Comparative Analysis of Forecasting Methods between Vector Auto Regression and ARIMA for Forecasting Broiler Meat Production in the Covid-19 Pandemic in West Java Province

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***Abstract*—** This study aims to predict the production of broiler meat in West Java Province in 2021-2025. The method used in this study is Autoregressive Integrated Moving Average (ARIMA) and Vector Auto Regression (VAR) method. The time series data used in this study is data on the production of broiler meat in West Java Province for 2000-2020. The use of ARIMA and VAR methods was compared to find out which the best method in forecasting broiler meat production by calculating the MAD, MSE, and MAPE forecasting errors. The software used as an analysis tool for ARIMA and VAR models is Eviews 10. The results of the study show that the best method used is VAR with a MAPE value of 13,45. The application of VAR method to the production of broiler meat for the next five years has increased..

***Keywords*—** Broiler meat; Forecasting; Time Series; ARIMA; VAR.

I. INTRODUCTION

Indonesia is a country with a population that is increasing every year. According to the Badan Pusat Statistik (BPS) (2020), total population of Indonesia in 2020 is 270.200.000 with an average population rate of 1,25% per year. Food security is an issue that is very close to population density. Food security is one of the important issues for the world, not only in Indonesia.

Accroding to Directorate General of Peternakan dan Kesehatan Hewan (PKH) (2020) in BPS (2020), in 2016-2020 period the largest average annual growth in livestock production was dominated by broilers at 17,56%, while beef and buffalo experienced negative growth -0,07 and -5,87%. The total production of broiler meat throughout Indonesia in 2020 is 3.275.325 million tons.

According to the Directorate General of PKH (2020), the consumption of broiler meat in 2019 was 12,18 kg/capita/year, while the realization due to the

Covid-19 pandemic was only 10,10 kg/capita/year. The realization of meat production has decreased, including the main sector, broiler meat and other meat sectors due to declining demand as a result of the COVID-19 pandemic. During the pandemic, there was a government policy, namely PSBB (Large-Scale Social Restrictions) which had an impact on closing hotels, tourist attractions, restaurants, and culinary tours in almost all regions throughout Indonesia which affected the demand for broiler meat. Many chicken farmers are at a loss because the price of purebred chicken has fallen as a result of declining consumer demand.

West Java Province is the province with the largest population in Indonesia. The large population affects the demand for raw materials including broiler meat in 2020 by 838.148 tons, a decrease of 6,2% compared to 2019 which was 894.386 tons. In 2000-2019 there was always an increase every year, but in 2019-2020 there was a decrease in broiler meat production due to the COVID-19 pandemic in West Java Province in 2020.

So in this study, forecasting analysis will be carried out using VAR method which will be compared with ARIMA method. The advantage of VAR method is that there are only independent variables. Each independent variable can be modeled separately. The advantage of ARIMA method is that it accepts all types of data models, although in the process it must be stationary first, this method is more accurate when used for short-term forecasting. From the advantages of VAR and ARIMA, the aim is to compare which method is more appropriate for forecasting chicken meat production data in West Java Province.

II. LITERATURE REVIEW

Broiler Meat

Broiler chicken is a type of chicken that is able to grow fast so it can produce meat in a relatively short time (5-7 weeks). Broiler chickens have an important role as a source of animal protein. Furthermore, in the cultivation sector, activities are carried out to raise chickens starting

from one day old or DOC (Day Old Chicken) until the age of slaughter (25-35 days).

The broiler poultry business in Indonesia has become an industry that has complete components from the upstream to downstream sectors where the development of this business is beneficial to the community as a source of animal protein and contributes significantly to the development of animal husbandry in Indonesia. In managing a chicken farming business, each farmer must understand three important elements in production, namely breeding, feeding, and management of livestock business. Breeders must be able to combine the use of production factors efficiently in this case, namely DOC (Day Old Chick) chicken seeds, feed, medicines and vitamins, as well as labor which are very important factors in broiler cultivation so that can achieve maximum profit and the expected level of efficiency (Yunus, 2009).

Forecasting

The development of analytical techniques and methods has a close relationship with the development of forecasting techniques and methods. Forecasting is very important because the economy in the business world is volatile, not static. The reason is because of the intent and purpose of economic analysis or company business activities that focus on analyzing situations and conditions that are happening now and in the past and are associated with their effects on future situations and conditions (Zakina, 2016).

