

Forecasting Unemployment Rate in Aceh Province: Can We Actually Overcome Those Numbers?

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Abstract: *This study examines unemployment state and predicts future unemployment conditions in Aceh Province. This study aims to analyze the state of unemployment in Aceh Province from 1990 to 2019 and forecast the picture of unemployment in Aceh in the next ten years (2020 to 2030). The data in this study are the unemployment data for Aceh Province in 1990-2019. The analytical method used is the Autoregressive Integrated Moving Average (ARIMA). This study concluded that the number of unemployed people in Aceh in 2030 amounted to 69,649 people. This number decreased by an average of 6.91%, but the unemployment rate in urban areas and Diploma and Bachelor graduates increased. This matter suggests the policy maker, educational institutions and other related stakeholders to identify the root causes, for instance they should push the higher education institutions to keep evaluating their curriculum or boost the relevant programs that enhance skills such as specialized professional or vocational training. It is an important note for the Aceh government to pay attention to the absorption of highly educated people's workforce to achieve equitable community welfare in Aceh Province.*

Keywords : *unemployment, forecasting, ARIMA*

Abstrak: *Studi ini mengkaji kondisi pengangguran dan memprediksi kondisi pengangguran di masa depan di Provinsi Aceh. Penelitian ini bertujuan untuk menganalisis keadaan pengangguran di Provinsi Aceh dari tahun 1990 hingga 2019 dan memperkirakan gambaran pengangguran di Aceh dalam sepuluh tahun ke depan (2020 hingga 2030). Data dalam penelitian ini adalah data pengangguran Provinsi Aceh tahun 1990-2019. Metode analisis yang digunakan adalah Autoregressive Integrated Moving Average (ARIMA). Penelitian ini menyimpulkan bahwa jumlah pengangguran di Aceh pada tahun 2030 berjumlah 69.649 orang. Jumlah ini turun rata-rata 6,91%, namun angka pengangguran di perkotaan dan lulusan Diploma dan Sarjana meningkat. Hal ini menyarankan pembuat kebijakan, institusi pendidikan dan pemangku kepentingan terkait lainnya untuk mengidentifikasi akar penyebabnya, misalnya mereka harus mendorong perguruan tinggi untuk terus mengevaluasi kurikulumnya atau meningkatkan program terkait yang meningkatkan keterampilan seperti pelatihan profesional khusus atau kejuruan. Menjadi catatan penting bagi pemerintah Aceh untuk memperhatikan penyerapan*

tenaga kerja bagi masyarakat yang berpendidikan tinggi untuk mewujudkan pemerataan kesejahteraan masyarakat di Provinsi Aceh.

Keywords : Pengangguran, Prediksi, ARIMA

INTRODUCTION

Development is a government policy process in creating a fair, prosperous, and equitable society. A crucial factor in the success of development can be seen in the labor factor, which is considered to have a positive effect in spurring national development and economic growth as a core part of human resources.

Based on the Republic of Indonesia law about employment, labor is everyone who can produce goods or services to meet their own needs and for the community. Aceh is a province that has workforce problems, one of which is the lack of employment opportunities so that human resources are not adequately allocated (Badan Pusat Statistik, 2019b).

Unemployment is a severe problem, so special attention is needed. Forecasting the number of unemployed is essential to know the estimated number of unemployed in the future, so it is necessary to have a strategy to reduce the unemployment rate through pre-employment programs so that there is the readiness of the government and the community to deal with the problem of unemployment that occurs.

Many forecasting methods can be used to predict, one of which is the ARIMA method. The Arima method has the advantage of short-term forecasting. It can analyze any data through the initial phase of the period. The ARIMA method also provides a relatively high level of accuracy compared to other forecasting methods (Fadly and Sari, 2020). This study aim to examine unemployment state and predicts future unemployment conditions in Aceh Province Indonesia and propose several recommendations based on the previous studies.

