



Determining factors of poverty line in East Java by using log-normal and log-gamma regression

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ABSTRACT

This study reviews the factors that have an impact on the poverty line in East Java. Poverty analysis is essential as it reflects regional welfare and economic conditions and guides policy design, given its systemic impact on other sectors. In addition, policies in poverty alleviation can reduce social disparities and economic development. This study uses a sample consisting of regencies and cities in East Java in 2023. A quantitative approach is applied in research with an associative research type. Data analysis technique used in the study is to apply log-normal regression and log-gamma regression. Referred to the results of the analysis carried out, the right model to represent the poverty line is log-gamma regression. With alpha 5%, the predictor variables that significantly affect positive are the education level, and open unemployment rate. Total population has negative effect the poverty line significantly. Another result shows that economic grows doesn't affect significantly to the poverty line. The results suggest that education, unemployment, and population are key determinants of the poverty line in East Java, highlighting the importance of comprehensive policies aimed at enhancing educational outcomes, expanding employment prospects, and ensuring inclusive development instead of depending exclusively on economic growth

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1. Introduction

Economic development is an effort that is carried out continuously and covers all aspects of the economy. It aims to ameliorate people's welfare and reduce poverty rates. In addition to efforts to improve people's welfare, it also emphasizes avoiding economic inequality in society, which if this continues to occur will cause social inequality and an undeveloped economy. It is carried out with changes in productivity and institutional development in increasing market efficiency. In addition, the government has a main part in supporting economic development through monetary and fiscal policies (Muslihatinningsih & Abidin, 2022). The policies owned by the government are the main instruments in managing the economy as whole that aim to control inflation, reduce unemployment, economic stability, and encourage economic growth. Thus, the focus in economic development activities is related to reducing poverty rates by improving people's lives better, facilitating health and education services, and increasing decent job opportunities for the community.

The main goal is to alleviate poverty in a nation or region, considering that poverty is a global economic concern with far-reaching effects on multiple sectors. Subsequently, destitution lightening endeavors must be carried out comprehensively, covering different viewpoints of people's lives and executed in a coordinate way. Each policy-making handle in managing with destitution must be caught on and caught on as a worldwide issue, hence its taking care of must moreover be in a global context. Hence, every poverty mitigation program must be understood globally and forbid with numerous other movement programs. Within the SDGs, there's no destitution expressed as the primary need. This implies that the world has concurred to dispense with destitution in all its shapes all over, counting Indonesia. Poverty alleviation will be closely related to other global goals (Manopo, 2017).

One of the indicators used to see the welfare of society in a region is the poverty line. The poverty line is a measure that indicates the ability of society in a region to meet their basic needs. The poverty line measures 2 things, namely the minimum income earned and expenditure for other needs outside of food in meeting the needs of life. Basic human needs, namely food needs, are measured from the number of calories needed for a healthy life and other basic human needs, namely clothing and shelter, the need for health services and access to education and others. The poverty line is dynamic and adjusts to the economic situation and cost of living in each country or region. The poverty line is a reference in determining policies for implementing programs such as welfare benefits and community social assistance programs. In general, the conditions of poverty in the regions of Indonesia are relatively diverse (Andina & Wahyudi, 2024). The heterogeneity of poverty in Indonesia shows the social inequality that occurs throughout so that it can be stated that there needs to be a policy in economic development. At present, there are still numerous individuals whose salary is as it were somewhat over the destitution line. The gather included within the close destitute is exceptionally defenseless to changes in financial conditions. One of the provinces in Indonesia that still has an increasing poverty line is East Java. The following is Figure 1 which shows the poverty line in East Java:

