

Optimization of Forecasting Method Selection in Overcoming Material Overstock and Stockout Problems in Instant Food Production (Case Study at PT. Mama Fuji Group)

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Abstract: PT Mama Fuji Group is a company that sells instant food through online platforms, such as Shopee, Lazada, Tokopedia, and Tiktok Shop. In 15 months in Q3 2022 - Q3 2023, PT Mama Fuji Group has a high fluctuation level, leading to a gap between production numbers and the actual demand. This problem causes several losses from the overstock or out-of-stock in finished goods warehouse. Hence, a company should prepare an effective production planning system, such as Forecasting. This research aimed to determine the most valid Forecasting using quantitative descriptive research methods with the Time Series method, such as Moving Average, SES (Single Exponential Smoothing), DES (Double Exponential Smoothing), or Holt's Method, Linear Exponential Smoothing (Winter Method), and Trend Linear. Data is analyzed with Microsoft Excel and Minitab 22 software. Based on ABC analysis, products with code RNDG700, KB0002, KB0001, RNDGMINI, and DNDNG160 are the A class and five highest contributors, with 65,58% of total product value, and Winter Method becoming the best method, which had the most minor error presentation for the entire product item with MAPE value from each item is RNDG700 for 1,16%, KB0002 for 8%, KB0001 for 5%, RNDGMINI for 25% and DNDNG160 for 3,92%

Introduction

The growth of the E-commerce market continues to increase every year in Indonesia. According to the Badan Pusat Statistik of Indonesia (BPS), in 2023, the number of E-commerce businesses in 2022 grew by 4.46% to 2,995,986 enterprises. E-commerce has become a well-known alternative for Indonesians to find and buy products easily. E-commerce growth also substantially impacts the food industry; based on Statistical Data information in 2022, as

many as 43.02% of the businesses in the E-commerce sector sell products or services, such as the Food, Beverage, and Groceries group. Then, followed by Fashion with a 15.04% business proportion and a group of goods/services for household needs, reaching 8.11%

Through E-commerce, customers can easily find food and beverages through online platforms without going to offline stores. This saves time and effort and expands the industry's reach, making food and beverages from various regions accessible to consumers anytime and anywhere. It's a promising trend that is set to further expand the industry's exposure to a bigger market.

The disappearance of the COVID-19 pandemic in Indonesia influenced the development of the food and beverage industry and also supported by the increase in population growth. It leads to a higher demand for food and beverages (Ministry of Industry, 2022). In the second quarter of 2023, there was an increase of 4.62% in the Gross Domestic Product (GDP) of the food and beverage industry, or equivalent to IDR209.51 trillion compared to the previous year (year on year/yoy) (see Figure 1.2).



Figure 1. GDP of Food and Beverage Industry

Source: Badan Pusat Statistik, 2023

Nevertheless, the food and beverage industry's growth also slowed down in Q1/2023 to QII/2023, following the trend that occurred in the previous quarter, Q1/2022 to QII/2022. This condition occurs in line with shifting consumer spending patterns in the country. Sometimes, people prioritize shopping or experiences, such as traveling, rather than buying food and beverages (which classified as secondary needs).

The change in consumer spending patterns caused the need for product demand in the food and beverage industry (F&B) to increase and decrease at any time (fluctuation). Companies should prepare the appropriate strategies to handle fluctuating market demand since this will be the main problem that often causes overstock and out-of-stock. Furthermore, the overstock resulted in an inventory build-up in the finished goods warehouse, which led to the loss. Meanwhile, the lack of stock decreased the company's performance from the consumer's perspective. It affected the consumers' decision to buy a product, and they lost the opportunity.

It is indeed a challenge to determine the best way of Product Forecasting demand, which has always been a concern for many small and large companies. One of them occurred at PT Mama Fuji Group, where due to the high fluctuations in food and beverage products

(F&B) in E-commerce, the demand for PT Mama Fuji Group's products also fluctuated from time to time

