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PREDICTION OF THE SUM TOTAL NEW FAMILY PLANNING ACCEPTORS IN THE IMPACT OF THE COVID-19 PANDEMIC: A STUDY USING THE ARIMA MODEL

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ABSTRACT

The sum total number of new family planning (KB) acceptors in Pamekasan Regency decreased from March to April 2020 due to the COVID-19 pandemic. This decline will hinder the increase in achieving the Modern Contraceptive Prevalence Rate (mCPR) as the target of the 2020-2024 National Medium-Term Development Plan (RPJMN), so modelling is needed to predict the sum total of new family planning acceptors in Pamekasan Regency. This research aims to predict the sum total of new family planning acceptors in Pamekasan Regency using the ARIMA model. This research is a non-reactive quantitative research. The unit of analysis for this research is all-new monthly family planning acceptors in Pamekasan Regency. The data used are the number of new monthly family planning acceptors from January 2016 to December 2021, sourced from the Pamekasan Regency Women's Empowerment, Child Protection and Family Planning Service. The research results show that the best model for predicting the number of new family planning acceptors in Pamekasan Regency is ARIMA [1,1,1] with the equation $0.001_1(B)1^1Z_t=0.006+0.000_1(B)a_t$. Prediction results using the ARIMA [1,1,1] model show that the number of new family planning acceptors tends to increase in January-December 2022. The sum of new family planning acceptors shows an increasing pattern, but the increase does not reflect the impact of the end of the COVID-19 pandemic.

Kata Kunci:
model ARIMA,
akseptor KB baru,
prediksi

ABSTRAK

Jumlah akseptor Keluarga Berencana (KB) baru di Kabupaten Pamekasan mengalami penurunan pada bulan Maret sampai April 2020 akibat adanya pandemi COVID-19. Penurunan ini akan menghambat peningkatan pencapaian Modern Contraceptive Prevalence Rate (mCPR) sebagai target Rencana Pembangunan Jangka Menengah Nasional (RPJMN) tahun 2020-2024, sehingga diperlukan pemodelan untuk memprediksi jumlah akseptor KB baru di Kabupaten Pamekasan. Tujuan dari penelitian ini adalah memprediksi jumlah akseptor KB baru di Kabupaten Pamekasan dengan menggunakan model ARIMA. Penelitian ini merupakan penelitian kuantitatif non-reaktif. Unit analisis penelitian ini adalah seluruh akseptor KB baru bulanan di Kabupaten Pamekasan. Data yang digunakan adalah jumlah akseptor KB baru bulanan Januari 2016-Desember 2021, yang bersumber dari Dinas Pemberdayaan Perempuan, Perlindungan Anak, dan Keluarga Berencana Kabupaten Pamekasan. Hasil penelitian menunjukkan model terbaik untuk memprediksi jumlah akseptor KB baru di Kabupaten Pamekasan adalah ARIMA [1,1,1] dengan persamaan $0.001_1(B)1^1Z_t=0.006+0.000_1(B)a_t$. Hasil prediksi dengan model ARIMA [1,1,1] menunjukkan bahwa jumlah akseptor KB baru cenderung meningkat pada Januari-Desember 2022. Jumlah akseptor KB baru menunjukkan pola yang meningkat, namun peningkatannya belum menggambarkan dampak dari berakhirnya pandemi COVID-19.

INTRODUCTION

The main population problem in Indonesia is caused by the high fertility rate and the increasing percentage of population growth. Indonesia has *a total fertility rate (TFR)* of as much as 2.3 where every woman in her lifetime gives birth to 2 to 3 children (1). The population of Indonesia in 2020 was 268.07 million people and the population

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growth rate 1.31%, making Indonesia the fourth country in the world with the largest population (2). The high rate of population growth can hinder the rate of economic development, which will increase poverty rates (3). The negative impacts can be anticipated by implementing the family planning program (KB). KB is a program initiated by the Indonesian government so that population growth can be controlled by planning pregnancy.

The program which was run by the government was hampered by the COVID-19 pandemic. COVID-19 is a contagious respiratory tract infection caused by SARS-CoV-2 with symptoms including cough, runny nose, and other more serious symptoms (4). The Spread of the COVID-19 virus is very fast and difficult to detect so the public is urged to implement the 5M health protocol, namely wearing masks, washing hands, maintaining distance, avoiding crowds, and reducing mobility (5). Steps to prevent the transmission of COVID-19 are also carried out by implementing the Large-Scale Social Restrictions (PSBB) policy. PSBB is a policy to limit interaction between people on a large scale and comprehensively in an area (6). Other policies implemented by the Indonesian Government to reduce mobility to suppress the number of COVID-19 transmissions are Work from Home (WFH) and Study from Home (SFH). WFH requires workers to complete their workload from home according to the work procedures of their company, while SFH requires students to study from home according to the procedures of each school (7).