LITERATURE REVIEW

Unemployment is a global issue that affects all countries, whether the situation is complex or under control. The impact of unemployment could negatively impact the government, community, and individuals. Unemployment occurs when an individual is seeking a paying job but cannot get one in which children, retirees, full-time students, part-time workers, and people who are not interested in

looking for a job are not included. A few words should be examined, such as long-term unemployment, which refers to someone seeking for work within four weeks, and discouraged unemployment, which refers to individuals looking for work within a year and are listed as jobless. Nonetheless, they are still interested in obtaining one (Ramli *et al.*, 2018).

According to Ruth, Emmanuel and Ndubuisi-Okolo (2014), unemployment is interpreted as a person at working age demanding a full-time job but is unable to secure one. There are two significant branches of unemployment which are voluntary and involuntary unemployment. Voluntary unemployment occurs when an individual leaves their current job to find another. In contrast, involuntary unemployment occurs when individuals are dismissed from their position and need to find a new one.

Urrutia, Tampis and Atienza (2017) mentioned that indicators that can forecast unemployment must be identified, including the Labor Force Participation Rate, the Population, the Inflation Rate, the Gross Domestic Product, and the Gross National Income. According to Asif (2013), the most important variables influencing the unemployment rate are GDP, inflation, population growth, and currency rates. All of the factors were examined in three countries: China, India, and Pakistan by Folawewo and Adeboje (2017) discovered a relationship between inflation and unemployment as dependent variables in their research, there are only two positive outcomes: employed or jobless.

RESEARCH METHODOLOGY

The data used in this study are time series data, namely data on the number of unemployed people in Aceh Province from 1990 to 2019, sourced from the Central Agency on Statistics, Badan Pusat Statistik (BPS) Aceh Province. The software used in this research is R. This moving average autoregressive method is carried out in four stages:

1. Identification of Stationary Data. In forecasting, a times series data must meet stationary requirements.

If the original data is not stationary, then the step of this stage is to stationary the data by doing a differencing process, then determining a temporary model.

2. Determine Model Parameters. Parameters are characteristics of a population. The AR, MA, ARMA, or ARIMA model equations are a form of regression. Thus, to obtain the best estimate is to minimize the number of error squares.
3. Model Verification. The next step that is taken after determining the model parameters is the model verification stage. There are two residual tests to be verified at this stage, namely the independence test and the normality of the residuals. The model's residual ACF and PACF graphs will be seen in the independence test.
4. Forecasting. The final step is to use the best model for forecasting. When the best model has been determined, the model is ready to be used for forecasting. According to (Sungkawa and Megasari, 2011), a method for evaluating the forecasting method using the number of absolute errors. The Mean Absolute Percentage Error (MAPE) is calculated using the fundamental error in each period divided by the real observed value for that period (Ho, Xie and Goh, 2002). Then, average the total percentage errors. The following formula can calculate MAPE.

$$MAPE = \frac{1}{n} \sum_{t=1}^n \frac{|Y_t - \hat{Y}_t|}{Y_t} \times 100 \quad (1)$$

The ARIMA model is a variant of the Box-Jenkins ARMA model intended for non-stationary time series applications. The non-stationary time series is first changed into stationary after differentiating process (Pandji, Indwiarti and Rohmawati, 2019). Differencing is an operation in which a new time series is constructed by taking the resulting difference from sequential prices, $Y_t - Y_{t-1}$, along with a non-stationary time series pattern. In general, the ARIMA model (p, d, q) consists of three parts, namely the Autoregressive Model (AR), moving average (MA), and the mixed model ARIMA (Autoregressive Integrated Moving Average) (Polasek, 2013).

1.1 Autoregressive Model (AR)

The general form of the autoregressive model at p , AR (p), or ARIMA ($p, 0, 0$) models are stated as follows:

$$X_t = \phi_1 X_{t-1} + \phi_2 X_{t-2} + \dots + \phi_p X_{t-p} + e_t \quad (2)$$

Where ϕ_p = Autoregressive parameter at p

e_t = error at time- t

1.2 Moving Average Model (MA)

The general form of the moving average model at q (MA(q)) or ARIMA ($0, 0, q$) models is stated as follows:

$$X_t = \mu' + e_t - \theta_1 e_{t-1} - \theta_2 e_{t-2} - \dots - \theta_q e_{t-k} \quad (3)$$