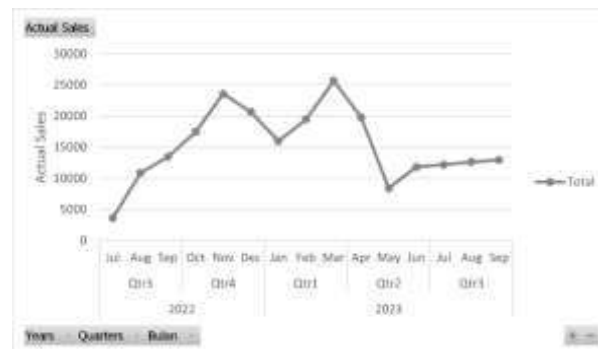


Figure 2. Data Actual Sales for Q3/2022 – Q3/2023

Source: Secondary Data of PT. MAMA FUJI GROUP

The graphic in Figure 2 shows fluctuations in the Actual Sales of PT Mama Fuji Group in the last 15 months (Q3/2022 - Q3/2023). The factors that caused these fluctuations were changing trends in instant food products, campaigns from e-commerce, and new social commerce sites such as TikTok Shop. However, to meet the significantly fluctuating demand, the company continued to increase production despite the subjective strategy or based on estimations and experience. It caused a difference between projections and actual needs, potentially causing losses for the company (Figure 3).

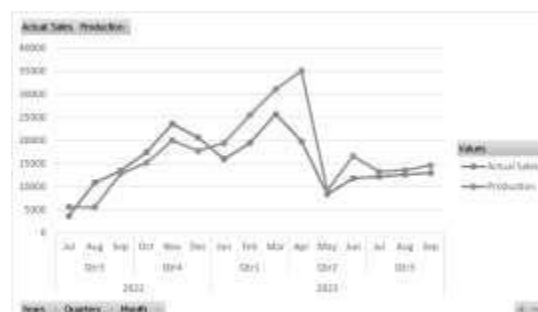


Figure 3. Data Actual Sales and Production for Q3/2022 – Q3/2023

Source: Secondary Data of PT. MAMA FUJI GROUP

Figure 3. shows the accumulation of stock that occurred in March and April 2023. It was predicted that there would be an increase due to Eid Al-Fitr 2023. Hence, the company maximized the production levels. Unfortunately, the stock maximization caused some items to overstock that passed the expiration date and could not be sold, so they had to be destroyed. Some instant food products owned by PT Mama Fuji Group require a maximum storage limit of 14 days after production.

Furthermore, a shortage of goods (stock out) occurred in Q3 and Q4 2022, which resulted in low ratings and affected consumer decisions to purchase a product due to the unavailability of goods in E-commerce. If this is left unchecked, the company will experience considerable losses from time to time.

Therefore, with proper Forecasting, the prediction of future demand for PT Mama Fuji Group will avoid the occurrence of overproduction, overstock, and out-of-stock. Forecasting will be carried out using the Time Series method with the Moving Average model, SES (Single Exponential Smoothing), DES (Double Exponential Smoothing) or Holt's Method, Linear Exponential Smoothing (Winter Method), and Linear Trend then determined by applying the calculation of the Mean Absolute Deviation (MAD), Mean Squared Error (MSE), and Mean Absolute Percentage Error (MAPE) values using Minitab 22 software for data processing. Forecasting with the smallest MAD, MSE, and MAPE values will be the most appropriate for PT Mama Fuji Group products. So that, in planning demand, companies can calculate accurately.

Based on the previous problem analysis, we identified the research problems as follows:

1. How is the best product classification at PT Mama Fuji Group?
2. How to determine the most proper Forecasting by the product characteristics of PT. Mama Fuji Group?

Literature Review Forecasting

Daily fluctuations in customer demand emphasize the need for companies to be more careful in designing strategies. One of the steps that can be taken by company management is Forecasting. According to Chopra & Meindl (2015), Forecasting means estimating future events or conditions beyond the company's control. The Forecasting process uses historical data, such as sales data from the previous year, which is analyzed and projected into the future using mathematical models. With Forecasting, companies can anticipate changes in demand, price-cut maneuvers from competitors, and substantial economic fluctuations (Bimantoro et al., 2021).

Time Series Forecasting Model

According to Heizer & Render (2015), a Time series is a model used to make predictions, understanding that the future is influenced by the past. In simple terms, a time series evaluates events over a certain time span by utilizing historical data to forecast the future.

The time series analysis approach is based on the belief that time series have components, such as Trend/Tendency (T), Cycle (C), Seasonal Pattern (S), and random variation (R) that can show a specific pattern.

