Forecasting With Time Series Method at PT. RSM in Bekasi Jawa Barat

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Abstract: This study aims to determine the most valid forecasting method based on the time series method. This research uses quantitative descriptive method, the research variable is sales data of MT products belonging to PT. RSM period August 2018 to January 2021. Data processing using Microsoft excel and Minitab 19 software. ABC analysis results show product codes RSM020, RSM021, and RSM017 occupy the three highest ranks in class A by contributing 26.16% sales figures. Based on the results of forecasting using various time series methods (linear trend, decomposition, moving average, single exponential smoothing, Holt Method, and Winter Method) it is found that the Winter Method produces the lowest MAPE value, which is below 20%. Product code RSM020 with an alpha value of 0.06; beta 0.09; and 0.07 gamma produces 17.2% MAPE. Product code RSM021 with an alpha value of 0.01; beta 0.01; and 0.01 gamma produces a 15.3% MAPE. Product code RSM017 with an alpha value of 0.01; beta 0.02; and 0.02 gamma produces 18.1% MAPE.

Keywords: Forecasting, ABC Analysis, Time Series

INTRODUCTION

The increasingly fierce competition among producers that produce the same product category has motivated them to continuously improve the quality and excellence of their products. However, the quality and advantages of a product will not be enjoyed by consumers if the product is not available in the market. Many factors affect the availability of a product on the market, according to Sauqi and Sagara (2015) external factors that affect the availability of a product include price, distribution channels, marketing network, facilities and infrastructure.

While the internal factor is the unavailability of a product in the market, one of which is caused by an error in forecasting product demand (forecasting).

According to Martani, et al (2012) inventory of an item is one of the important assets for companies engaged in retail, manufacturing, or other types of business. Therefore, every company must carry out good management of the availability of each product sold in the market. Companies that are committed to providing superior service to their customers must be able to plan raw material needs and make predictions or forecasts on the quantity of products needed by the market. This is done so that the products are always available in the market, so that whenever consumers want to buy their products, the products are always available *(ready stock).*

The problem of determining the right forecasting method is a problem for many companies, both small and large companies. Qualitative forecasting methods are generally more often used in many daily forecasting decisions. In this case the forecast is said to be good or not depending on many things, including experience, estimates and knowledge. Quantitative forecasting method is forecasting based on past quantitative data. According to Musmirani et al (2015) forecasting quantitative methods can be applied if the following three conditions exist: information about past data is available, the information can be quantified in the form of numerical data, and the information can be projected to continue in the future.
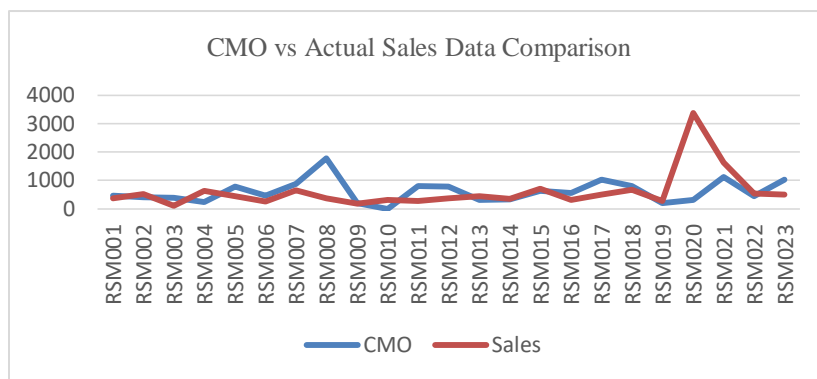

Figure 1. Forecasting and Actual Sales of PT.RSM

Inappropriate forecasting methods will have a detrimental impact on the company, because it has the potential to cause a gap between the projected figures and actual needs. Based on the data in Figure 1, it can be seen that there will always be a gap between production forecasting (CMO) and product sales (Sales). The larger the gap, the greater the potential loss received by the company. The problems that are often experienced by PT. RSM is a mismatch between the availability of goods and the need, causing excess or shortage of goods. In addition to the problems caused by excess goods, shortages of goods on the market (especially in e-commerce) will cause stock outs which have an impact on decreasing company performance in the eyes of consumers, low ratings can affect consumer decisions in making purchases of a product in online stores.

Companies that realize how important it is to maintain customer satisfaction will always improve themselves and innovate, including in planning accurate requests so that their products are always available in the market. Companies should try to develop alternative forecasting

methods other than relying on experience alone, of course, by collaborating with quantitative methods that use mathematical or statistical calculations. Therefore, the authors are interested in conducting research with the title "Forecasting with Time Series Analysis Methods at PT. RSM".

The formulation of the problem in the study is as follows:
1. Which product is the flagship product of PT. RSM ?
2. What is the most suitable time series forecasting method for PT.RSM's product characteristics?