The COVID-19 pandemic has caused many fertile couples (PUS) to postpone their desire to use family planning because they are worried about contracting COVID-19.(8). In addition, the recommendation to work from home requires various public service locations to be closed, including family planning and reproductive health services (9). The closure of family planning services has resulted in a reduction in KB acceptors, both active KB acceptors and new KB acceptors.

Active KB acceptors are PUS who routinely use contraceptives and do not experience pregnancy (10). New KB acceptors are PUS who have just become KB participants, either those who have started using it for the first time or PUS who have started using contraception again after pregnancy, giving birth, or having a miscarriage (11).

Based on data from the Women's Empowerment, Child Protection, and Family Planning Service (DP3AK) of Pamekasan Regency in 2020, the number of new KB acceptors in Indonesia from February to April 2020 decreased significantly. The number of new KB acceptors in Indonesia was 426,571 in February 2020but fell to 419,992 in March 2020 and in April 2020 it fell again to 369,368. The decline in the number of new KB acceptors during the pandemic also occurred in Pamekasan Regency, East Java. The number of new KB acceptors in Pamekasan Regency in February 2020, decreased from 8,428 to 7,560 in March 2020.

One of the targets of the 2020-2024 National Medium-Term Development Plan (RPJMN) is to increase the achievement of the Modern Contraceptive Prevalence Rate (mCPR). However, the increase in mCPR or the prevalence rate of modern contraception can be hampered by a decline in the number of new KB acceptors in Indonesia. So to anticipate this, a policy is needed, where, in formulating the policy, supporting data are needed. The required data can be sourced from a forecast.

Forecasting is a process that aims to predict a data value with the help of past data values (12). Forecasting methods can be useful for decision-making and policy formulation in the future. Forecasting can be done using various methods, one of which is time series analysis.

Time series is a research method with a quantitative approach using past data as a reference for predicting future data (13). Time series analysis aims to determine the movement pattern of an event during a certain period and can be used to predict future events(14). Time series analysis techniques are divided into two methods, namely forecasting based on statistical mathematical models and forecasting based on artificial intelligence (15). Some time series analysis methods are based on statistical mathematical models, including exponential smoothing, moving average, regression, and Autoregressive Integrated Moving Average (ARIMA). Some examples of time series analysis methods are based on artificial intelligence, including neural networks, classification, and genetic algorithms.

One of the methods is ARIMA modeling. ARIMA is a linear method in time series analysis that is formed from a combination of Autoregressive (AR), Moving Average (MA) elements, and data non-stationary elements (14). ARIMA is used because it is simple, accurate in predicting short-term data, can predict large-scale data, and can predict fluctuating data, so the ARIMA model is suitable for predicting several new KB acceptors. The existence of new KB acceptor data recorded every month in Pamekasan Regency strengthens researchers to choose the ARIMA method because there is the necessary historical data.

Based on the background description, this study aims to predict the number of new KB acceptors in Pamekasan Regency using the ARIMA model. It is expected that this research can be used as a reference for the preparation of policies regarding the right steps in increasing the number of new KB acceptor users.

METHODS

This study is a non-reactive quantitative study using the time series method. The unit of analysis used is the number of new monthly KB acceptors in Pamekasan Regency. This study used a sample of 72 samples obtained through total sampling.

The data used are secondary data on the number of new monthly KB acceptors from January 2016 to December 2021 sourced from the Women's Empowerment, Child Protection, and Family Planning Service (DP3AK) of Pamekasan Regency. There are two variables in this study, namely the number of new KB acceptors and time (month). This study took place from March to July 2022.

Data were analyzed using the time series analysis method using the ARIMA model. ARIMA is a univariate time series analysis method that produces predictions based on historical data patterns. The ARIMA model was chosen because it is simple, accurate in predicting the short term, and can predict large-scale data. ARIMA modeling is done using Minitab software.

The initial stage in ARIMA modeling is checking stationarity. If the data do not meet the assumption of stationarity in the variance, transformation is required, if the data do not meet the assumption of stationarity in the mean, differencing is required. If the data have met the assumption of stationarity, a temporary model identification can be obtained. Furthermore, the results of the temporary modeling are estimated by parameters to see the homogeneity of the variance between errors, and a diagnostic test is carried out to determine the mean square error (MSE). The ARIMA model with the smallest MSE value will be selected as the best model which is then used to make predictions.