Moving Average Model

According to Silalahi et al. (2021), the MA (Moving Average) method uses the arithmetic average of complete data to predict the future. This method helps forecast future demand using the latest demand data. The Moving Average method generates demand Forecasting values to help identify long-term trends or cycles in time series data. This method also serves to smooth out fluctuations in market behavior. The moving average is calculated using the following formula: Descriptions:

$$F_t = MA_n = \frac{\sum_{i=1}^n D_i}{n} \dots\dots\dots(2.1)$$

- F_t = exponentially smoothed forecast for period t
- D_i = demand in period i
- n = number of periods

Single Exponential Smoothing Model

According to Bimantoro et al. (2021), the Single Exponential Smoothing method estimates future values based on previous estimations and an estimated percentage error. The Single Exponential Smoothing method is a technique that uses a moving average with past data as the basis for the forecast. The following is the formula for Single exponential Smoothing:

$$F_t = F_{t-1} + \alpha (F_{t-1} - A_{t-1}) \dots\dots\dots(2.2)$$

Description:

- F_t = exponentially smoothed forecast for period t
- F_{t-1} = exponentially smoothed forecast made for the previous period
- A_{t-1} = actual demand of the previous period
- α = smoothing constant

Double Exponential Smoothing Model (Holt's Method)

According to Hidayatullah and Yudoko (2016), Double Exponential Smoothing in the Forecasting process involves a two-time smoothing process using two parameters α and γ. This approach is a development of the Single Exponential Smoothing method, which is expressed through the following equation:

$$F_{t+m} = S_t + b_t m \dots\dots\dots(2.3)$$

Description:

- F_{t+m} = Forecasting in period t + m
- S_t = trend smoothing value in period -t
- b_t = trend factor at -t
- m = number of periods to m forecasted

Linear Exponential Smoothing Model (Winter Method)

According to Hidayatullah and Yudoko (2016), Winter's Linear Exponential Smoothing forecasts data that shows seasonal patterns. This method is a development of the primary Exponential Smoothing method with the application of three different smoothing constants: constants for the overall level, trend, and seasonal. The formula is as follows:

$$F_{t+m} = S_t + b_t m + I_{mt-l+m} \dots\dots\dots(2.4)$$

Description:

- F_{t+m} = Forecasting in period t + m
- S_t = trend smoothing value in period -t
- b_tm = trend smoothing in period t - 1
- I_{mt} = seasonal smoothing in period t

- L = seasonal length (Number of months/quarters in 1 year)
- M = number of future periods forecasted

Trend Linier Model

The Linear Trend Method, a powerful analytical technique, is used to estimate or forecast future trends. It's particularly useful when you're expecting a linear increase or decrease in value (Alfiani, 2020).

The straight line depicted on the graph shows a rectangular coordinate system, it can expressed in the equation:

$$\hat{Y} = a + bX \dots\dots\dots(2.5)$$

Description :

- \hat{Y} = expected value of the Xth time period X = time period
- a = Y intersection point of the trend line with the Y-axis
- b = coefficient of trend line direction

Forecasting Error Test (Validation Test)

The forecast error is the difference between actual and predicted values. Some standard methods used to assess the accuracy of predictions are Mean Absolute Deviation (MAD), Mean Square Error (MSE), and Mean Absolute Percentage Error (MAP).

MAD is the average absolute error over a given period regardless of whether the Forecasting result is larger or smaller than reality. Systematically, the formula for MAD is as follows:

$$MAD = \frac{\sum_{t=1}^n |At - Ft|}{n} \dots\dots\dots(2.8)$$

Description :

- At = Actual demand in period t
- Ft = Forecasting demand in period t
- n = Number of Forecasting periods involved

MSE is the result of the sum of the squares of the Forecasting error in each period, then divided by the number of Forecasting periods. Mathematically, the MSE formula can be explained as follows:

$$MSE = \frac{\sum_{t=1}^n |At - Ft|^2}{n} \dots\dots\dots(2.9)$$

Description :

- At = Actual demand in period t
- Ft = Forecasting demand in period t
- n = Number of Forecasting periods involved

MAPE is also the average value of the percentage error, but it gives an absolute value to the difference between the actual value and the forecasted value.

$$MAPE = \frac{\sum \left| \frac{x_t - F_t}{x_t} \right| \times 100}{n} \dots\dots\dots(2.10)$$

Description :

Xt : Actual data occurred

Ft : Forecast data calculated from the model used at time or year t

n : Many data of Forecasting results

ABC Analysis

According to Wahyuni (2015), ABC analysis was discovered by HF Dickie in 1950. This analysis uses the Pareto principle and aims to focus inventory control on products that have a high value compared to those with a low value. In ABC analysis, inventory is divided into three classes based on the value or volume of inventory. i.e., classes A, B, and C.

Minitab Software

Minitab is computer software created specifically to process statistical data. It can perform complex statistical analysis, unlike Microsoft Excel, which can be used easily with complex statistical analysis capabilities. Therefore, it can facilitate Forecasting a lot of data (Simarmata, 2010).