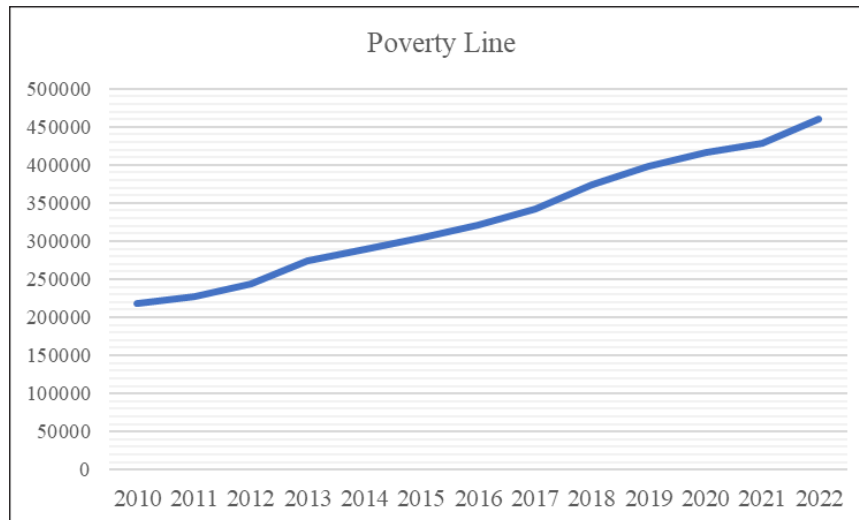


Figure. 1. The Poverty Line of East Java Province

Based on the visualization of poverty line data in East Java shown in Figure 1, the poverty line in East Java has an increasing pattern. This condition indicates that poverty in East Java is possibly caused by several interrelated factors, namely social, economic, and other factors. When viewed from the unemployment condition which also shows an increasing number so that the community's ability to meet needs is also decreasing. Especially in the informal sector which causes unemployment to increase. On the other hand, the condition of the population or total population which allows for an increase, can have an impact on poverty conditions if this is not balanced with the welfare of the community. The inability to provide employment and an increasing population, so that it can worsen poverty conditions in an area (Didu & Fauzi, 2016). The uneven condition of the population in East Java which tends to gather in several districts/cities can cause high social inequality and lead to an increase in the poverty line. Furthermore, poverty conditions that are allowed to continue will worsen environmental conditions such as crime, declining economic growth, and the quality of human resources is also not good. On the other hand, the condition of weak human resources resulting from a low level of education will also have an impact on people's ability to develop themselves to obtain a better and more decent living. Moreover, education is the basis of development goals, so when educational standards are not achieved, then development steps will not be implemented appropriately (Murdiyana & Mulyana, 2017).

Previous studies have analyzed the effect of total population, education level, open unemployment rate, and economic growth on the poverty line. Research conducted by Sari & Rofuiddin (2022), which shows that population and economic growth have a significant effect on the poverty line. Research conducted by Husniatul et al. (2024), also shows that education level and economic growth affect the poverty line. The results of other studies conducted by Adam et al. (2022a), show that education and unemployment rates have a significant effect on the poverty line. Research that reviews the analysis of economic growth on the poverty line was conducted by Alisah & Yulhendri (2021), where economic growth has a significant effect. While other results conducted by Putri & Yuliana (2023), showed that economic growth did not have a significant effect on the poverty line. Other results of research conducted by Usman & Diramita (2018), shows that the unemployment rate does not have a significant effect. Other research conducted by Natari (2022), shows that education does not have a significant effect on the poverty line, while the study by Wati & Suharianto (2025), found that the total population has no significant effect.

Referring to the review and the research that has been conducted, an analysis related to poverty in East Java is needed as a basis and input in poverty alleviation efforts. Several factors including total population, education level, open unemployment rate, and economic growth can affect the poverty line conditions in the region. To be the right input, the analysis process also needs to identify the appropriate model. So that the poverty line variable is tested for log-normal and log-gamma distributions to obtain a model that can represent poverty conditions. Based on this description, the article takes the title “Determining Factors of Poverty Line in East Java by Using Log-normal and Log-gamma Regression”.

2. Literature Review

The Effect of Total Population on Poverty Line

The populace of a locale plays an essential part within the improvement of the locale. Population becomes a problem and concern for the process of economic development of a region. Increasing population growth creates an opportunity for increasing imbalanced environmental conditions. If the population increases sharply and continuously, it can have an impact on the failure to the objectives of economic development. However, if the increase in population in an area is not in line with the development of economic conditions, then this indicates that the condition of the community has a relatively low income but can meet existing needs. Conditions like this can be said to be an increase in the population of an area that is not in line with economic conditions, which also indicates that number of people are still on the poverty line. Government policies are needed to reduce poverty and improve the economy in a population. In addition, it also creates social problems such as poverty and social disparities, thus overpopulation can have an effect on the destitution line in a region (Suaidah et al., 2023).