According to Sutawidjaya (2016), the choice of forecasting method depends on the following factors: a). Sufficient time to make forecasts. b). Availability and relevance of past data. c). The type of product, in this case a balance between goods and services. d). It requires accuracy and the minimum expected cost of the forecast.

Vector Auto Regression (VAR)

The VAR model is a dynamic linear model that is widely used for forecasting applications for economic variables in the long term and in the medium to long term. In addition, the VAR model can also be used to determine cause-and-effect relationships. As part of econometrics, the VAR method is one of the discussions in multivariate time series.

According to Widarjono (2007), the VAR model is a non-theoretical time series econometric model building. Some of the advantages of the VAR model (Widarjono, 2007), namely:

a. Researchers do not need to distinguish between endogenous and exogenous variables because all VAR variables are endogenous
b. The estimation method is simple, namely by using the least squares method and separate models can be made for each endogenous variable.

ARIMA

ARIMA is a time series model used based on the assumption that the time series data used must be stationary, which means that the average variation of the data in question is constant. The ARIMA model is divided into three groups, namely, the Autoregressive Model (AR), Moving Average (MA) and the mixed model Autoregressive Moving Average (ARMA) (Rasyidi, 2017).

Evaluation of Forecasting Models

Forecasting is a form of approach, so there is no method that is most superior or better. The overall accuracy of the forecasting model can be determined by comparing the forecasted values with the actual values. Forecasting error tells how the performance of a model is compared to the model itself using past data. The overall accuracy of each forecasting model (moving average, exponential smoothing, or others) can be explained if Ft represents the forecast in period t, and At represents the actual demand in period t, then the forecasting error (deviation) is: Forecasting Error = At – ft.

There are several calculations that can be used to calculate the total forecast error. This calculation can be used to compare different forecasting models, monitor forecasst, and ensure forecast is running well. Three kinds of calculations that can calculate forecasting errors include:

a. Mean Absolute Deviation (MAD)

The first measure of the overall forecast error for the model is MAD. This value is calculated by adding up the absolute values for the individual forecast errors (deviations) and dividing the amount of data in periods (n):

$$\text{MAD} = \frac{\sum|Actual-Forecasting|}{n}$$

MAD can be calculated by entering the absolute deviation value (α). Almost all forecasting software includes a feature that automatically calculates the smoothing constant with the smallest forecast error value. Some software modifies the value of α if the error becomes larger than acceptable.

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b. Mean Squared Error (MSE)

MSE is the second way to measure overall forecasting error. MSE is the mean of the square of the difference between the forecasted value and the actual value. The formula is:

$$\text{MSE} = \frac{|Actual - Forecasting|}{n}$$

c. Mean Absolute Percentage Error (MAPE)

The problem with both MAD and MSE values is that they are dependent on the predicted change in value. To avoid this problem, MAPE is used which is calculated based on the absolute difference between the predicted and actual values. That, if there are forecasted and actual values for n periods, MAPE is calculated as follows::

$$\text{MAPE} = \frac{\sum_{i=1}^{n} 100 \left| Actual\ i - Forecasting \ / \ Actual\ i \right|}{n}$$

III. RESEARCH METHODOLOGY

Type and Source of Data

The data used in this study is secondary data, namely data obtained indirectly from the annual data report on the BPS official website (www.bps.com). This study uses time series data on broiler meat production in Indonesia on an annual basis with an observation period of 2000-2020.

Population and Sample

Animal husbandry data collection was carried out at companies in the province of West Java. Companies that are covered are livestock companies with legal entities (PT, CV, Firms, Cooperatives, Foundations) that carry out business activities of breeding and cultivating livestock.

The determination method used in this research is the saturated sample method. The saturated sample method is a sampling technique when members of the population are used as samples. According to Sugiyono (2002), saturated sampling is a sampling technique when all members of the population are used as samples. Another term for saturated sample is census.

Technique and Analysis of Data

The data analysis method used in this study is to analyze the problems that have been formulated in the formulation of the problem, namely descriptive analysis. Descriptive analysis is used to determine the description or general description of all the variables used in this study. Descriptive analysis in this study was processed using and EVIEWS 10 and Microsoft excel 2010.

IV. RESULT AND DISCUSSION

Data on broiler meat production was taken in West Java Province. Based on annual data, broiler meat production tends to increase.