E-commerce

E-commerce is a dynamic combination of technologies, applications, and business processes that connect companies, consumers, and specific communities. Through e-commerce, goods are exchanged between retailers and consumers of various commodities on a large scale using electronic transactions. Moreover, in the delivery process, goods are shipped from retailers using transportation from one region to another until they arrive in the consumers' hands. In it, there is a mutually beneficial relationship for both parties

Research Method

Research Design

This research applied a descriptive quantitative research approach to describe the present condition of the research object. Machali (2021) explained that descriptive research aims to identify the value of independent variables, either one variable or more, without any comparison or relationship between these variables. Meanwhile, quantitative research emphasizes using data in the form of numbers, starting from the data collection stage and interpreting the analysis results. The writer chose a descriptive quantitative approach to the research to get the proper Forecasting method with the lowest standard error.

Research Variables

According to Machali (2021), Research variables are the focus of a study. Meanwhile, according to the theory quoted by Izzatul (2022), variables are defined as attributes of

individuals or objects that experience variations between one entity and another. The variables in this study consist of Product Forecasting sales on E-commerce owned by PT Mama Fuji Group.

Sample and Population

Population includes a generalization, which consists of objects or subjects with specific qualities and characteristics determined by the researcher to be researched and considered (Sugiyono, 2012). The population in this study consists of products produced by PT Mama Fuji Group. Meanwhile, the sample is part of the total number and characteristics of the population (Sugiyanto, 2012). The purposive sampling technique uses the Pareto principle. The sample used is the top 5 products that experience the highest sales from product data in E-commerce for 15 months starting from Q3 2022 to Q3 2023.

Data Analysis Technique

Sugiyono (2012) explained that data analysis techniques are a way or method to convert data into information. The data analysis technique makes the characteristics of the data more accessible and helpful in finding solutions to problems, especially in the context of research. The writer conducted ABC analysis using Microsoft Excel, then performed Time Series Forecasting consisting of methods, Moving Average, SES (Single et al.), DES (Double et al.) or Holt's Method, Linear Exponential Smoothing (Winter Method), and Linear Trend using Minitab 22. After obtaining the Forecasting results, the researcher looked for the smallest MAD, MSE, and MAPE values to determine the best Product Forecasting.

Result and Discussion

ABC Analysis

This research used ABC analysis to determine which product variants will be sampled for each Forecasting method. Forecasting is not possible for all product variants because the products sold at PT Mama Fuji Group have more than 20 variants. The parameter that is used as a reference in ABC analysis in this study is the investment value to determine the product's importance level.

Table 1. Products with the Highest Investment Value

Name of Product	Product Code	Investment Value	Investment Presentation	Category
Mamafuji - Rendang Padang Asli 700gr	RNDG700	7.213.963.930	28,14	A
Mamafuji - Kue Bawang Original 750gr	KB0002	3.845.622.354	15,00	A
Mamafuji - Kue Bawang Original 250gr	KB0001	2.858.275.709	11,15	A
Mamafuji - Rendang Daging 350gr	RNDGMINI	1.852.081.479	7,22	A

Mamafuji - Dendeng DNDNG160	1.067.872.977	4,17	A
Balado Kering			
Total		65,68%	

Souce: *Processed Secondary Data (2024)*

Components belonging to category A are the most important category in the production process. Thus, product availability must be guaranteed at all times. Reports on product expenditures and remaining stocks should be appropriately recorded, and Product Forecasting quantities for the next period should be attempted to be close to actual needs. Based on the results of ABC analysis, the 5 (five) products that are the top ranking are products with codes RNDG700, KB0002, KB0001, RNDGMINI, and DNDNG160. The percentage of these five product variants contributes 65.68% of the total investment value, which means that these five product variants are the top products of PT Mama Fuji Group.

Forecasting of Rendang Padang Asli 700gr Product (RNDG700)

The sales trend of RNDG700 for July 2022 - September 2023 is shown in Figure 4.



Figure 4. Sales Data Pattern RNDG700

Based on the figure above, the sales data pattern for RNDG700 products is classified as a seasonal data pattern, with the highest sales occurring in March 2023 and the lowest in July 2022. For RNDG7 products, this drastic increase in sales patterns occurred during Ramadan and the end of the year. Since public consumption increases during these months, people tend to consume delicious food from Ramadan to Eid al-Fitr.