RESULT

The number of new KB acceptors over time can be described by a time series plot. The number of images of the new KB acceptor in Pamekasan Regency from January 2016 to December 2021 can be shown in the following figure.

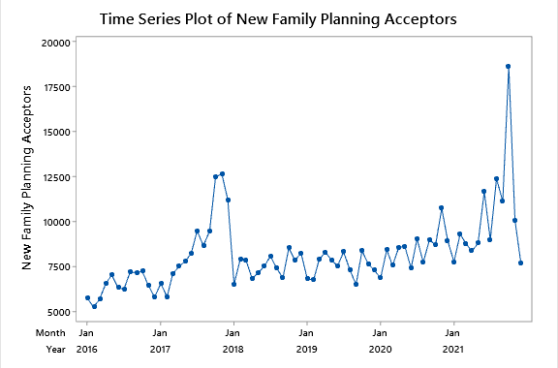

Figure 1. Graph of the Number of New KB Acceptors in Pamekasan Regency in January 2016-December 2021

Figure 1 shows that the number of new KB acceptors in Pamekasan Regency is unstable or fluctuating because the value has fluctuated drastically. The data pattern illustrates the number of new KB acceptors in Pamekasan Regency before the pandemic, during the pandemic, and after the COVID-19 pandemic.

Stationarity Check

The first step in implementing the ARIMA model is checking for stationarity. ARIMA has assumptions that must be met, namely using stationary data. The data must be stationary to the variance and mean.

Examination of the correlation with the variance can be shown by the Box-Cox plot at rounded value.

The results of the analysis show the number of d new KB acceptor still does not meet the stationarity assumption concerning variants because the rounded value is -2.00. So data transformation is needed so that the rounded value is equal to 1 or close to 1. After one transformation, the rounded value is 1, so it can be seen that the data have met the stationarity assumption against variants.

Examination variance of the mean can be shown by Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF). The results of the analysis also show that the data have not met the assumption of stationarity to the mean, so a differencing process is needed. The results of the 1-time difference are shown in the following figure.

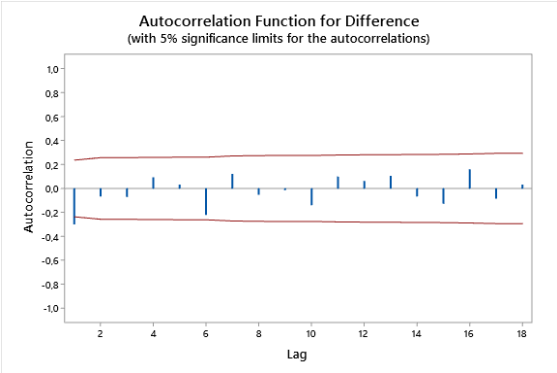

Figure 2. Autocorrelation Function Graph of the Number of New KB Acceptors in Pamekasan Regency in January 2016-December 2021

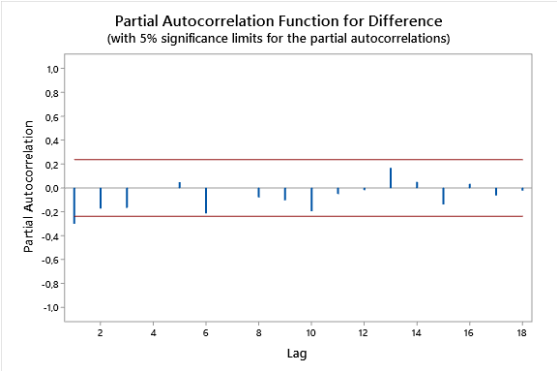

Figure 3. Partial Autocorrelation Function Graph of the Number of New KB Acceptors in Pamekasan Regency in January 2016-December 2021

Figure 2 shows that the 1st lag of the ACF plot does not approach zero or is outside the confidence line. Figure 3 also shows that the 1st lag of the PACF plot does not approach zero or is outside the confidence line. Based on this analysis, it can be seen that the data meet s the stationarity assumption in means.

Temporary Model Identification

The data have been transformed once, so the temporary model obtained is ARIMA [0,1,1]. The data have been subject to differencing once, so the temporary model of the ACF plot is Moving Average/ MA [1] and the temporary model of the PACF plot is Autoregressive/ AR [1]. So at the stage of identifying the temporary model, three models are obtained, ARIMA [1,1,0], ARIMA [0,1,1], and ARIMA [1,1,1].

