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Implementation of Trend Moment Method in Egg Forecasting System in Sukamulia Farm

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ABSTRACT.
The needs of the egg become a problem at certain times. Sukamulia Farm is one of farms that produces an egg in South Sumatra. By implementing Trend Moment Method in forecasting system, Sukamulia farm can predict how many of egg that is needed by the customer in a certain time. The trend moment method that used in this research is based on historical demand. As a result, this forecasting method can produce a recommendation quantity of purchase in fulfillment the need of broiler-egg by involving seasonal index. This study use Mean Square Error to analyze error of forecasting. The result of MSE of this study is 19399,5833
Keywords: *trend moment, forecasting, egg*

Introduction

Increasing population and public awareness of the importance in consuming high nutritioun food, as well as increasing development in the livestock sector is one of the factors underlying the increasing need for animal protein consumption. In this case, the livestock sector has an important role in providing community needs.
The broiler egg is one of a source of animal protein that is widely consumed by various groups of people because the price is affordable and easy to obtain. Commodity sales of broiler eggs in Indonesia still frequently fluctuate. This fluctuation can occur when breeders make the wrong anticipation, it will cause overproduction and make a supply in the market was declined.
The level of demand for livestock products such as chicken eggs can be influenced by certain factors or seasons or periods. Economic and non-economic factors together influence consumer behavior and purchasing power.
By using the factors that influence the demand for broiler eggs can be used as a reference to predict the needs of broiler eggs in the future and a forecasting system can be built by observing and analyzing patterns of monitoring results from farm historical data to then be processed in order to produce a system forecasting that can predict the future state[5][6][7].

Literature References

Forecasting.

Forecasting is data in the past that is used for the purposes of estimating future data. Thus, forecasting is an estimation of future demand based on a number of forecasting variables, often based on historical time-series data. [1][2]
Demand forecasting of a product and services for the future is very important in planning and monitoring products. Operational management use forecasting to make a decision that related to the selection process, capacity planning, facility layout and for sharing decisions that are continuous regarding planning, scheduling, and inventory.
Forecasting can be divided into two; qualitative forecasting and quantitative forecasting. Quantitative forecasting methods can be divided into two parts; time series forecasting method, and casual method, while qualitative methods are divided into exploratory and normative methods. Quantitative forecasting techniques are very diverse. Quantitative techniques developed from various disciplines and for various purposes. Each technique will have been chosen has its own characteristics, accuracy, level of difficulty and costs that must be considered.

Pattern of data.

The analysis of forecasting should be based on the existing pattern of data. There are four data patterns that are commonly used in forecasting techniques.[2]

Horizontal Pattern.

The horizontal pattern occurs when data has fluctuation with the average of data. The sample of data that categorized in this pattern is product whose sales have not increased or decreased over a period of time[3]. The structure of data can be described as figure 1

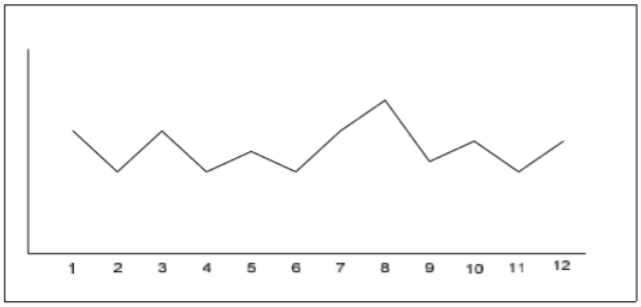

Figure 1. Horizontal Pattern

Seasonal Pattern.

The seasonal pattern occurs when data values are influenced by seasonal factors[3]. The structure of data can be described as figure 2

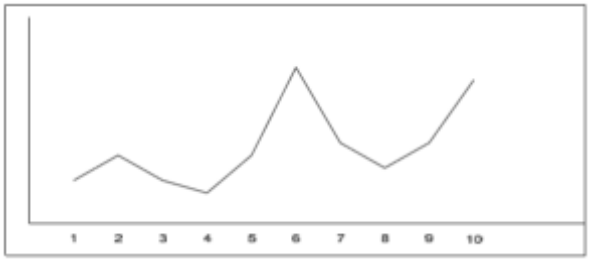

Figure 2. Seasonal Pattern

Cyclical Pattern.

The Cyclical pattern occurs when data is affected by long-term economic fluctuations such as those related to business cycles[3]. The structure of data can be described as figure 3

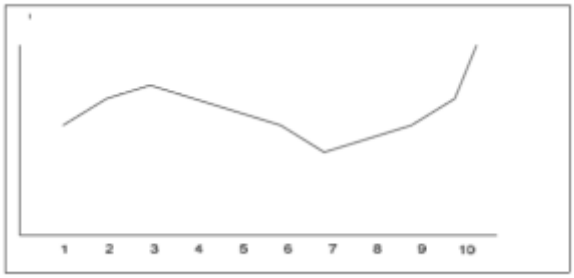

Figure 3. Cyclical Pattern

Trend Pattern.