The results of the Forecasting analysis indicated that the Winter Method has the most minor error value compared to the other four methods. The Winter Method has a MAPE of 1.16%, MAD of 15.37, and MSD of 2090.63. A low MAPE signified a high level of accuracy in predicting the actual value. By choosing a Forecasting with MAPE below 5%, the writer can ensure higher prediction accuracy. It is helpful for proper planning and decision-making. The Linear Exponential Smoothing (Winter Method) model is also suitable for the RNDG700 product dataset as it handles seasonal patterns correctly. The following is a comparison of the Forecasting results of Rendang Padang Asli 700gr (RNDG700) using 5 Time Series methods:

Table 2. Product Forecasting Results RNDG700 Jul 2022 – Sep 2023

Period	Actual Data RNDG700	MA	SES	Holt's	Winter	Trend
Jul-22	817	*	1307,01	517,86	883,46	2638,97
Aug-22	1763	*	1006,76	1013,57	1598,86	2605,50
Sep-22	2381	1653,67	1470,14	1397,94	2381,00	2572,02
Oct-22	2715	2286,33	2028,27	2030,07	2715,00	2538,55
Nov-22	3096	2730,67	2449,06	2505,32	3096,00	2505,08
Dec-22	4014	3275,00	2845,47	2951,37	4014,00	2471,61
Jan-23	1648	2919,33	3561,49	3762,74	1648,00	2438,14
Feb-23	3876	3179,33	2389,00	2389,20	3876,00	2404,67
Mar-23	4822	3448,67	3300,16	3442,65	4822,00	2371,20
Apr-23	4030	4242,67	4232,67	4501,28	4030,00	2337,72
May-23	969	3273,67	4108,48	4328,76	969,00	2304,25
Jun-23	1626	2208,33	2184,77	2091,66	1626,00	2270,78
Jul-23	1170	1255,00	1842,38	1714,34	1170,00	2237,31
Aug-23	1490	1428,67	1430,38	1256,11	1490,00	2203,84
Sep-23	1653	1437,67	1466,91	1317,55	1653,00	2170,37
	MAPE	39	56	57	1,16	58
	MAD	697	960	984	15,37	1057
	MSD	856401	1519052	1622701	2090,63	1506636

Source: Processed using Minitab 22 software

Description: MA = *Moving Average Model*

SES = *Single Exponential Smoothing Model*

Holt's = *Double Exponential Smoothing Model (Holts Method)*

Winter = *Linear Exponential Smoothing Model (Winter Method)*

Trend = *Trend Linear Model*

Moreover, to evaluate the accuracy of Forecasting, the writer has compared the Forecasting from Winter model with actual data for the next month, which is October 2023 to oversee the performance of Winter could predict the behavior in actual data in the following Table 3.:

Table 3. Comparison of Actual Data and Forecasting of RNG700 Products

Period	Actual Data RNDG700	MA	SES	Holt's	Winter	Trend
Oct'23	838	1437,67	1580,94	1463,42	790,465	2136,90

Source: Processed using Minitab 22 software

Description: MA = *Moving Average Model*

SES = *Single Exponential Smoothing Model*

Holt's = *Double Exponential Smoothing Model (Holts Method)*

Winter = *Linear Exponential Smoothing Model (Winter Method)*

Trend = *Trend Projection Model*

Forecasting in Winter Method showed data that is closed to actual data. It indicated that Winter Method is quite effective in handling seasonal component and trend component from the observed time data and able to give the accurate estimation and close to the real condition of existing seasonal data.

Forecasting of Kue Bawang Original 750gr Product (KB0002)

Then, the sales trend of product KB0002 for the period July 2022 - September 2023 can be seen in Figure 5. as follows:

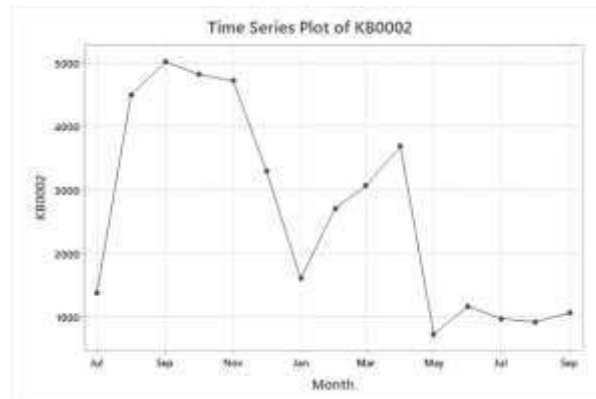


Figure 5. Sales Data Pattern KB0002

Based on the figure above, it can be noted that the sales data pattern for product KB0002 is classified as a seasonal data pattern, for which the highest sales occurred in September 2022, and the lowest sales occurred in May 2023.