LITERATURE REVIEW
Forecasting Concept
The activity of estimating a required volume in the future is known as forecasting. According to Chopra & Meindl (2014), forecasting is an activity to predict future events or conditions that are beyond the control of the company, where forecasting is part of strategic management. The ultimate goal of strategic planning is to determine what the company should do in the future, such as competing with what type of market, with what products, and determining the direction of the company's growth. Forecasting is needed by companies to cope with various seasons, changes in demand, maneuvers for price cuts from competitors, or even very large fluctuations in the economy.

According to Heizer et.al (2017:146), forecasting is the science and art of predicting an event in the future. Forecasting is done by processing historical data which is then projected into the future through various models or mathematical combinations that are adapted to company policies. Junior and Filho (2012) state that demand forecasting methods can be based on mathematical models using historical data or in the format of qualitative methods, planned according to administrative experience and customer reviews. Forecasting can also be done using a combination of quantitative and qualitative methods.

Time Series Forecasting Model
Broadly speaking, the quantitative model consists of a time series analysis forecasting model and a causal model. Time series forecasting models use historical data to predict the future assuming a pattern of data in the past that continues into the future. Heizer and Render (2009:169) state that the time series analysis method is based on a sequence of data points that are equidistant in time (weekly, monthly, quarterly, and others).

Forecasting Error Test
The purpose of this test is to minimize forecasting errors. The forecast error is the difference between the actual value and the forecast value. The three most well-known measures are the mean absolute deviation (MAD), the mean squared error (MSE), and the mean absolute percent error (MAPE).

MAD (absolute mean deviation) is the first measure of overall error for the model. The formula is as follows.

$$MAD \ = \frac{\sum|A_t - F_t|}{n}$$

MSE (mean error squared) is the second way to measure overall forecast error. MSE is the average of the difference squared between the predicted and observed values. The formula is as follows.

$$MSE = \frac{\sum|A_t - F_t|^2}{n}$$

MAPE (absolute mean percentage error) is calculated as the absolute mean difference between the predicted and actual values, reflected as a percentage of the actual values. Mathematically, MAPE is expressed as follows.

$$MAPE = \left(\frac{100}{n}\right)\sum\left|At - \frac{Ft}{At}\right|$$

ABC Analysis

Shroeder (2010) states that ABC analysis is a method of classifying goods based on value ratings from the highest to the lowest. In this method the classification is divided into 3 major groups, namely classes A, B, and C. The principle used in this analysis is Pareto, where the principle focuses or prioritizes controlling goods or services that have a high or critical value compared to those with low or trivial values.

RESEARCH METHODS
Design

The method used in this research is descriptive quantitative, where quantitative is usually used to examine a particular population or sample, sampling techniques are generally carried out randomly, data collection uses research instruments, data analysis is quantitative/statistical, with the aim of testing the established hypothesis. While descriptive research is research conducted to determine the existence of independent variables, either only on one or more variables without making comparisons or connecting other variables (independent variables are independent variables, not independent, because if the independent variable is always paired with the dependent variable (Sugiyono , 2015:53) Descriptive quantitative method was chosen because it is in accordance with the research to be achieved, namely wanting to get the right finished goods forecasting method with the smallest standard error.

Variable

According to Sugiyono (2015:38), the research variable is an attribute or nature or value of people, objects or activities that have certain variations set by researchers to study and draw conclusions. The variables in this study are product sales data at MT (Modern Trade) for 30 months starting from August 2018 to January 2021 belonging to PT. RS.

Analysis Method

Researchers conducted ABC analysis using POM QM software, then performed time series forecasting which consisted of linear trend methods, decomposition, moving averages, exponential smoothing, double exponential smoothing (Holt's Method), and triple exponentials. (Winters' method) as well as measuring the level of forecasting error using Minitab 19.

The research method contains the type of research, sample and population or research subject, time and place of research, instruments, procedures and research techniques, as well as other matters related to the research method. This section can be divided into several sub-chapters, but it is not necessary to include the numbering.

FINDINGS AND DISCUSSION
ABC Analysis

In this study, ABC analysis was carried out to determine which product variants would be sampled for each forecasting method. Researchers cannot predict all product variants, because the products sold at PT. RSM more than 20 variants.

Table 1. Results of ABC Analysis of PT RSM Products

Produk	Sales (Rp)	Persentase	Kategori
RSM020	625.392.500,00	12,97%	A
RSM021	357.595.000,00	7,01%	A
RSM017	324.138.500,00	6,18%	A

Product category A is a product group that produces the highest sales figures, therefore the availability of its products must always be guaranteed. Reports of expenditure and remaining product stock must be recorded properly, then forecasting the quantity of products for the next period must be approached to approach the actual needs. Based on the results of ABC analysis, the three products that occupy the top rank are products coded RSM020, RSM021, and RSM017. The percentage of the three product variants contributed 26% of the total sales, which means that the three product variants are superior products from PT. RSM for sales in Modern Trade (Retail).

