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CRICKET PRODUCTION FORECASTING USING THE MOVING AVERAGE METHOD

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ABSTRACT
Cricket production in Indonesia has promising business potential, particularly in rural areas. However, production variability is often a major challenge for farmers to maintain economic stability. Therefore, production forecasting methods are needed for better management. This study aims to predict cricket production using Moving Average (MA) and Weighted Moving Average (WMA) methods and compare their accuracy. The research was conducted in Rejotangan District, Tulungagung, using 12 weeks of cricket production data from May to August 2024. The accuracy of the method was measured using Mean Absolute Deviation (MAD), Mean Squared Error (MSE) and Mean Absolute Percentage Error (MAPE). From this research, the best model that can be used to predict the amount of cricket production is the Weighted Moving Average (WMA) model with n = 4 with the lowest prediction accuracy value (MAD, MSE and MAPE) of 16.05, 514.513 and 10.985% respectively. From the forecasting results, the total production of crickets in the existing farm for one period ahead with the WMA model n = 4 is 150.9 kg.

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I. INTRODUCTION

CRICKETS are insects that are widely used in Indonesia, particularly as animal feed [1]. Cricket farming is one of the promising businesses in Indonesia, especially in rural areas. The advantages of cricket cultivation are high market demand and stable cricket prices, and it is easy to cultivate, does not require a large area and small business capital [2]. However, one of the main challenges faced by farmers is the variability of cricket production, which can affect their economic stability[3]. Several studies have been conducted to understand the factors that affect cricket production and to develop predictive models that can help farmers better manage their production [4].

Forecasting is a method of estimating the quantity or amount of future needs based on past data in terms of quantity, time and location using a statistical technique approach [5]. While the objectives of forecasting include decision making [6], inventory management [7], meeting consumer needs [8], identification and risk mitigation [9].

Production forecasting is a way of helping cricket farmers estimate the amount of cricket production in the future. Forecasting is a process step of an activity to estimate future products within a certain period of time based on historical data [10]. Thus, forecasting can help in making the right decisions related to the management of cricket farming businesses, such as determining the number of crickets to be grown, managing business capital and finding the right market. One of the most commonly used methods of forecasting production is the moving average method. This is a forecasting method that uses historical data to calculate the average production for a given period [11]. This average is then used to estimate future production.

Some of the previous studies used as references for this research include: the research using the Weighted Moving Average method. The results show that the system has worked as required and for the use of the method get an error value of 21%, so the system with the Weighted Moving Average method can be used to predict the amount of production [12]. Subsequent research using the Single Moving Average method. The results show that the Single Moving Average method concludes that the forecast using Moving Average 3 can be used because the error rate is relatively smaller than Moving Average 4 and 5, with a Mean Absolute Percent Error value of 10.0% and a Mean

Absolute Deviation of 19.604 [13]. The research was carried out using the moving average method. The results show that consumption in Indonesia in 2022 will increase by 10.36% or 1.643 million tonnes from the total consumption in 2021 which was only 15.857 million tonnes. This can be said to be good as consumption continues to experience a significant increase every year [14]. Then the research is carried out with the Time Series Model Moving Averages Method. The results show the amount of production in the district of Loano for the next 4 periods, after 2015, from the WMA model, namely 113.91 tonnes; 135.62 tonnes; 101.96 tonnes; and 89.88 tonnes. The best model result is the Weighted Moving Average (WMA) model with the lowest prediction accuracy value, namely the MSE value of 1,833.07 and the MAE of 36.07 [15].

Based on the background described, this research is proposed with the aim of forecasting cricket production based on the Moving Average Method. The results of the study are expected to be used as a consideration, especially for cricket growers, in evaluating production results in relation to the desired production target, so that the target to be achieved can be more realistic. In addition, the research results of this study can also be a reference for other studies on the same topic.

II. RESEARCH METHODS

This study uses cricket production data in Rejotangan District, Tulungagung in a period of 12 weeks from 1 May to 3 August 2024. The research procedure uses forecasting methods including Moving Average (MA) and Weighted Moving Average (WMA). These different studies are analysed to compare the best forecasting accuracy thresholds. Forecast accuracy is expressed in terms of MAD (Mean Absolute Deviation), MSE (Mean Squared Error) and MAPE (Mean Absolute Percentage Error).