Forecasting results indicated that the Winter Method has the most minor error value among the 5 methods above, including the MAPE value of 8%, the MAD value of 230, and the MSD value of 528729. Thus, based on the smallest MAPE, MAD, and MSD values, the Winter Method is the best method for Forecasting KB0002 product sales. The following is the Forecasting result of Kue Bawang Original 750gr (KB0002) products using 5 Time Series methods:

Table 4. Result of Product Forecasting KB0002 Jul 2022-Sep 2023

Period	Actual Data KB0002	MA	SES	Holt's	Winter	Trend
Jul-22	1374	*	1495,08	4348,37	2094,93	4348,37
Aug-22	4501	*	1378,66	4074,71	1778,65	4104,75
Sep-22	5016	3630,33	4380,85	3835,11	5016,00	3861,14
Oct-22	4818	4778,33	4991,56	3603,16	4818,00	3617,52
Nov-22	4720	4851,33	4824,68	3371,68	4720,00	3373,91
Dec-22	3301	4279,67	4724,03	3141,67	3301,00	3130,30
Jan-23	1602	3207,67	3355,76	2899,78	1602,00	2886,68
Feb-23	2714	2539,00	1669,48	2643,20	2714,00	2643,07
Mar-23	3064	2460,00	2673,81	2400,31	3064,00	2399,45
Apr-23	3684	3154,00	3048,99	2163,41	3684,00	2155,84
May-23	725	2491,00	3659,56	1935,23	725,00	1912,22
Jun-23	1167	1858,67	837,92	1679,62	1167,00	1668,61
Jul-23	973	955,00	1154,34	1430,94	973,00	1425,00
Aug-23	921	1020,33	979,98	1182,76	921,00	1181,38
Sep-23	1066	986,67	923,27	936,52	1066,00	937,77
	MAPE	40	53	50	8	50
	MAD	623	870	895	230	888
	MSD	751141	1715470	1347110	528729	1333454

Source: Processed using Minitab 22 Software

Description: MA = Moving Average Model
 SES = Single Exponential Smoothing Model
 Holt's = Double Exponential Smoothing Model (Holt's Method)
 Winter = Linear Exponential Smoothing Model (Winter Method)
 Trend = Trend Linear Model

Furthermore, to evaluate the accuracy of the Forecasting, the author compares the Forecast from the Winter model with the actual data in the following month, October 2023, to see how well it can predict the behavior in the actual data in Table 5. below:

Table 5. Actual Data Comparison and Product Forecasting of KB0002

Period	Actual Data	MA	SES	Holt's	Winter	Trend
	KB0002					
Oct'23	1130	986,667	1060,51	694,197	1098,38	694,152

Source: Processed using Minitab 22 software

Description :
 MA = *Moving Average Model*
 SES = *Single Exponential Smoothing Model*
 Holt's = *Double Exponential Smoothing Model (Holt's Method)*
 Winter = *Linear Exponential Smoothing Model (Winter Method)*
 Trend = *Trend Linear Model*

Forecasting in Winter Method showed data that is closed to actual data than the other five models. It indicated that the Winter Method is quite effective in accurately estimating and approaching the exact conditions of the existing seasonal data patterns. Thus, the writer can prove that the Winter Method works appropriately for the product characteristics of KB0002

Forecasting of Kue Bawang Original 250gr Product (KB0001)

The sales trend of product KB0001 for the period July 2022 - September 2023 can be seen in Figure 6. as follows:

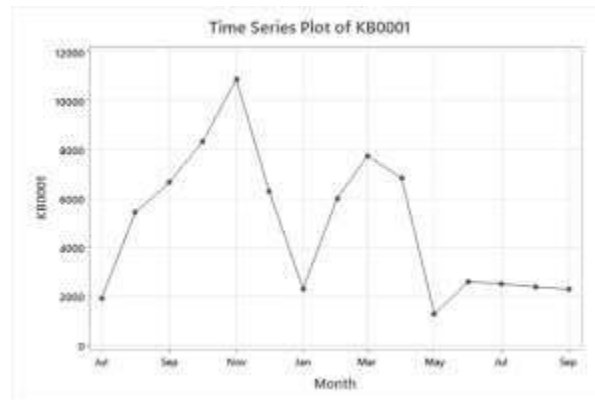


Figure 6. Sales Data Pattern KB0001

Based on the figure above, the sales data pattern for product KB0001 is classified as a seasonal data pattern, with the highest sales occurring in November 2022 and the lowest sales occurring in May 2023.