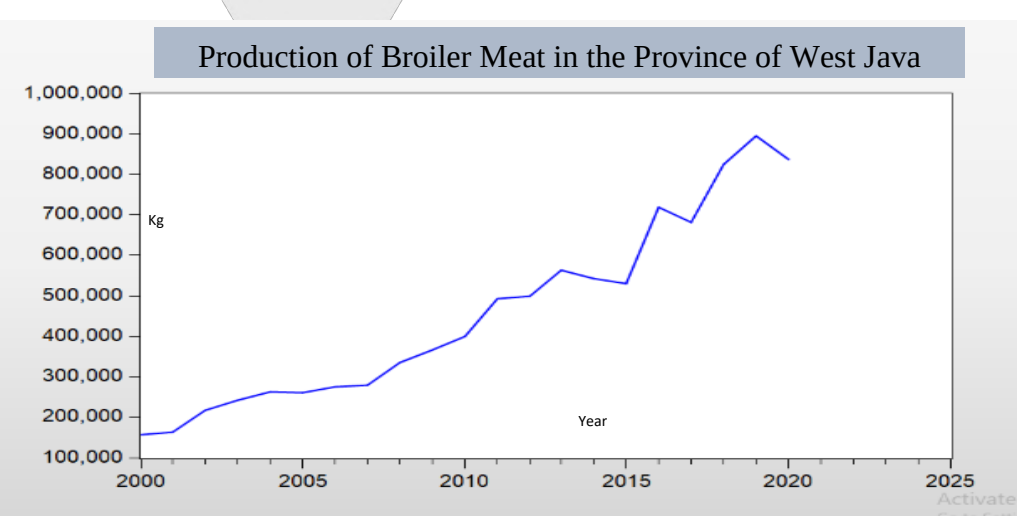


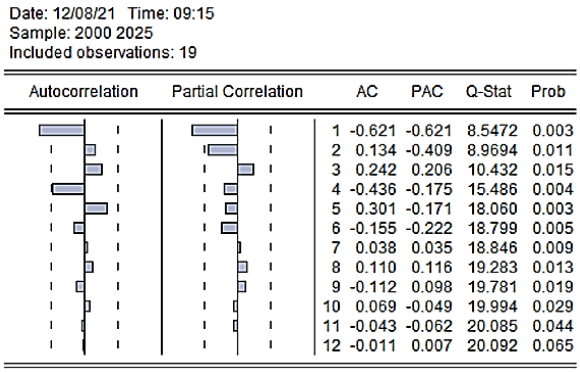
Figure 1: *Forecasting Analysis of Broiler Meat Production with ARIMA Method*

Stationary Test

The stationary test explains that the data is stationary at the 2nd Difference level because the probability result is α=5% with a result of 0,0035 while the Level and 1st Difference results are more than α=5%.

Autocorrelation Test

Autocorrelation test was used to determine the AR(1) and MA(1) values.


Date: 12/08/21 Time: 09:15
Sample: 2000 2025
Included observations: 19

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.621	-0.621	8.5472	0.003
		2	0.134	-0.409	8.9694	0.011
		3	0.242	0.206	10.432	0.015
		4	-0.436	-0.175	15.486	0.004
		5	0.301	-0.171	18.060	0.003
		6	-0.155	-0.222	18.799	0.005
		7	0.038	0.035	18.846	0.009
		8	0.110	0.116	19.283	0.013
		9	-0.112	0.098	19.781	0.019
		10	0.069	-0.049	19.994	0.029
		11	-0.043	-0.062	20.085	0.044
		12	-0.011	0.007	20.092	0.065

Partial Correlation represents AR while Autocorrelation represents (MA). Lag 1 potential for AR(1) model, for lag 2-12 there is no potential because the bar does not cross the dotted line. Likewise with Lag 1 potential for MA(1) model, for lag 2-12 there is no potential because the bar does not cross the dotted line. So the ARIMA model (P,D,Q) is the ARIMA model (1,2,1).

From the two plot results, forecasting can be done, then four criteria are checked to determine the AR(1) or MA(1) model for forecasting, namely the adjusted r-squared value is determined with a larger value, the sum squared residual value is determined. with a smaller value, the akaike info criterion value is determined with a larger value and the Schwarz criterion value is determined with a smaller value

Table 1: *Models for forcasting AR(1) or MA(1)*

	AR(1)	**MA(1)**
Adjusted R-squared	0.103175	0.01082
Sum squared resid	5.24E+10	5.25E+10
Akaike info criterion	24.83641	24.8384
Schwarz criterion	24.98577	24.98776

From the four criteria above, the AR(1) value is obtained because the adjusted r-squared value is 0.103175, the sum squared resid value is 5.24E+10, the akaike info criterion value is 24,83641 and the Schwarz criterion value is 24,98577 which matches the criteria for forecasting compared to MA(1).