The trend pattern occurs when there is a long-term secular increasing or decreasing of data[1], [4]. The structure of data can be described as figure 4

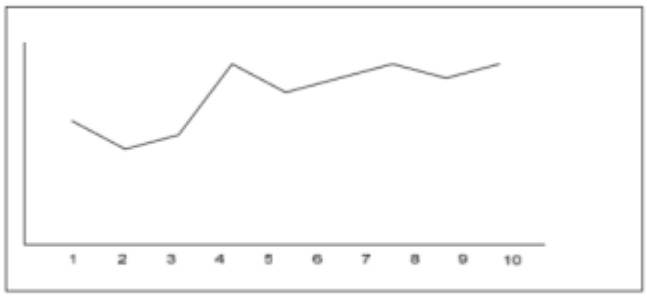

Figure 4. Trend Pattern

Trend Moment Method.

In the application of Trend Moment method can be done using historical data from one variable, the formula used in drafting of this method[3]:

$$Y = a + b\,X \qquad (1)$$

Where:
Y = Trend or variable value to be predicted
A = number of constants
b = slope or trend line coefficient
X = time

To find A and B values in the formula above, it is used in a mathematical manner (linier regression) with the completion of the substitution method and method of elimination[3].

$$a = \frac{(\Sigma y)(\Sigma x^2) - (\Sigma x)(\Sigma xy)}{n(\Sigma x^2) - (\Sigma x)^2} \qquad (2)$$

$$b = \frac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{n(\Sigma x^2) - (\Sigma x)^2} \qquad (3)$$

Where:
Σy = Sum of the sales data
Σx = Sum of time periods
Σxy = sum of sales data times by time period
N = amount of data

Once the forecast has been obtained from forecasting with the Trend Moment method, it will be corrected against seasonal influences using the season index. Calculation of the season index [2]:

Seasonal index = Period Average/Overall Average (4)

To get the result of the final prediction after being influenced by the season index, it will use the following calculations [2]:

$$Y^* = \text{Seasonal Index} \times Y \qquad (5)$$

Where:
Y * = result of forecast by using Trend Moment method which has been influenced by the season index.
Y = result of forecast by using Trend Moment.

After that, identify the smallest mistake used in this Trend Moment method using MSE (Mean Square Error), the formula among others [2]:

$$MSE = \frac{\sum e^2}{n} \qquad (6)$$

Where the value of E is the difference between the Y value and the forecasting (Y^). Models that have the smallest MSE are the most well-modeled equations.

Summary

Forecasting calculations with the trend moment method start with data demand of eggs in Sukamulia farm that show in Table 1.

Table 1. Request Calculation table

Series	Demand	Time	X^2	X*Y
January 2017	520	0	0	0
February 2017	650	1	1	650
March 2017	540	2	4	1080
April 2017	810	3	9	2430
May 2017	600	4	16	2400
June 2017	500	5	25	2500
July 2017	650	6	36	3900
August 2017	620	7	49	4340
September 2017	320	8	64	2560
October 2017	420	9	81	3780
November 2017	500	10	100	5000
December 2017	550	11	121	6050
January 2018	600	12	144	7200
February 2018	580	13	169	7540
March 2018	650	14	196	9100
April 2018	1240	15	225	18600
May 2018	550	16	256	8800
June 2018	422	17	289	7174
July 2018	320	18	324	5760
August 2018	420	19	361	7980
September 2018	570	20	400	11400
October 2018	500	21	441	10500
November 2018	600	22	484	13200
December 2018	600	23	529	13800
TOTALS	13732	276	4324	155744
AVERAGE	572,167	11,5	180,167	6489,333

From those data, based on formula (1) and (2) to check wheter the data is error or not this study try to analyze error that shows in table 2 below