The following are the results of Forecasting 250gr Original Onion Cake (KB0001) products using 5 Time Series method:

Table 6. Product Forecasting Result of KB0001 Jul 2022 – Sep 2023

Period	Actual Data KB0001	MA	SES	Holt's	Winter	Trend
Jul-22	1918	*	1153,6	6923,44	2585,3	6923,44
Aug-22	5432	*	2096,3	6581,83	3260,9	6632,39
Sep-22	6648	*	6210,0	6278,67	6648,0	6341,33
Oct-22	8294	6688,63	6750,2	5990,73	8294,0	6050,28
Nov-22	10843	7910,13	8654,1	5722,36	10843,0	5759,23
Dec-22	6279	7473,25	11353,5	5482,67	6279,0	5468,17
Jan-23	2306	6643,00	5095,4	5199,83	2306,0	5177,12
Feb-23	5994	5966,25	1655,4	4879,79	5994,0	4886,07
Mar-23	7729	5643,88	7005,9	4599,94	7729,0	4595,01
Apr-23	6814	5581,38	7897,6	4340,56	6814,0	4303,96
May-23	1271	5027,50	6561,3	4074,87	1271,0	4012,91
Jun-23	2598	3949,63	37,1	3756,12	2598,0	3721,85
Jul-23	2502	2742,13	3195,3	3453,71	2502,0	3430,80
Aug-23	2381	2314,38	2340,3	3153,28	2381,0	3139,75
Sep-23	2282	2314,38	2390,5	2854,56	2282,0	2848,69
	MAPE	55	66	64	5	63
	MAD	1572	2065	2041	189	2026
	MSD	4440333	7211290	6348710	343931	6283967

Source: Processed using Minitab 22 software

Description: MA = Moving Average Model
SES = Single Exponential Smoothing Model
Holt's = Double Exponential Smoothing Model (Holt's Method)
Winter = Linear Exponential Smoothing Model (Winter Method)
Trend = Trend Linear Model

Forecasting analysis results indicated that the Winter Method has the most minor error value among the five methods observed. The Winter Method has a MAPE value of 5%, MAD of 189, and MSD of 836720. Thus, based on these values, it can be inferred that the Winter Method is the best method to forecast the sales of product KB0001. It is also the same for the RNDG700 product, where a low MAPE indicated higher accuracy in predicting the actual value. By using a Forecasting with a MAPE below 5%, the writer can ensure a lower error rate and a more accurate prediction. It is essential for proper planning and decision-making.

To evaluate the accuracy of the Forecasting, the writer compared the forecast from the Winter model with the actual data in the following month, October 2023, to observe how well the Winter model can predict the behavior in the actual data in the following Table 7:

Table 7. Actual Data Comparison and Product Forecasting of KB0001

Period	Actual Data KB0001	MA	SES	Holt's	Winter	Trend
Oct'23	1942	2314,38	2256,70	2557,78	1684,36	2557,64

Source: Processed using Minitab 22 software

Description: MA = Moving Average Model
SES = Single Exponential Smoothing Model
Holt's = Double Exponential Smoothing Model (Holt's Method)
Winter = Linear Exponential Smoothing Model (Winter Method)

Forecasting in Winter Method showed data that is closed to actual data than the other five models. It proved that the Winter Method worked properly for the KB0001 product characteristics.

Forecasting of Rendang Daging 350gr Product (RNDGMINI)

The sales trend of RNDGMINI products for the period July 2022 - September 2023 can be seen through Figure 7. is as follows:

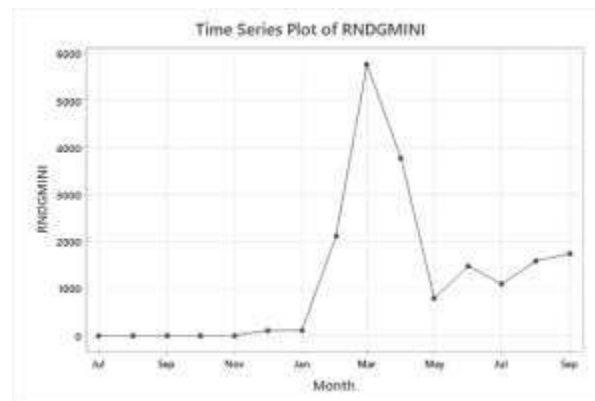


Figure 7. Sales Data Pattern RNDGMINI

Based on the figure above, the conclusion is the sales data pattern for RNDGMINI products is classified as a seasonal data pattern. Although this product was only available in November 2022, the trend is increasing monthly. The increasing trend of product sales indicated that RNDGMINI products are recognized and preferred by consumers.