Where μ' = Constanta

θ_1 to θ_q are the moving average parameters

e_{t-k} = error at time $t-k$

1.3 Mix Model

The general form to mix process AR(1) and MA(1), for example, ARMA(1,1) as follow:

$$X_t = \phi_1 X_{t-1} + \dots + \phi_p X_{t-p} + w_t + \theta_1 w_{t-1} + \dots + \theta_q w_{t-q} \quad (4)$$

If non-stationarity is added to the mix ARMA process, the general ARIMA model (p, d, q) is fulfilled. The equation for the simple case of ARIMA (1,1,1) is as follows:

$$(1 - B)(1 - \phi_1 B)X_t = \mu' + (1 - \theta_1 B)e_t$$

RESULTS AND DISCUSSIONS

An overview of the number of unemployed in Aceh Province in the 1990-2019 period is presented in Figure 1.

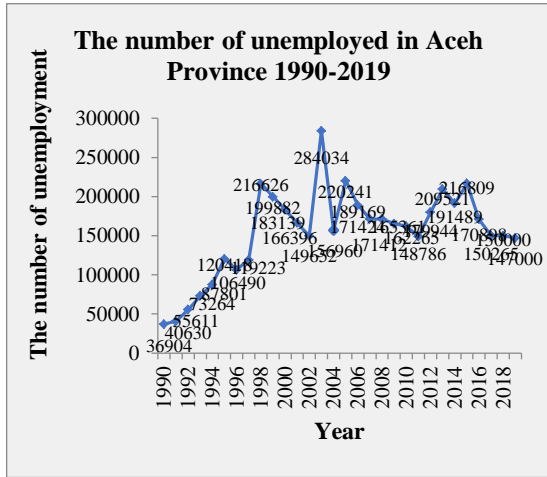
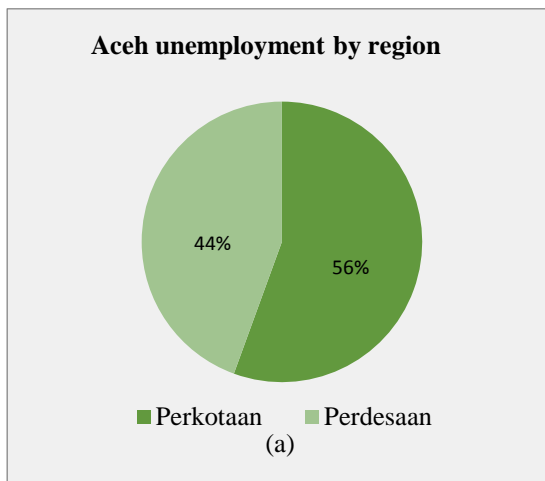


Figure 1. The number of unemployed in Aceh Province 1990-2019

Figure 1 shows that the number of unemployed in Aceh Province is fluctuating. The highest number of unemployed was obtained in 2003 with 284,034 people. Conversely, the lowest number of unemployed was obtained in 1990 with 36,904 people. In 1990 the unemployment rate in Aceh Province was generally below 5%, which indicates that unemployment is on a reasonable scale. The unemployment rate ranges from 2 to 3% is called the natural unemployment rate. That means that if the unemployment rate is at the highest 2 to 3%, it assumes that the economy is in full employment conditions. Unemployment in Aceh from 2004 to 2020 experienced migration from rural areas to urban areas. So that it raises new problems in urban spatial planning, the following is an overview of unemployment in Aceh in urban and rural areas.



(a)

