capacity shows the ability of the prospective debtor to repay his/her loan obligations. Accordingly, the bank must be selective in channeling the funds by knowing in detail sources of financing owned by the debtors in their business which will be funded by the bank.

The managerial implications based on the socioeconomic profile are as follows:

a) Based on the age, improving accompaniment in managing the business for problematic debtors aged <30 years old.
b) Based on education level, conducting training/coaching for the prospective and existing debtors aimed to improve the discipline and responsibility in fulfilling credit repayment obligation.
c) Based on marital status, conducting intensive monitoring on default debtors to know their income and expenditure.
d) Based on business experience, providing a briefing for debtors who have not had many experiences (less than or equal to 12 years) in their business field so that they will always allocate the capital obtained from the bank to a more productive activities to give an added value to their business.
e) Based on loan period, conducting a more in-depth and detailed analysis on whether the given period has been according to the debtors' capacity to repay the credit every month by focusing on the factors which significantly affect credit default.

It is suggested to conduct a more in-depth observation and there need to be a direct field inspection before deciding the creditworthiness of the prospective debtors. It is important to do to gain a more complete and clearer information about prospective debtors so that the bank can avoid the fraud of the prospective debtors.

5. Conclusion

This paper examines the determinants of loan repayment among borrowers of Bank XYZ. Almost entire socioeconomic profiles had a significant effect on the default of MSME loan, which was gender (X1), age (X2), marital status (X3), education level (X4), region (X5), business sector (X6), business experience (X7), loan installment to income ratio (X9), loan period (X10), and installment amount (X11). Only business income (X8) which had no significant effect on the default of MSME loan.

The results of survivor analysis shows that the possibility of debtors to experience credit default was constantly increasing, with the highest possibility of credit default, on average, happened in the 48th month since the credit disbursement with the percentage of 15% or 0.15.

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Author Profile

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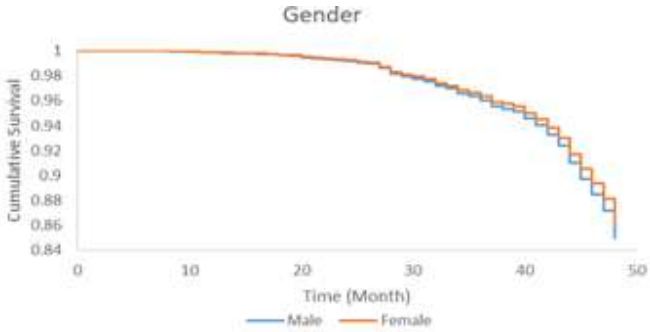
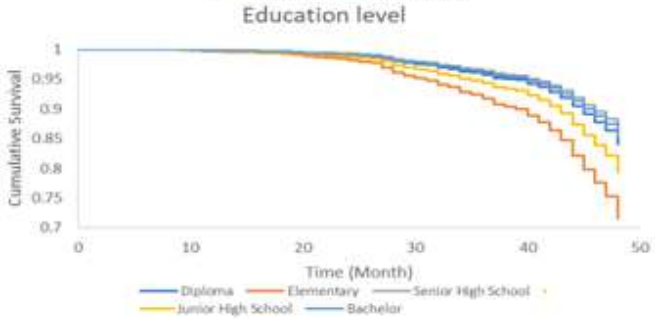
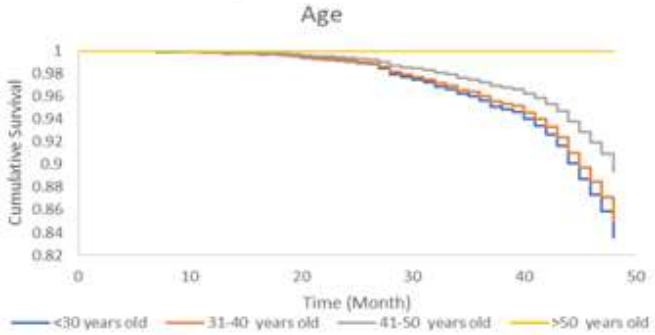
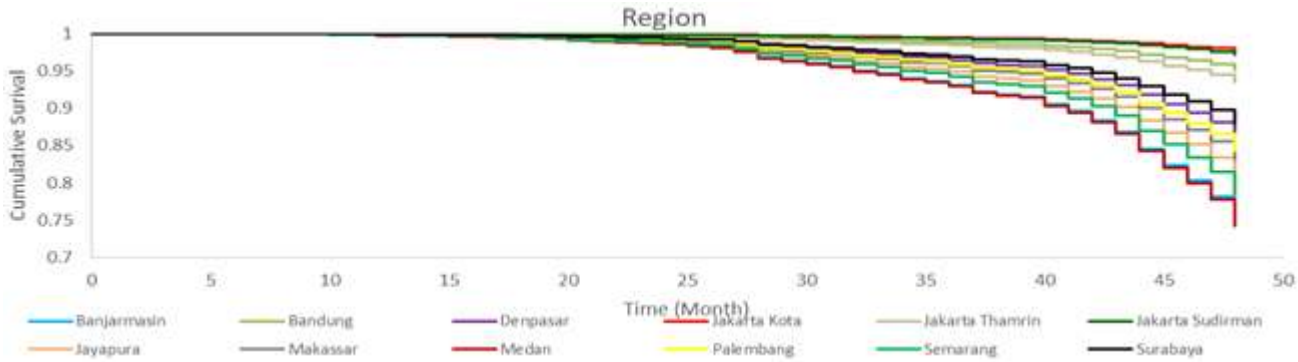
Appendix 1









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