The results of forecasting data using the ARIMA method (1,2,1) are compared with the actual data per year, then the forecast for the next five years is obtained, namely in 2021 is 891.751, 2022 is 927.680, 2023 is 963.609, 2024 is 999.538, 2025 is 1.035.467.

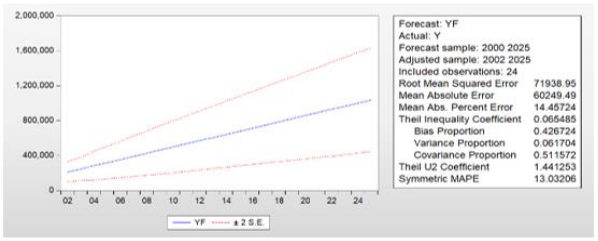


Table 2: *Forecasting Analysis of Broiler Meat Production with VAR Method*

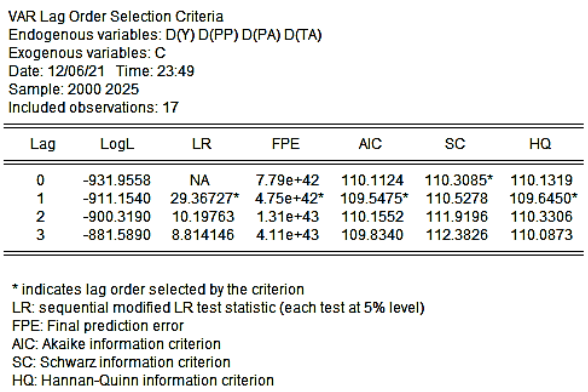
VAR data with four variables, namely data on broiler meat production, population, broiler population, and broiler egg production.

Stationary Test

The data is stationary at the 2nd Difference level because the data is stationary when the probability number is below =5%. One variable with another variable needs to be at the same level, namely 2nd Difference.

Optimal Lag Test

From this test, it was found that the optimal lag is in lag 1 because the number of stars in this variable is the largest, lag 0 has 1 star, lag 1 has 4 stars, lag 2 has no stars, lag 3 has no stars. There are 4 lags tested.


VAR Lag Order Selection Criteria
Endogenous variables: D(Y) D(PP) D(PA) D(TA)
Exogenous variables: C
Date: 12/06/21 Time: 23:49
Sample: 2000 2025
Included observations: 17

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-931.9558	NA	7.79e+42	110.1124	110.3085*	110.1319
1	-911.1540	29.36727*	4.75e+42*	109.5475*	110.5278	109.6450*
2	-900.3190	10.19763	1.31e+43	110.1552	111.9196	110.3306
3	-881.5890	8.814146	4.11e+43	109.8340	112.3826	110.0873

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Causality Test Data

The causality test of the data is looking for a reciprocal relationship between one variable and another. A significant relationship is that the probability value is smaller α=5% between the variables PA (population of broilers) and Y (production of broiler meat), and TA (production of broiler eggs) with Y (production of

broilers) and TA (production of broilers egg) with PA (population of broilers).

Cointegration Test

Cointegration is the statistical implication of the long-run relationship between economic variables. The main purpose of cointegration test is to test whether the cointegration regression residual is stationary or not (Istiqomah and Mansoer, 2005). The cointegration test results obtained a probability of 0.0038, meaning that the VAR data is cointegrated because the probability value is less than α=5%.

VECM Test

VECM analysis is an analysis carried out to reconcile short-term economic behavior with long-term economic variables (Nugroho et al, 2016). An important concept of VECM is the long-term balance of the time series which is called cointegration and is the response between one variable and another (Nugroho et al, 2016).