Characteristic of Sales Data

This study only uses secondary data derived from sales data owned by the Sales Division. Sales data for MT products owned by the Sales Division only contains information related to the quantity of sales per day. Daily sales data for MT products is then accumulated day by day to form monthly sales data. Then each of these sales data the authors collect to form sales data for 30 months for each variant of the MT product at PT.RSM. Testing the sales data pattern of RSM020, RSM021, and RSM017 processed with Minitab 19 software. The sales pattern for the RSM020 product can be seen in Figure 2.
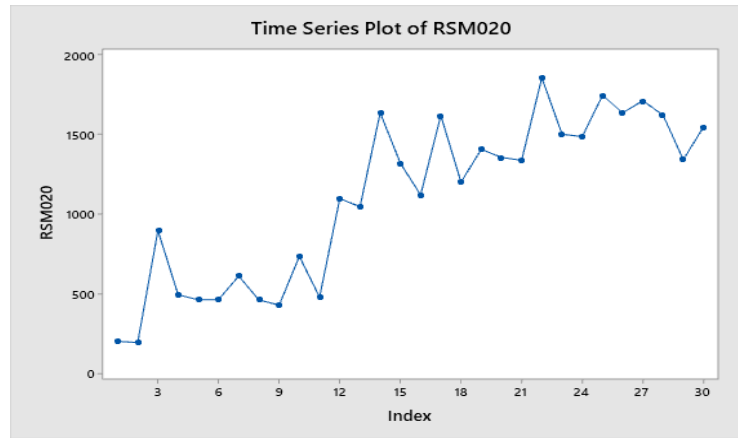
Figure 2. Characteristic RSM020

Figure 2 shows that sales of RSM020 products tend to increase every month, the data pattern depicted is a trendline pattern with seasonal movements. A drastic increase in sales patterns occurred in the month of Ramadan and the end of the year.
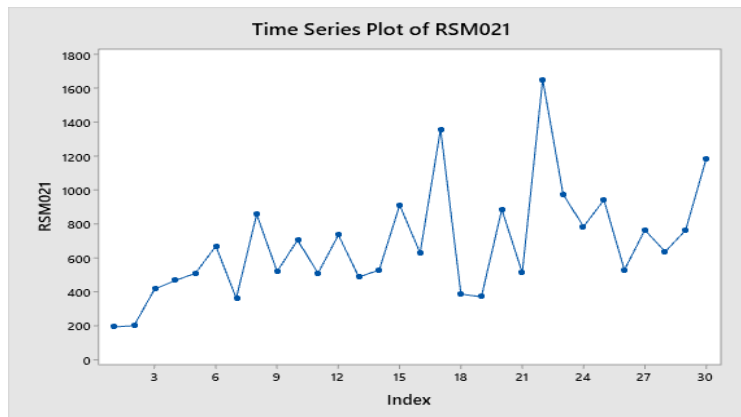

Figure 3. Characteristic RSM021

Figure 3 shows that the sales of RSM021 products have a tendency to increase with seasonal data patterns. Based on interviews, the trend of drastic increase in sales occurred in the month of Ramadan and the end of the year.
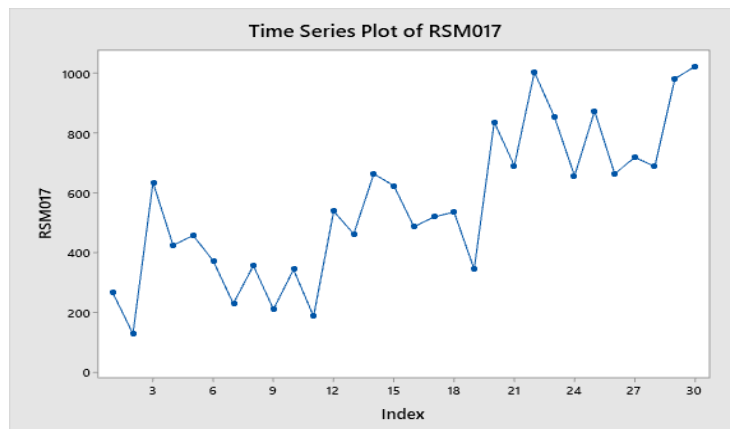
Figure 4. Product Data Pattern RSM017

Figure 4 shows that the sales of RSM017 products tend to increase every month, the data pattern depicted is a trendline pattern with seasonal movements. The trend of increasing product sales indicates that the RSM017 product is increasingly recognized and liked by customers.