The research conducted by Parawansa et al. (2024), showed that the total population variable has a significant effect on poverty line. Therefore, the hypothesis of the total population variable against the poverty line can be concluded as follows:

H_1 : Total population affect significantly on poverty line

The Effect of Education Level on Poverty Line

One factor that has a significant impact on poverty in an area is the level of education. When people in an area have a good level of education, this has an impact on decreasing the level of education because they have good abilities, the skills they master are increasingly developed, and people’s productivity increases. Linearly, this condition also has an impact on the jobs of people with high incomes. On the other hand, a high level of education can also increase capabilities in optimal resource management and a developing economy. Through various interrelated mechanisms, increasing the average level of education in society tends to lower the poverty line and increase social and economic welfare. Efforts to improve access and quality of education, especially for disadvantaged groups, are critical to achieving sustainable poverty reduction. Thus, to reduce the poverty line in an area and increase economic development, education is one of the keys to achieving this goal (Suripto & Subayil, 2020).

Research conducted by Surbakti et al. (2023), resulted in an analysis that the level of education has a significant effect on the poverty line. Referring to the research, it can be concluded that the hypothesis of the level of education on the poverty line is as follows

H_2 : Education level affect significantly on poverty line

The Effect of Unemployment Rate on Poverty Line

The level of open unemployment has a direct relationship with the poverty line in a country. When the unemployment rate is high, many individuals lose their source of income, leading to an increase in the number of households living below the poverty line. Prolonged unemployment also results in reduced ability to meet basic needs, such as food, healthy and education, thereby exacerbating poverty (Sinurat, 2023). In addition, high unemployment can create economic and social instability, reduce economic growth, and widen income gaps. Therefore, reducing the level of open unemployment through job creation and skills training is an important key in efforts to lower the poverty line and improve community welfare.

The effect of the open unemployment rate that has a significant effect on the poverty line was carried out by Ristika et al. (2021). Based on the results of the analysis, it can be concluded that the hypothesis of the two variables is as follows:

H₃: Unemployment Rate has effect significantly on poverty line

The Effect of Economic Growth on Poverty Line

Economic growth and the poverty line in a country have a complex relationship and affect each other. Positive economic growth is generally expected to reduce poverty by creating new jobs, increasing incomes, and providing more resources for the government to fund social programs. When the economy develops, business and investment opportunities increase, which can have an impact on improving the overall welfare of society. However, economic growth is not always equitable and can lead to greater inequality if the benefits of that growth are not spread fairly. In a situation where economic growth is only enjoyed by a few people or certain sectors, the poverty line may not change much, and can even get worse if vulnerable groups do not get access to existing economic opportunities (Lumbantoruan & Hidayat, 2015). Therefore, to ensure that economic growth is truly effective in reducing poverty, policies are needed that are inclusive and focus on poverty alleviation and reducing social disparities. Based on this explanation, it can be stated that economic growth has an impact on the poverty line.

Research conducted by Jayadi & Bata (2016), shows that economic growth has an effect on the poverty line. Therefore, the hypothesis of the effect of economic growth on the poverty line can be stated as follows:

H₄: Economic Growth has effect significantly on poverty line

3. Research Method

A quantitative and associative approach are used in this study to determine factors of the poverty line in East Java. It also aims to compare the log-gamma regression and log-normal regression models to determine which of the two methods is the most appropriate. Log-gamma regression and log-normal regression are developments of multiple regression which consider the dependent variable which is approximated by a log-normal distribution and a log-gamma distribution pattern (Erdkhadifa, 2021). The study employs secondary data sample from 2023, covering all regencies and cities in East Java, with the sampling technique applied being purposive sampling. The research variables used are divided into 2, namely independent variables and dependent variables as follows:

Table 1. Operational Definision of Variables

Variable	Operational Definision	Unit/ Scale	Data Source	Period
Total Population	The total number of residents who permanently reside and are officially registered with an identity card within each regency or city in East Java Province at a given time.	Number of People	BPS- Statistics Indonesia	2023
Education Level	The average years of schooling completed by individuals aged 15 years and over.	Years	BPS- Statistics Indonesia	2023
Unemployment Rate	The percentage ratio calculated from the number of unemployed individuals in each regency or city in East Java divided by the total labor force.	Percent (%)	BPS- Statistics Indonesia	2023
Economic Growth	The percentage change in Gross Regional Domestic Product compared to the previous year	Percent (%)	BPS- Statistics Indonesia	2023
Poverty Line	The proportion of individuals whose monthly per capita expenditure falls below the established poverty threshold.	Rupiah per Capita per Month	BPS- Statistics Indonesia	2023

4. Result and Discussion

Distribution Data Test

The initial step taken in forming an appropriate model is to test the data distribution. The following are the results of the data distribution test shown in Table 2:

Table 2. Distribution Data Test

Distribution	P-value	Decision
Log-normal	0.3762	Accepted H_0
Log-gamma	0.3375	Accepted H_0
Normal	0.1672	Accepted H_0
Gamma	0.2314	Accepted H_0

Based on the results of testing the dependent variable data distribution shown in table 2, the poverty line variable follows a log-normal distribution, a log-gamma distribution, a normal distribution, and a gamma distribution. This result can be seen from the p-value which is more than the 10% significance level. Be that as it may, on the off chance that seen from encourage examination, the test measurable values created within the log-normal and log-gamma dissemination examination have superior values compared to the gamma distribution and the normal distribution. Subsequently, the log-normal and log-gamma approaches would be more fitting. Here is the formation of the distribution model for the poverty line variable in East Java shown in Figure 2.