Parameter Estimation

This stage aims to determine whether the temporary model obtained has significant significance or not. The following table shows the significance values of the three models.

Table 1. Parameter Estimates for the Number of New KB Acceptors in Pamekasan Regency in January 2016-December 2021

Model	Coefficient	*p value*
ARIMA [1,1,0]		
AR 1	-0.375	0.001
Constant	53.000	0.801
ARIMA [0,1,1]		
MA 1	0.681	0.000
Constant	72,200	0.267
ARIMA [1,1,1]		
AR 1	0.413	0.001
MA 1	0.971	0,000
Constant	29.300	0.006

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Based on Table 1, ARIMA [1,1,0] shows AR [1] has a significant value, while the constant has no significant value. ARIMA [0,1,1] shows that MA [1] has a significant value, while the constant value is not significant. Meanwhile, ARIMA [1,1,1] shows that AR [1], MA [1], and constant have significant values, so it is found that ARIMA [1,1,1] is significant in compiling the model.

Diagnostic Test

The next stage is a diagnostic test that aims to determine the homogeneous nature of the variance between errors. Diagnostic tests can be carried out with white noise test statistics. Analysis through the white noise tests shows that the significance value of all lags in all models is greater than 0.05. This means, that model ARIMA [1,1,0], ARIMA [0,1,1], and ARIMA [1,1,1] already have a homogeneous variance value between errors.

Best Model Selection

The best model used for prediction is selected through the mean square error (MSE) generated. The model with the smallest MSE value is the selected model.

The results of the analysis show ARIMA [1,1,0] has MSE amounting to 3,104,688, ARIMA [0,1,1] has MSE amounting to 2,831,546 and ARIMA [1,1,1] has MSE amounting to 2,682,030. Based on the results of the analysis, the model with the smallest MSE is ARIMA [1,1,1]. So it can be concluded that the best model in this study is ARIMA [1,1,1] which has the following similarities:

$$0.001_1(B)1^1Z_t = 0.006 + 0.000_1(B)a_t$$

Prediction Results

The final stage in ARIMA modeling is the prediction of results using the best-selected model. The prediction results obtain the number of new KB acceptors in Pamekasan Regency using ARIMA [1,1,1] for January to December 2022, which is shown in the following image.

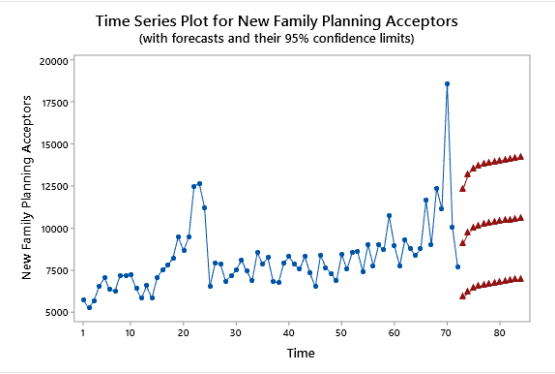

Figure 4. Graph of Prediction Results of the Number of New KB Acceptors in Pamekasan Regency in January 2022-December 2022

Figure 4 shows the prediction results using ARIMA [1,1,1] have an increasing pattern. The blue graph represents the actual data on the number of new KB acceptors in Pamekasan Regency in January 2016-December 2021 and the red graph is the result of the predicted number of new KB acceptors using ARIMA [1,1,1]. The prediction result shows the number of new KB acceptors in Pamekasan Regency from January 2022 to December 2022 continued to increase, as presented in the following table.

Table 2. Prediction Results of the Number of New KB Acceptors in Pamekasan Regency in January 2022-December 2022

Period	Prediction
January 2022	9,073.1
February 2022	9,681.8
March 2022	9,962.2
April 2022	10,107.2
May 2022	10,196.3
June 2022	10,262.3
July 2022	10,318.8
August 2022	10,371.4
September 2022	10,422.4
October 2022	10,472.6
November 2022	10,522.7
December 2022	10,572.6

DISCUSSION

The presence of the COVID-19 pandemic has resulted in the number of new KB acceptors in Pamekasan Regency decreasing from February to March 2020. The decrease in new KB acceptors can increase the number of unwanted pregnancies, which causes an increase in the population growth rate up to a population explosion. Anticipatory steps that can be taken to suppress the increase in population are to predict the number of new KB acceptors in the next period.

Prediction is a systematic process for estimating future events based on information from the past and present to minimize the occurrence of errors (16). Prediction does not present definite results but tries to find the most accurate results possible. Many time series analysis methods function to predict data, one of which is ARIMA.