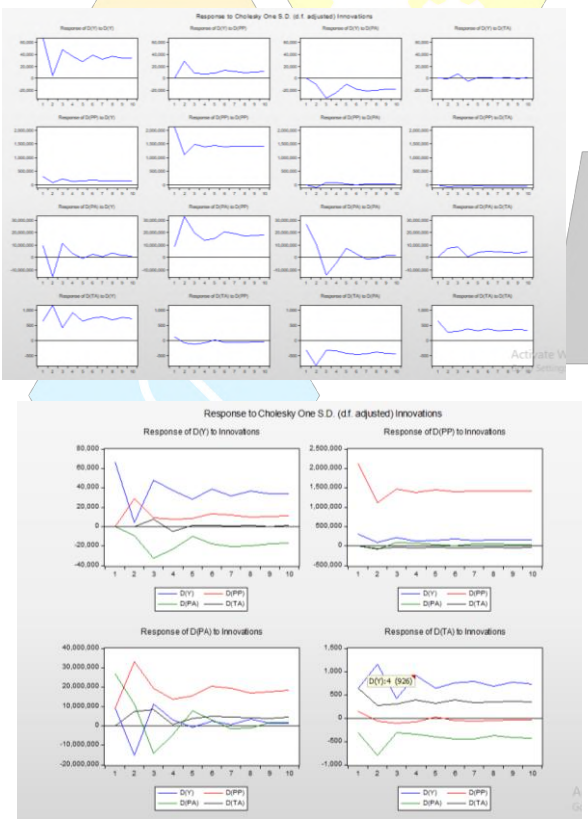


Figure 2: *The VECM results*

Forecasting Results of VAR Model

The results of forecasting data using the VAR method are compared with actual data per year, so that the forecast for the next five years is obtained, namely in 2021 is 883.180, 2022 is 919.185, 2023 is 955.190, 2024 is 991.196, and 2025 is 1027.201.

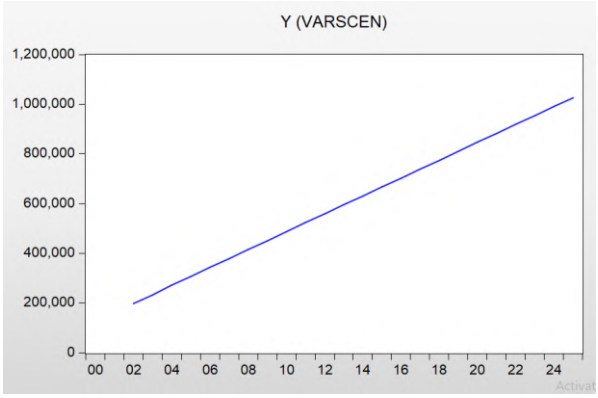


Figure 3: *Graph of the VAR method forecasting which results in a positive trend or an increase from 2000 to 2025 modeling.*

Calculation of MAD, MSE, and MAPE

The results of MAD, MSE, and MAPE on the ARIMA model with values is 60249, 5175212876 and 14.45. The results of MAD, MSE and MAPE on the VAR model with values is 230763004, 4384497082 and 13.45.

The VAR model provides better forecasting results with a score of 13.45 in terms of forecasting accuracy.

As an initial comparison, we can compare the ARIMA model and the VAR model. From the data processing, the MAD (ARIMA) value is 60249 < MAD (VAR) 230763004 and the MSE (VAR) value is 4384497082 < MSE (ARIMA) 5175212876.

So it can be concluded temporarily that the VAR model is better than the ARIMA model because the MSE and MAPE values are smaller on the VAR Model.

Table 2: *Comparision of ARIMA Model and VAR Model*

	ARIMA	**Description**	**VAR**	**Description**
MAD	60249	Minimum (Better)	230763004	Larger
MSE	5175212876	Larger	4384497082	Minimum (Better)
MAPE	14.45	Good Category	13.45	Best Category

V. CONCLUSION

Overview of Chicken Meat Production in West Java Province from 2000-2020 increased from the previous year. The production figure in 2000 was 216.632 tons and the production in 2020 was 838.184 tons with a difference is 621.552 tons in a period of 20 years. While the population of broilers in West Java Province from 2000-2020 also increased from the previous year, the population in 2000 was 269.778.372 tons and the population in 2020 was 760.143.059 tons with a difference is 490.364.687 tons in a period of 20 years.

The variables that affect the production of broiler meat are PA (population of broilers) with Y (production of broiled chicken meat), and TA (production of broilers eggs) with Y (production of broiler meat).

The VAR method gives better forecasting results with a score of 13.45 in terms of forecasting accuracy calculated by the MAD, MSE, and MAPE methods compared to ARIMA with a score of 14.45.

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