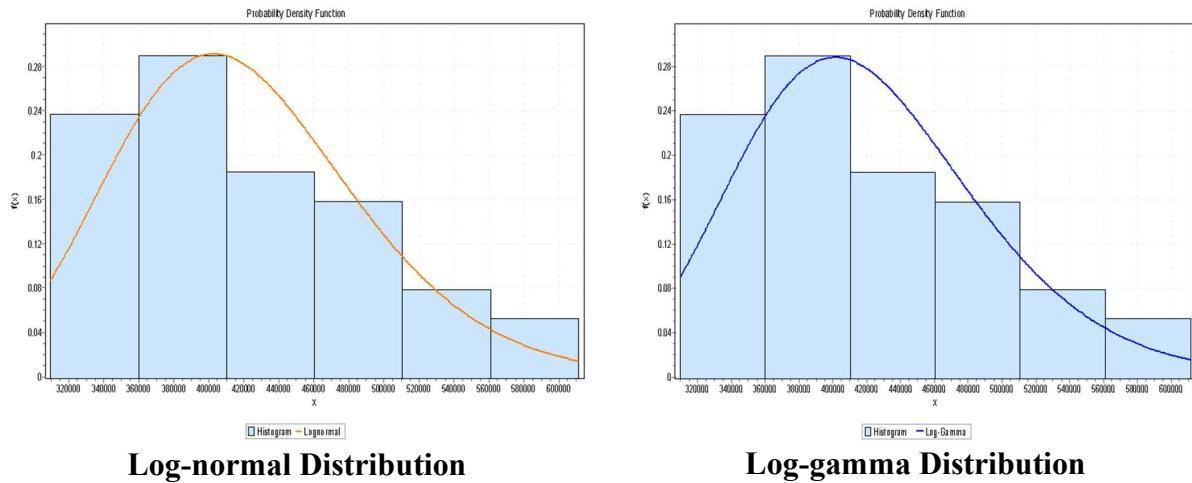


Figure 2 Test of Data Distribution

Based on the results of the distribution model formation shown in the Figure that the line of distribution corresponds to the form of the histogram formed. The analysis results also show that the model parameters for the log-normal distribution are obtained of 0.16895 and of 12.935 whereas for the Log-gamma distribution the parameter distribution is of 5707 and of 0.00227.

Multicollinearity Test

The next step that needs be done is a multicollinearity test to find out whether there is a relationship or correlation between the independent variables. To carry out multicollinearity test, the test is using the variance inflation factors (VIF) values. The following are the results of the multicollinearity test analysis with the VIF values shown in Table 3:

Table 3. Multicollinearity Test

Distribution	VIF
Total Population	1.103
Education Level	1.795
Unemployment Rate	1.743
Economic Growth	1.143

The results of the multicollinearity analysis shown in Table 3 show that the population VIF value is 1.103, the VIF for the education level factor is 1.795, the VIF value for the unemployment rate is 1.743, and the VIF value for economic growth is 1.143. The VIF value of independent variables is less than 10 (Yan & Su, 2009). Therefore, it can be concluded that the independent variables used in the analysis are not related to each other or there is no multicollinearity condition.

Log-normal and Log-gamma Model

After conducting distribution testing and multicollinearity analysis, the next step is to form a model between the poverty line and the influencing factors. The results of the model formation from the log-normal regression and log-gamma regression methods are shown in the following table:

Table 4. Log-normal and Log-gamma Regression Models

Method	Model
Log-normal	$\log \log Y = 12,168 - 5,92.10^{-8}X_1 + 0,037X_2 + 0,058X_3 + 0,004X_4 + \varepsilon$
Log-gamma	$\log \log Y = 12,172 - 6,18.10^{-8}X_1 + 0,036X_2 + 0,06X_3 + 0,002X_4 + \varepsilon$