ARIMA is a time series prediction method that uses the time variable as the

dependent variable and does not use independent variables (17). The ARIMA method can be applied to all data patterns, including non-stationary data (18). The advantages of the ARIMA method are that it is simple and accurate in predicting short-term data.

A study concluded that ARIMA is more accurate than the Artificial Neural Network (ANN) method in carrying out the prediction process (19). Other studies show that the ARIMA method is accurate for predicting future unmet needs in East Java Province because it does not require any specific data motifs (20). The use of the ARIMA method in this study is relevant because the data to be predicted are volatile and can change quickly, namely the data number of new KB acceptors due to the impact of the COVID-19 pandemic.

The purpose of this study is to predict the number of new KB acceptors due to the impact of the COVID-19 pandemic in Pamekasan Regency in 2022. The results show that the ARIMA model is suitable for use in this study because it can find the best model that can be used to predict the number of new KB acceptors in Pamekasan Regency, namely ARIMA [1,1,1]. The model has an MSE of 2,682,030. The prediction results show the number of new KB acceptors in Pamekasan Regency from January to December 2022 tends to increase.

An increase in the number of new KB acceptors can occur due to the implementation of new habits and the elimination of Large-Scale Social Restrictions (PSBB). PSBB is a policy to limit interaction between communities on a large and comprehensive scale, whereby during PSBB large-scale comprehensive community interaction in a region is limited. Adapting to new habits in the implementation of a new lifestyle to maintain productivity during the COVID-19 pandemic (21)is carried out by continuing to implement health protocols to prevent the transmission of COVID-19. Adaptation to new habits is also marked by the opening of public places, including health services. Health services that have returned to normal operations can increase the interest of potential new KB acceptors.

This result is in line with previous research that predicted the number of new KB acceptors using the Women's Operation Method (MOW) in Jember Regency from 2020 to 2024 using the ARIMA [0,0,12] model. The results of the study showed the number of new KB acceptors using the MOW methods in the Jember Regency tended to increase during that period (22). Research with different variables will get different results. A study in the same place and time aims to predict the number of new KB acceptors using intrauterine device (IUD) methods in Jember Regency from 2020 to 2024 using the ARIMA [11,1,2] model. The research results show a constant value because there was no drastic increase or decrease during the period 2020 to 2024 (22). Research with different variables shows that the number of new KB acceptor implant methods in Jember Regency from 2020 to 2024 using the ARIMA [0,0,8] model tends to experience a decline (22).

Other research results using the ARIMA [2,1,1]model to predict the number of active users of long-term contraceptive methods (LMPs) show that active LMP users in Indonesia in the period from January 2021 to December 2022 tend to experience a slight decline (23). The decline was due to the ongoing COVID-19 pandemic until the research period, so this will also affect the number of active MKJP KB participants in the following period.

Restrictions on activities during the COVID-19 pandemic, such as maintaining distance, avoiding crowds, and limiting mobility, have resulted in suboptimal family planning services and participation (23). In addition, the differences in the implementation of PSBB-level policies in each region also have an impact on the differences in the number of active KB acceptors and new KB acceptors in each region. This is due to the PSBB level which affects the operating hours of public service places, so that, in a forecast, differences in place and time of research will have an impact on the research results or predictions that will be obtained.

The results of this prediction can be used as a parameter for the number of new KB acceptors in Pamekasan Regency in the future. The results of this prediction can also be used by Pamekasan District Government as a reference for formulating policies to increase the number of new KB acceptors.

CONCLUSION AND SUGGESTIONS

Conclusion

The best model for predicting the number of new KB acceptors in Pamekasan Regency is ARIMA [1,1,1] which has the following equation:

$$0{,}001_1(B)1^1Z_t = 0{,}006 + 0{,}000_1(B)a_t$$

The prediction results using ARIMA [1,1,1] show that the number of new KB acceptors in the Pamekasan Regency has a pattern that tends to increase. These prediction results do not clearly show the impact of the COVID-19 pandemic. This may occur because other factors influence the number of new KB acceptors that were not examined in this study.

Suggestion

The Pamekasan Regency Government can use the results of this prediction as a reference for formulating policies to increase the number of new KB acceptors in the Pamekasan Regency. Further research is recommended to use Autoregressive Integrated Moving Average with Exogenous Variable (ARIMAX) model analysis, which is a combination of ARIMA and time series regression models so that the prediction results obtained can clearly show the pattern of the impact of an event.

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