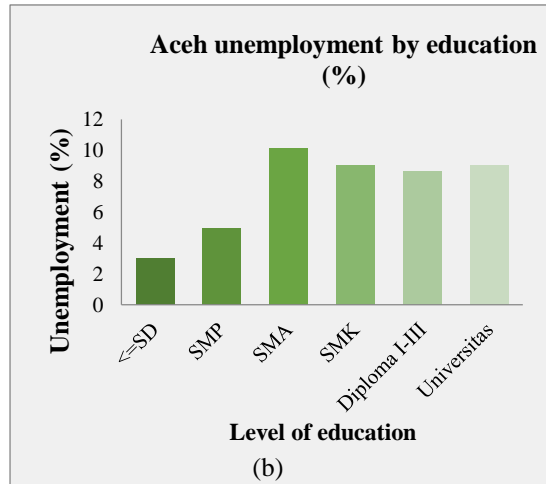
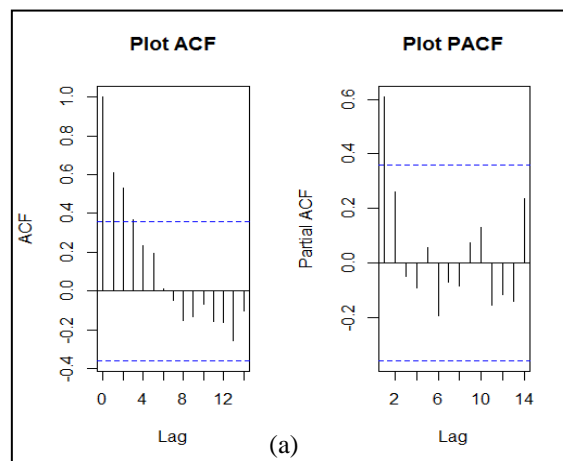


Figure 2. (a) Aceh unemployment by region, (b) Aceh unemployment by education.

Figures 2 (a) and (b) describe that Aceh's urban areas is dominated by unemployed people with a higher education level than SMA/ SMK. This condition shows that Aceh's employment opportunities have not absorbed human resources with a good education. There need to be substantial efforts from policymakers for this problem.

4.1. Stationary Test of Variances and Means

The stationary data check was carried out by testing the stationarity of the data on the variance and mean. In addition, the initial examination can be carried out by identifying the shape of the ACF and PACF plots (Prybutok, Yi and Mitchell, 2000). The ACF and PACF plots for the number of unemployed in Aceh Province are shown in Figure 3(a). The ACF and PACF plots of the data that have been stationary to the variance and mean are presented in Figure 3(b).



(a)

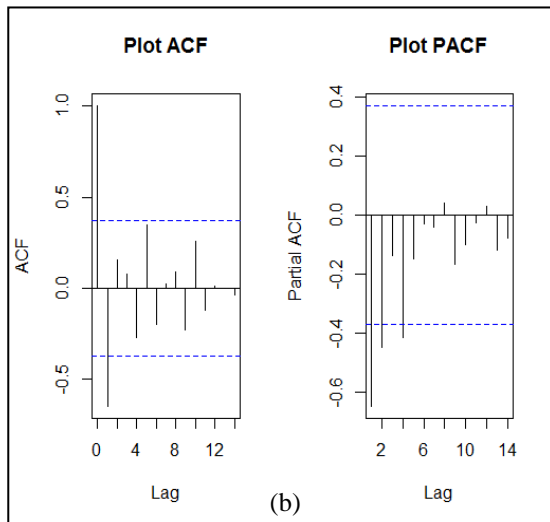


Figure 3. (a) ACF and PACF plots for the number of unemployed in Aceh Province, (b) ACF and PACF plots of the data that have been stationary to the variance and mean

Figure 3 (a) shows that the ACF plot tends to decrease sinusoidally (dies down), and the PACF plot cuts off after the second lag, so it can be assumed that the suitable model for this data is the AR model. The data stationarity test for variants was carried out using the Box-Cox test. The value of λ is -0.4827846 . Because the value obtained is very far from 1, which means that the data is not stationary concerning the variant, it is necessary to carry out a transformation. After one transformation, namely using the $\ln y_t$ transformation once and y_t^2 twice, the λ value is obtained of 0.9667683 (~ 1) so that the data can be said to have been stationary to the variance.

The stationarity test of the data on the mean is carried out with the first step to establish a testing hypothesis. The null hypothesis used is the data on the number of unemployed people who are not stationary. In contrast, the alternative hypothesis is the data on the number of unemployed Acehese stationary. The null hypothesis will be rejected if the p -value $< \alpha$. In contrast, the null hypothesis cannot be rejected if p -value $> \alpha$ —obtained p -value from the augmented dickey fuller test results of 0.09438 . By using $\alpha = 0.05$, a decision was obtained that could not reject H_0 , and it could be concluded that the Aceh unemployment data were not stationary. Because the data is not

stationary to the mean, it is necessary to do differencing and do a stationarity test on the mean again using the differencing data. After differencing, the p -value for the first differencing is 0.1659 , indicating that the data is not stationary to the mean. Furthermore, the second differencing was carried out and obtained a p -value of 0.01 which means that the data has been stationary to the mean. After one transformation and two differencing, the data on the number of unemployed in Aceh Province has been stationary with respect to the variance and mean to carry out the following analysis stage.