Referring to Table 4 which shows the results of model formation by applying the log-normal regression method and log-gamma regression. The parameter coefficient values formed between the two models have relatively the same value and the direction of the effect of the predictor variables on the response variables is also the same. The results of model formation obtained in log-normal regression explain that the whole population variable encompasses a negative impact on diminishing the poverty line value by 5.92.10⁻⁸. While the variables of education level, open unemployment rate, and economic growth have positive parameter coefficient values where these variables increase the poverty line in East Java. The model of log-gamma regression model was obtained that every increase in the total population value would decrease the poverty line by 6,18.10⁻⁸. An increasing education level factor would increase the Poverty Line by 0.036. In the same way, an increase in unemployment rate variables and economic growth would also increase the povety line in the east of Java by the coefficient parameters of 0.06 and 0.002

The second step is carrying out a simultaneous test to find out whether there was one of the independent variables that had a significant effect on the poverty line in East Java. Simultaneous test results on the log-normal model and log-gamma model are shown in Table 5 as follows

Table 5. Simultaneous Test

Model	Statistics		
	G ²	p-value	Decision
Log-normal	50.130	0.000	Rejected H ₀
Log-gamma	50.223	0.000	Rejected H ₀

The results of the simultaneous test examination appeared in Table 5 in both the log-normal demonstrate and the log-gamma show clarify that the predictor variables at the same time have a critical impact. This shows the meaning that there is one independent variable that has a significant effect on the poverty line. This can be seen from the value of G² which compared to the value of of 7.779 has a greater value. The analysis value obtained is that G² value for the log-normal model is 50.130 and G² value for the log-gamma model is 50.224. Moreover, the conclusions are also obtained from the p-value which is less than the 5% significance level.

The next step is the partial test and model selection to determine the significance of each independent variable and the most appropriate model for modeling the poverty line. The partial test results and goodness of fit of the model are shown in Table 6 as follows:

Table 6. Partial Test and Goodness of Fit

Variables	Log-normal Model			Log-gamma Model		
	coefficient	Z-test	sig	coefficient	Z-test	sig
X ₁	-5.92E-08	2.656	0.004	-6.18E-08	2.758	0.003
X ₂	0.037	1.720	0.043	0.036	1.709	0.044
X ₃	0.058	6.080	0.000	0.060	6.303	0.000
X ₄	0.004	0.509	0.305	0.002	0.377	0.353
Statistics	Goodness of Fit					
AIC	921.464			918.538		
AICc	924.173			921.248		
BIC	931.289			928.364		

Based on the analysis shown in Table 6, the partial test results for both log-normal and log-gamma models show that there are the same independent variables that have significantly effect: X₁ Total Population, X₂ Education Level, and X₃ Unemployment Rate. This result is seen from the absolute value of Z-test yield more than of 1.64. In the log-normal model, the Z-test result for the total population variable was 2.656, the education-level variable had a Z-test value of 1.720, and the unemployment rate of the variable yield Z-test value of 6.08. Therefore, it was concluded that on the variable economic growth did not significantly affect the poverty line in East Java. Other results were also seen from the value of the p-value variable independent total population, education level, unemployment rate worth less than the significant level 0.1.

The information obtained from Table 6 also shows that in the log-gamma model, the total population variable obtains absolute Z-test value of 2.758, Z-test of education level variable was 1,709, and for the unemployment rate variable has Z-test value of 6,303. The same result as in log-normal that the economic growth variabel of 0.377 is less than of 1.64. So economic growth on the log-gamma demonstrate has no significant effect on the poverty line in East Java. The p-value esteem is additionally gotten that the economic growth variable is more than a critical level of 10% or 0.1.

Referring to both modeling results obtained results that have the similarity of independent variables that significantly affect the poverty line, then it is necessary to select the appropriate model. Some of the criteria used for modeling the poverty line are Akaike’s Information Criterion (AIC), Finite Sample Corrected AICc, Bayesian Information Kriterion. (BIC). The results of analysis in Table 6 show that the value of the log-gamma model is smaller than the value of log-normal model. The AIC value is 918.538, the AICc value is 921.248, and the BIC is 928.364. While in the log-normal model the AIC value was 921.464, the AICc value was 924.173, and the BIC value is 931.289. Hence, the most appropriate modeling in describing the poverty line in East Java is the log-gamma model.