A. Moving Average

The moving average method is used to forecast demand by calculating the average of actual demand over a period of time [16]. The purpose of the MA method is to eliminate or reduce randomness in the time series. The mathematical formulation is as follows

$$F_{t+1} = \frac{X_t + X_{t+1} + \cdots + X_{t-n+1}}{n} \quad (1)$$

Notes:
F_{t+1}= forecasting in the period of t+1
X_t = actual data of period t
n = number of periods in MA

B. Weight Moving Average

To produce more accurate forecasts, the WMA forecasting method gives greater weight to the most recent values of the periodic series [17]. The WMA approach gives greater weight to the most recent data in the forecast, resulting in more adaptive forecasts of changing trends.

$$F_t = \frac{\sum(Weight\ for\ the\ period\ t) \times (demand\ of\ period\ n)}{\sum Weight} \quad (2)$$

Notes:
F_t = forecasting in the period of t
n = number of periods in MA

C. Mean Absolute Deviation

In order to measure the level of forecasting accuracy, the mean absolute deviation (MAD) of the different forecasting methods is calculated, which is considered to be the most accurate [18]. The formula for calculating the MAD follows the following rules.

$$MAD = \frac{\sum_{t=1}^{n} |X_t - F_t|}{n} \quad (3)$$

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D. Mean Squared Error

Another way to measure the accuracy of a forecasting method is to use MSE. This method differs from MAD in that MSE squares each forecast error before combining them [19]. This squaring method accounts for larger forecast errors. The formula for calculating the MSE is as follows

$$MSE = \frac{\sum_{t=1}^{n}(X_t - F_t)^2}{n} \quad (3)$$

E. Mean Absolute Percentage Error

The MAPE helps to select the most appropriate prediction model in situations where the size of the predicted variable is critical. The model with the lowest MAPE is the most effective in predicting the data values in relative terms [20]. The MAPE formula is

$$MAPE = \frac{\sum_{t=1}^{n}\left|\frac{X_t - F_t}{X_t}\right|}{n} \quad (3)$$

The criteria for the accuracy or precision of the MAPE are as follows.
(1) Very good forecast accuracy when MAPE < 10%.
(2) Good forecast accuracy when MAPE is in the range of 10% - 20%.
(3) Forecasting accuracy is sufficient when the MAPE is in the range of 20% - 50%.
(4) Inaccurate prediction accuracy when MAPE > 50%.

III. RESULTS

Below are the results of the data analysis for Moving Average (MA) and Weighted Moving Average (WMA). The model that will be used to forecast the amount of cricket production is the most accurate model between the two models above. Selection of the best model based on prediction accuracy. The following are the results of the data analysis of the two models and a comparison of their accuracy.

A. Moving Average

The following are the results of the data analysis for Moving Average (MA). The data analysis for these two models took n as 2, 3 and 4. The most accurate prediction of cricket production is characterised by a low level of difference between the actual results and the predicted results. Conversely, poor accuracy is characterised by a high level of difference. The higher the difference between the actual value and the predicted result, the lower the accuracy.

TABLE I
MOVING AVERAGE FORECAST ACCURACY CALCULATION DATA WITH N = 2

Periode	X_t	F_t	$\lvert X_t - F_t \rvert$	MAD	MSE	MAPE
Week 1	140	-				
Week 2	101	-				
Week 3	207	120,5	86,5	86,5	7482,25	41,787%
Week 4	103	154	51	51	2601	49,515%
Week 5	137	155	18	18	324	13,139%
Week 6	163	120	43	43	1849	26,38%
Week 7	120	150	30	30	900	25%
Week 8	135	141,5	6,5	6,5	42,25	4,815%
Week 9	118	127,5	9,5	9,5	90,25	8,051%
Week 10	131	126,5	4,5	4,5	20,25	3,435%
Week 11	175	124,5	50,5	50,5	2550,25	28,857%
Week 12	151	153	2	2	4	1,325%
Week 13		165		301,5	15863,25	202,304%
			Error Value	30,15	1586,325	20,23%

From Table 1, forecasting with Movement 2 or Moving Average 2 produces a forecast value for the next cricket production quantity of 165 kg and an error value of Mean Absolute Deviation 30.15, Mean Squared Error 1586.325

and Mean Absolute Percentage Error 20.23%.