Recapitulation of Forecasting Results

One of the advantages of using time series forecasting is that it makes it easier for management to apply and make decisions in the future, forecasting with this method only needs to use data for several periods back until the time of forecasting. Based on various time series forecasting methods carried out by researchers, Table 2 below presents a recapitulation of forecasting results from the Linear trend, Decomposition, Moving Average, Single Exponential Smoothing, Double Exponential Smoothing, and Winter's Method

Table 2. Recapitulation of Time Series Forecasting Results

No	Kode Item	Metode	MAD	MSE	MAPE
1.	RSM020	Linear Trend	182,9	60804,4	24,7
		Dekomposisi	171,3	43786,6	21,3
		Moving Average	180,1	72088,3	11,1
		Single Eksponential	184,6	70776,3	19,7
		Holt's Method	183,8	61456,4	24,7
		Winter's Method	153,8	42130,4	17,2
2.	RSM021	Linear Trend	204,9	73607,8	34,8
		Dekomposisi	141,7	44427,8	29,2
		Moving Average	172,7	60334,4	17,4
		Single Eksponential	217,9	93884,8	34,5
		Holt's Method	206,0	74363,7	35,0
		Winter's Method	99,8	16082,4	15,3
3.	RSM017	Linear Trend	127,4	23145,9	31,0
		Dekomposisi	107,7	24026,1	25,7
		Moving Average	182,9	51399,8	24,7
		Single Eksponential	137,1	31013,4	29,5
		Holt's Method	128,1	23385,9	31,1
		Winter's Method	90,3	12328,5	18,1

The results of data processing with Minitab 19 software show that the product code RSM020 produces the smallest error percentage in the Moving Average forecasting method where the resulting MAPE value is 11.1%, while for the product code RSM021 and RSM017 the smallest error percentage is generated in the Winter's Method forecasting method. The product code RSM021 produces a MAPE value of 15.3%, and the code RSM017 produces a MAPE value of 18.1%.

The results of this study are in line with research conducted by Barbosa (2015). In his research entitled "Demand forecasting for production planning in a food company", he compared

which time series method is the most valid by producing the smallest error, in his research Barbosa concluded that the Winter method produces the smallest MAPE compared to other methods (Moving average, single exponential smoothing). , double exponential smoothing). Another study conducted by Hidayatullah (2016) with the research title "Demand Forecasting Analysis Using Time Series Methods At Ayam Lodho Pak Yusuf Restaurant" also states that the Winter method produces the best estimates for restaurants during holidays and weekends.

CONCLUSION AND RECOMMENDATION
Conclusion
Based on the results and discussion of the research that has been done, the following conclusions can be drawn:
1. The results of ABC analysis show that three products have the highest value or are included in the three highest rankings in class A, namely product codes RSM020, RSM021, and RSM017. The three product codes contributed 26.16% of the total revenue for MT products, with each product code RSM020 amounting to Rp. 625,392,500, RSM021 in the amount of Rp. 357,595,000, and RSM017 in the amount of Rp. 324,138,500.
2. The application of the Triple exponential method (Winter's method) to the three product codes produces the smallest consistent error rate (<20%) compared to other forecasting methods. This value is generated from the alpha, beta and gamma values of each of:
    i. Product code RSM020 with an alpha value of 0.06; beta 0.09; and 0.07 gamma produces an MAD value of 153.8 ; MAPE is 17.2% and MSE is 42130.4
   ii. Product code RSM021 with an alpha value of 0.01; beta 0.01; and 0.01 gamma produces an MAD value of 99.8; MAPE is 15.3% and MSE is 16082.4
  iii. Product code RSM017 with an alpha value of 0.01; beta 0.02; and 0.02 gamma produces an MAD value of 90.3; MAPE is 18.1% and MSE is 12328.5

Suggestion
Based on the conclusions of the research that has been done, the suggestions that can be given are as follows:
1. PT. RSM should start considering quantitative forecasting methods in determining the quantity of MT products to be produced in the next period, the Triple Exponential (Winter's Method) forecasting method which shows MAPE <20% can be applied with the help of software such as Minitab or QM For Windows. The use of quantitative methods is expected to solve problems such as overstock and stock outs due to forecasting which is often far off the mark based on considerations/experience.
2. The expected forecasting result is to produce a MAPE value < 10%, where the smaller the resulting MAPE, the forecast is expected to be more valid. For further research that examines chili and seasoning product variants, it is recommended to use the VAR method or combine it with primary data (panel data and pool data). Primary data variables that can be extracted include the price of goods, consumer income, technology and consumer tastes (the lifestyle of consumers who want to be more practical), or it can be developed to explore variables from the selling price of the product, the price of substitute and complementary products, as well as technology and company capacity. .

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