Table 2. Error Analysis Demand Data

Data			Error analysis				
Period	**Demand (y)**	**Period(x)**	**Forecast**	**Error**	**Absolute**	**Squared**	**|% Error|**
January 2017	520	0	593,9067	-73,9	73,90666667	5462,195	14,2%
February 2017	650	1	592,0162	58,0	57,98376812	3362,117	8,9%
March 2017	540	2	590,1258	-50,1	50,1257971	2512,596	9,3%
April 2017	810	3	588,2354	221,8	221,7646377	49179,55	27,4%
May 2017	600	4	586,3449	13,7	13,65507246	186,461	2,3%
June 2017	500	5	584,4545	-84,5	84,45449275	7132,561	16,9%
July 2017	650	6	582,5641	67,4	67,43594203	4547,606	10,4%
August 2017	620	7	580,6736	39,3	39,32637681	1546,564	6,3%
September 2017	320	8	578,7832	-258,8	258,7831884	66968,74	80,9%
October 2017	420	9	576,8928	-156,9	156,8927536	24615,34	37,4%
November 2017	500	10	575,0023	-75,0	75,00231884	5625,348	15,0%
December 2017	550	11	573,1119	-23,1	23,11188406	534,1592	4,2%
January 2018	600	12	571,2214	28,8	28,77855072	828,205	4,8%
February 2018	580	13	569,331	10,7	10,66898551	113,8273	1,8%
March 2018	650	14	567,4406	82,6	82,55942029	6816,058	12,7%
April 2018	1240	15	565,5501	674,4	674,4498551	454882,6	54,4%
May 2018	550	16	563,6597	-13,7	13,65971014	186,5877	2,5%
June 2018	422	17	561,7693	-139,8	139,7692754	19535,45	33,1%
July 2018	320	18	559,8788	-239,9	239,8788406	57541,86	75,0%
August 2018	420	19	557,9884	-138,0	137,9884058	19040,8	32,9%
September 2018	570	20	556,098	13,9	13,90202899	193,2664	2,4%
October 2018	500	21	554,2075	-54,2	54,20753623	2938,457	10,8%
November 2018	600	22	552,3171	47,7	47,68289855	2273,659	7,9%
December 2018	600	23	550,4267	49,6	49,57333333	2457,515	8,3%
			Total	0,0000000000007958	2615,561739	738481,5	479,7%
Intercept	593,9066667		**Average**	0,0000000000000332	108,9817391	30770,06	20,0%
Slope	-1,89043478			**Bias**	**MAD**	**MSE**	**MAPE**
					SE	**183,2139**	
Next period	**546,6457971**	25					
					Correlation	-0,07439	

From table 2, the prediction of next 12 months demand shows in table 3 below. Based on table 3, it shows MAPE (Mean Absolute Percent Error) is 20%, Bias (Mean Error) is 0, and MSE (Mean Squared Error) is 30770,06

Table 3. Result Forecasting

Measure	Value	Future Period	Forecast
Error Measures		24	548,536
Bias (Mean Error)	0	25	546,646
MAD (Mean Absolute Deviation)	108,982	26	544,755
MSE (Mean Squared Error)	30770,06	27	542,865
Standard Error (denom=n-2=22)	183,214	28	540,974
MAPE (Mean Absolute Percent Error)	19,989%	29	539,084
Regression line		30	537,194
Demand(y) = 593,907		31	535,303
-1,89 * Time(x)		32	533,413
Statistics		33	531,522
Correlation coefficient	-,074	34	529,632
Coefficient of determination (r^2)	,006	35	527,741
Forecast		36	525,851
x = 12	571,2214	37	523,96

From Table 3 above, to get final result of forecasting that influenced by seasonal indexed, the next step this study using formula (4) to get seasonal index. Table 4 shows result of seasonal index of each next 12 months.

Table 4. Seasonal index

Month	2017	2018	Average	Seasonal Index
January	520	600	560	0,9787
February	650	580	615	1,0749
March	540	650	595	1,0399
April	810	1240	1025	1,7914
May	600	550	575	1,0050
June	500	422	461	0,8057
July	650	320	485	0,8477
August	620	420	520	0,9088
September	320	570	445	0,7777
October	420	500	460	0,8040
November	500	600	550	0,9613
December	550	600	575	1,0050
	Overall Average		572,1667	

As final result of forecasting that influenced by seasonal indexed, The Forecasting data is calculated with formula (5). The result of those formula shows in table 5 below

Table 5. Forecasting calculation Results

Series	X	Y= a + b.X	Seasonal Index	Prediction	e (Y - prediction)	e²
January 2019	24	549	0,9787	**537**	12	144
February 2019	25	547	1,0749	**588**	-41	1.681
March 2019	26	545	1,0399	**566**	-22	484
April 2019	27	543	1,7914	**972**	-430	184.900
May 2019	28	541	1,0050	**544**	-3	9
June 2019	29	539	0,8057	**434**	105	11.025
July 2019	30	537	0,8477	**455**	82	6.724
August 2019	31	535	0,9088	**486**	49	2.401
September 2019	32	533	0,7777	**415**	119	14.161
October 2019	33	532	0,8040	**427**	104	10.816
November 2019	34	530	0,9613	**509**	20	441
December 2019	35	528	1,0050	**530**	-3	9

From Table 5, there is error (e) with positive and negative forecast error. To avoid those problem, this study use MSE (Mean Squared Error) that shows below

$MSE = (\Sigma e^2) / n$

$MSE = 232.795 / 12$

$MSE = 19399,5833$

SUMMARY

The main objective of the implementing forecasting method is to help Sukamulia farms to increase the productivity of poultry products especially for broiler egg. As the result, from historical data (24 months), it can predict next 12 months by using linier regression forecasting method. This study use seasonal index to predict more accurate. Because, the demands of broiler egg depend on seasonal, such as holiday, feast day, and event. To analyze the error of forecasting data, this study use Mean Square Error (MSE). The result of MSE Forecasting Egg demands in Sukamulia Farm is 19.399,5833

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