TABLE 2
MOVING AVERAGE FORECAST ACCURACY CALCULATION DATA WITH N = 3

Periode	X_t	F_t	$\lvert X_t - F_t \rvert$	MAD	MSE	MAPE
Week 1	140					
Week 2	101					
Week 3	207					
Week 4	103	149,3	46,3	46,333	2146,777	44,984%
Week 5	137	137	0	0	0	0%
Week 6	163	149	14	14	196	8,589%
Week 7	120	134,3	14,3	14,333	205,444	11,944%
Week 8	135	140	5	5	25	3,704%
Week 9	118	139,3	21,3	21,333	455,111	18,079%
Week 10	131	124,3	6,67	6,667	44,445	5,089%
Week 11	175	128	47	47	2209	26,857%
Week 12	151	141,3	9,67	9,667	93,445	6,402%
Week 13		152,3		164,333	5375,222	125,648%
			Error Value	18,259	597,247	13,961%

From Table 2, the prediction with Movement 3 or Moving Average 3 gives a predicted value for the next cricket production of 152 kg and an error value of Mean Absolute Deviation 18.259, Mean Squared Error 597.247 and Mean Absolute Percentage Error 13.961%.

TABLE 3
MOVING AVERAGE FORECAST ACCURACY CALCULATION DATA WITH N = 4

Periode	X_t	F_t	$\lvert X_t - F_t \rvert$	MAD	MSE	MAPE
Week 1	140					
Week 2	101					
Week 3	207					
Week 4	103					
Week 5	137	137,75	,75	,75	,563	,547%
Week 6	163	137	26	26	676	15,951%
Week 7	120	152,5	32,5	32,5	1056,25	27,083%
Week 8	135	130,75	4,25	4,25	18,063	3,148%
Week 9	118	138,75	20,75	20,75	430,563	17,585%
Week 10	131	134	3	3	9	2,29%
Week 11	175	126	49	49	2401	28%
Week 12	151	139,75	11,25	11,25	126,563	7,45%
Week 13		143,75		147,5	4718	102,055%
			Error Value	18,438	589,75	12,757%

From Table 3, forecasting with Movement 4 or Moving Average 4 gives a predicted value for the next cricket production of 143.75 kg and an error value of Mean Absolute Deviation 18.438, Mean Squared Error 589.75 and Mean Absolute Percentage Error 12.757%.

B. Weighted Moving Average

Below are the results of the data analysis for the Weighted Moving Average (WMA) method. The data analysis for these two models took n as 2, 3 and 4. The most accurate prediction of cricket production is characterised by a low level of difference between the actual results and the predicted results. Conversely, poor accuracy is characterised by a high level of difference. The higher the difference between the actual value and the predicted result, the lower the accuracy.

In Table 4, the prediction with Movement 2 or Moving Average 2 gives a predicted value for the next cricket production of 159 kg and an error value of Mean Absolute Deviation 31.167, Mean Squared Error 1855.855 and Mean Absolute Percentage Error 21.366%.

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TABLE 4
MOVING AVERAGE FORECAST ACCURACY CALCULATION DATA WITH N = 2

Periode	X_t	F_t	$\lvert X_t - F_t \rvert$	MAD	MSE	MAPE
Week 1	140					
Week 2	101					
Week 3	207	114	93	93	8649	44,928%
Week 4	103	171,667	68,667	68,667	4715,112	66,667%
Week 5	137	137,667	,667	,667	,444	,487%
Week 6	163	125,667	37,333	37,333	1393,777	22,904%
Week 7	120	154,333	34,333	34,333	1178,777	28,611%
Week 8	135	134,333	,667	,667	,444	,494%
Week 9	118	130	12	12	144	10,169%
Week 10	131	123,667	7,333	7,333	53,778	5,598%
Week 11	175	126,667	48,333	48,333	2336,111	27,619%
Week 12	151	160,333	9,333	9,333	87,111	6,181%
Week 13		159		311,667	18558,55	213,657%
			Error Value	31,167	1855,855	21,366%

in Table 5, forecasting with movement 3 or moving average 3 gives a forecast value for the next cricket production of 155,667 kg and an error value of mean absolute deviation 20,167, mean square error 795,651 and mean absolute percentage error 15,613%.