Based on Figure 63(b), it can be seen that the ACF plot is cut off, and PACF dies down, so it can be assumed that the suitable model for this data is the IMA model.

4.2. Identification of the model number of unemployment in Aceh Province

Model identification can be started by looking at the ACF and PACF plots of data that have been stationary to the variants and mean to obtain a tentative model that can be used and then determine the order model (Maindonald, 2009). Defining the model order can be done by testing several values of the order p and q in turn into the model. The following is the AIC value obtained for each model order tested. Table 1 shows the AIC value for the forecasting model. To get the best model, several experiments were carried out by changing the p and q values in the model. Based on the results above, it can be seen that the AIC value of each model has been tested. The model that has the smallest AIC value is model 5. However, this model cannot be immediately said to be the best model because the difference in AIC values between models is minimal. The parameter significance test is then carried out to choose the best model.

Tabel 1 Parameter Model

Model	Order	AIC
1	1,2,0	-360,023
2	2,2,0	-364,692
3	3,2,0	-363,182
4	0,2,1	-365,213
5	0,2,2	-367,822
6	0,2,3	-366,276
7	1,2,1	-366,472
8	1,2,2	-367,548
9	2,2,1	-365,018
10	3,2,1	-363,608

4.3. Diagnosis of the model number of unemployment in Aceh Province

Model diagnosis is carried out to ensure that the model used is the best model and can be used for forecasting. Diagnosis can be made through parameter significance testing and White Noise diagnostic tests. Before the parameter results are applied in the model, the parameter significance test must be tested first. The null hypothesis used in this test is an insignificant parameter in the model, while the alternative hypothesis is a significant parameter in the model. This test is done by looking at the p-value of each parameter in the model. The null hypothesis is rejected if $p\text{-value} < \alpha$ and cannot be rejected if $p\text{-value} > \alpha$. A good model is a model where all the parameters are in the model. After testing 10 models with an error rate of 5% ($\alpha = 0.05$). Models that have significant parameters are model 1, model 2, model 4, model 5, model 7, and model 8. Then a White Noise diagnostic check can be done for model 1, model 2, model 4, model 5, model 7, and model 8.

Diagnostic tests using White Noise need to be done because the White Noise requirement is an assumption that follows the stationarity test. The null hypothesis used is that the residual meets the White Noise requirements, and the alternative hypothesis is that the residual does not meet the White Noise requirements. The null hypothesis is rejected if $p\text{-value} < \alpha$, whereas if $p\text{-value} > \alpha$, then the null hypothesis cannot be rejected (Azad, Abdul

Kalam and Mahsin, 2011). After testing using $\alpha = 0.05$, the p-value of model 1 is 0.08543, model 2 is 0.6626, model 4 is 0.03769, model 5 is 0.9945, model 7 is 0.52 and model 8 is 0.5943. Because $p\text{-value} > \alpha$ for both models, it can be decided not to be able to reject H_0 so that the conclusion is that the residual values of both models meet the White Noise requirements. To choose which model is the best, it can be compared again to the AIC value obtained by each model.

Based on the AIC value on the parameter significance test and diagnostic tests using White Noise, the models that can be used for forecasting this data are models 1, 2, 5, 7, and 8. To choose which model is the best, the AIC values of the five models can be compared again. The best model is the model that has the smallest AIC value so in this case the best model that can be used for forecasting is model 5, namely ARIMA (0, 2, 2) or IMA (2, 2) with an AIC of -367,8214.