Discussion

Based on previous analysis showing that total population has a significant impact on increasing the poverty line. The increase in total population in East Java identifies that there needs to be regional economic growth and encouragement to provide jobs for the workforce. On the other hand, it is also necessary to develop productivity. The impact that arises when the total population

in a region increases, the domestic market also grows so that this affects the decline in the price of goods and ultimately the purchasing power of the community is also greater. In addition, increasing the population in theory also expands access to education, health, and employment, all of which contribute to poverty reduction. Based on the analysis review, the relationship between total population and the poverty line is highly dependent on effective management of population growth, proper management of resources, and policies that support sustainable economic development. Without proper management, population growth can burden resources, increase inequality, and even worsen poverty. The population plays a fundamental role in the economic development of a region. Uncontrolled population growth can hinder the achievement of the main goal of economic development, which is improving public welfare and reducing poverty levels. Rapid population growth may lead to excessive pressure on natural resources, a decline in savings, environmental degradation, and ecological destruction. Consequently, these conditions can give rise to various social problems such as poverty and underdevelopment.

The results of the analysis on the level of education have a significant positive effect on the poverty line. Basically, education is the foundation needed by individuals to develop themselves with knowledge and skills that are useful for the welfare of their lives. The higher the education possessed by the community, the more it will impact the jobs that will be obtained with a higher income. So that it will reduce poverty in the community. In addition, education also plays a role in forming people's mindsets and lifestyles with broader knowledge and insight in improving the economy. In addition, people with higher education tend to have better access to resources such as health services, technology, and information, all of which contribute to improving overall welfare and reducing poverty. Therefore, increasing access and quality of education is an important step in poverty alleviation efforts. This analysis is related to the previous research which is conducted by [Husniatul et al. \(2024\)](#), that level of education has significant impact for poverty line.

The open unemployment rate has a positive impact on increasing the poverty line in East Java. The results of this analysis are consistent with the findings of [Adam et al., \(2022b\)](#), which indicate that the level of education has an impact on the poverty line. However, these findings differ from those of [Usman & Diramita \(2018\)](#), suggesting a variation in how education influences poverty across different contexts or study approaches. An increasing open unemployment rate in an area indicates that the inability of the community to meet daily needs such as primary needs even make it possible that there will be no health insurance in the future for their survival. In relation to people's purchasing power, the increasing open unemployment rate also affects the decline in people's purchasing power where this affects economic growth in an area and will ultimately have an impact on increasing poverty rates. Elevated unemployment levels suggest that a considerable segment of the population lacks adequate income to fulfill their basic needs, resulting in lower welfare and increased poverty. Furthermore, ongoing unemployment tends to create a chain reaction such as diminishing household spending, hindering economic growth, and heightening reliance on governmental aid. Thus, the unemployment rate becomes a vital measure of economic resilience and social well-being, as its escalation directly implies declining living standards and a worsening poverty situation.

Economic growth that does not have a significant impact on the poverty line is possible because there is an economic condition where the economic growth or development is not evenly distributed or does not reach all levels of society. Although when the economic growth conditions in a region increase, but when the economy only reaches certain communities, then the conditions of society in other parts will not be better. The conditions of inequality that occur related to the

distribution of income and wealth are the main reasons why economic growth does not have a significant impact on poverty alleviation or reducing the poverty line. In addition, if there is a shortage of employment, poor access to education, health and social services, or policies that do not provide benefits to the community, even though economic growth occurs, the poverty line conditions will also increase. Therefore, it is important to ensure that economic policies are designed in such a way that economic growth can provide benefits to all levels of society, especially those below the poverty line. The results of this study differ from the findings of Putri & Yuliana (2023), which indicate that economic growth has a significant effect on the poverty line. However, the results are consistent with the study conducted by Alisah & Yulhendri (2021), which found that economic growth does not always have a direct impact on reducing the poverty line.

5. Conclusions

Based on the results of the analysis that have been presented previously, the most appropriate model to describe the poverty line in East Java is a model formed by applying log-gamma regression. The results of further analysis conducted showed that the predictor variables that significantly affect the poverty line are total population, education level, and open unemployment rate. Of the three variables, the total population has a negative effect, meaning that the larger the total population, the lower the poverty line. Meanwhile, increasing education levels and open unemployment rates are linearly related to increasing poverty lines. These results indicate that there needs to be an increase in employment opportunities in various sectors and evenly distributed throughout East Java. The more the number of workers in East Java is absorbed, it will automatically have an impact on the economic conditions of the community which are getting better so that the poverty line also decreases. On the other hand, the higher the level of education, but if it is not balanced by increased employment opportunities and regulations that facilitate the absorption of labor, the poverty line will also remain high.

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