TABLE 5
MOVING AVERAGE FORECAST ACCURACY CALCULATION DATA WITH N = 3

Periode	X_t	F_t	$\lvert X_t - F_t \rvert$	MAD	MSE	MAPE
Week 1	140					
Week 2	101					
Week 3	207					
Week 4	103	160,5	57,5	57,5	3306,25	55,825%
Week 5	137	137,333	,333	,333	,111	,243%
Week 6	163	137,333	25,667	25,667	658,777	15,746%
Week 7	120	144,333	24,333	24,333	592,111	20,278%
Week 8	135	137,167	2,167	2,167	4,694	1,605%
Week 9	118	134,667	16,667	16,667	277,778	14,124%
Week 10	131	124	7	7	49	5,344%
Week 11	175	127,333	47,667	47,667	2272,111	27,238%
Week 12	151	150,833	,167	,167	,028	,11%
Week 13		155,667		181,5	7160,86	140,514%
			Error Value	20,167	795,651	15,613%

In Table 6, forecasting with Movement 4 or Moving Average 4 produces a predicted value for the next cricket production of 150.9 kg and an error value of Mean Absolute Deviation 16.05, Mean Squared Error 514.513 and

TABLE 6
MOVING AVERAGE FORECAST ACCURACY CALCULATION DATA WITH N = 4

Periode	X_t	F_t	$\lvert X_t - F_t \rvert$	MAD	MSE	MAPE
Week 1	140					
Week 2	101					
Week 3	207					
Week 4	103					
Week 5	137	137,5	,5	,5	,25	,365%
Week 6	163	137,2	25,8	25,8	665,64	15,828%
Week 7	120	147,6	27,6	27,6	761,76	23%
Week 8	135	134,6	,4	,4	,16	,296%
Week 9	118	136,3	18,3	18,3	334,89	15,508%
Week 10	131	128	3	3	9	2,29%
Week 11	175	126,8	48,2	48,2	2323,24	27,543%
Week 12	151	146,4	4,6	4,6	21,16	3,046%
Week 13		150,9		128,4	4116,1	87,877%
			Error Value	16,05	514,513	10,985%

Mean Absolute Percentage Error 10.985.

IV. DISCUSSION

The overall comparison of MA and WMA methods with n values of 2, 3 and 4 is compared numerically using prediction accuracy. The accuracy measures used are Mean Absolute Deviation (MAD), Mean Squared Error (MSE) and Mean Absolute Percentage Error (MAPE). The results of the calculations are presented in Table 7 below.

TABLE 7
FORECAST ACCURACY VALUES FOR EACH OF THE METHODS

Method	MAD	MSE	MAPE	Accuracy rate of MAPE
MA 2	30,15	1586,325	20,23%	Sufficient
MA 3	18,259	597,247	13,961%	Good
MA 4	18,438	589,75	12,757%	Good
WMA 2	31,167	1855,855	21,366%	Sufficient
WMA 3	20,167	795,651	15,613%	Good
WMA 4	16,05	514,513	10,985%	Good

From Table 7 above, the lowest value for MAD is 16.05 for the WMA n = 4 model. The lowest value for MSE is 514.513 for the WMA n = 4 model and the lowest value for MAPE is 10.985% for the WMA n = 4 model. From the accuracy value used to compare the three models of MAD, MSE and MAPE, the WMA n = 4 model has the lowest accuracy value of all, which means that the WMA n = 4 model is the best model for predicting the amount of production in cricket farming in Rejotangan Tulungagung.

V. CONCLUSION

From this research, it can be concluded that the best model that can be used to forecast the amount of cricket production in the existing farm in Rejotangan Tulungagung is the Weighted Moving Average (WMA) model with n = 4 with the lowest forecasting accuracy value (MAD, MSE and MAPE) of 16.05, 514.513 and 10.985% respectively. From the results of forecasting, the total production of crickets in the existing farm in Rejotangan Tulungagung for one period ahead with the WMA model n = 4 is 150.9 kg.

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