4.4. Forecasting the number of unemployment in Aceh Province

The last step in the ARIMA method is forecasting using the best model that has been obtained in the previous stage. The data used in forecasting is transformation data. Therefore, the forecast results obtained must be transformed into the original data unit form. The final results of forecasting total Aceh tax revenue until 2030 using the IMA model (2, 2) are as follows:

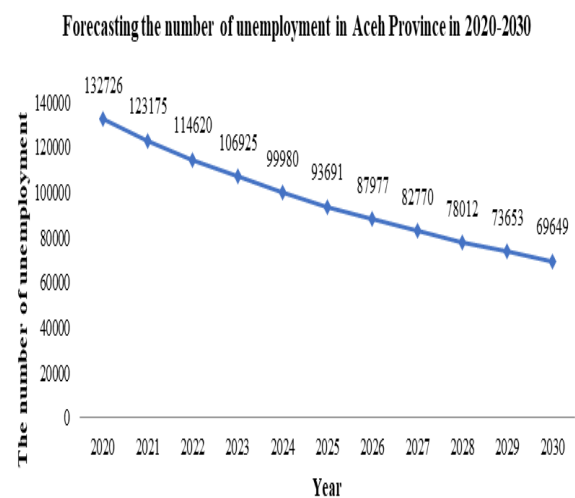


Figure 4 Forecasting the number of unemployment in Aceh Province in 2020-2030

Based on the results of statistical tests, the MAPE value for Acehese unemployment forecasting for Model 5 is 8.75. This value is included in the criteria for the MAPE value <10 , which indicates that the accuracy of the forecasting results is outstanding. Model 5 has been able to predict data on the number of unemployed in Aceh in 2020-2030 with exceptional results because the data expected is only one type of data. With a decrease in the number of unemployed in Aceh in 2030, it is hoped that it will become an important note for the government in controlling the workforce so that a prosperous Acehese society can be realized with a decent living (Badan Pusat Statistik, 2019a).

CONCLUSION

1. Unemployment is still one of the issues that should be solve across nations, the numbers never been highly decrease as the globalization drives the changes in every aspect in our life and required us to adapt in order to survive. The skills, abilities, or competencies needed today will be troublesome for some groups and if they cannot cope with that hence it will reduce their quality of life even their prosperity. The successful jobs and business nowadays will evolve overtime and can be vanished overtime when the industry is changing especially due to information and communication technology development.
2. We predict the unemployment rate in Aceh Province by using ARIMA. The ARIMA method produces 10 Aceh unemployment models with the best model, namely the fifth model, ARIMA (0, 2, 2) or IMA (2, 2) with an AIC of -367.8214 .
3. Based on the analysis results using the 29-year time-series data, the number of unemployed people in Aceh in 2030 is 69,649 people. The resulting accuracy of forecasting is very good because the MAPE value is $<10\%$, which is 8.75. The average number of unemployed people in Aceh has decreased by 6.91% annually but has experienced an increase in urban unemployment and higher education.
4. Regardless of the forecasting results show that the number of the unemployment in Aceh will decrease in 2030, it is still a long way to go. The decreasing number will be achieved even lower if government, business owner, and other relevant stakeholders work out to come up with the alternative solutions for the unemployment. Mseleku (2022) suggests that governments should play a key role in bridging the gap between higher education and industry and in tackling unemployment among young graduates. Also, strengthen cooperation between governments, higher education institutions and employers to create employment opportunities in the face of limited labor market demand, skill mismatches and lack of work experience.
5. Most studies suggest that in reducing unemployment is to be self-employed or become an entrepreneur and it can be started by developing new skill through short education and training program. Government of Indonesia has been established an entity such as Balai Pelatihan Vokasi dan Produktivitas Kemnaker to facilitates the training program that offer various hard skill training that suitable with current business environment. The other program that government has been created is Prakerja where you need to register and get the support for upgrading skills in certain institutions in order to get a job or start a business. Regarding this matter Massar (2020) summarizes that education and training programs aimed at stimulating entrepreneurial activity among different groups appear to be highly effective. However, these programs, aimed at improving the knowledge and skills necessary to succeed in entrepreneurship, are only partially responsible for the decision to enter self-employment, and for the entrepreneur's performance and survival.
6. Future research should use the other method of forecasting to get various results and divided the types of unemployment specifically so that the solution to reduce the numbers will be more in depth according to certain categories group of people.

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