The forecasting result indicated that despite its high error value, the Winter Method is a viable option for predicting RNDGMINI product sales. With a MAPE of 25%, MAD of 444, and MSD of 424688, the Winter Method's potential is evident. Its use is particularly beneficial in the context of limited historical data and significant product fluctuations, offering promising prospects for future use. The following is the Forecasting result of Rendang Daging 350gr product (RNDGMINI) using 5 Time Series method:

Table 8. Product Forecasting Result of RNDGMINI Jul 2022-Sep 2023

Period	Actual Data RNDGMINI	MA	SES	Holt's	Winter	Trend
Jul-22	0	*	0,00	0,00	0,00	0,00
Aug-22	0	*	0,00	0,00	0,00	0,00
Sep-22	0	0,00	0,00	0,00	0,00	0,00
Oct-22	0	0,00	0,00	0,00	0,00	0,00
Nov-22	0	0,00	0,00	0,00	0,00	0,00
Dec-22	107	35,67	147,61	-40,80	64,33	889,02
Jan-23	107	71,33	69,83	-63,30	105,99	1061,88
Feb-23	2113	775,67	141,02	-38,84	2578,71	1234,73
Mar-23	5750	2656,67	3917,89	3901,69	7586,23	1407,59
Apr-23	3758	3873,67	7426,87	7279,60	4981,01	1580,45
May-23	788	3432,00	399,99	84,57	301,67	1753,30
Jun-23	1475	2007,00	1143,13	1172,95	1103,90	1926,16
Jul-23	1094	1119,00	1778,75	1480,71	1098,31	2099,02
Aug-23	1582	1383,67	467,27	433,47	1824,61	2271,88
Sep-23	1747	1474,33	2602,28	2411,42	2124,69	2444,73
	MAPE	62	55	78	25	213
	MAD	640	793	799	444	986
	MSD	1443460	1573589	1549998	424688	1999072

Source: Processed using Minitab 22 software

Description:

MA = Moving Average Model

SES = Single Exponential Smoothing Model

Holt's = Double Exponential Smoothing Model (Holts Method)

Winter = Linear Exponential Smoothing Model (Winter Method)

Trend = Trend Linear Model

However, to evaluate the accuracy of the method, the writer compared the forecast of the Winter model again in the following month, October 2023, to see how properly the Winter model can predict actual sales in Table 9:

Table 9. Actual Data Comparison and Product Forecasting of RNDGMINI

Period	Actual Data RNDGMINI	MA	SES	Holt's	Winter	Trend
Oct'23	1909	1474,33	964,190	828,777	1632,89	2617,59

Source: Processed using Minitab 22 software

Description: MA = Moving Average Model

SES = Single Exponential Smoothing Model

Holt's = Double Exponential Smoothing Model (Holts Method)

Winter = Linear Exponential Smoothing Model (Winter Method)

Trend = Trend Linear Model

Although the Winter Method still has a significant error value, the Forecasting results indicated that the data that is close to the actual data is the Winter model. It proved that Winter's method works appropriately for RNDGMINI product characteristics.

Forecasting of Dendeng Balado Kering Pedas Product (DNDNG160)

The sales trend of DNDNG160 products for the period July 2022 - September 2023 can be seen through Figure 8.

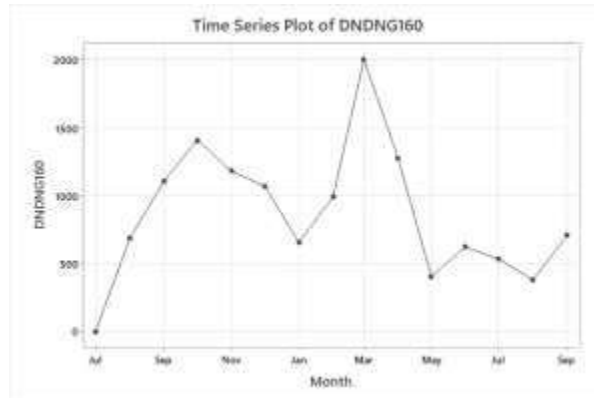


Figure 8. Sales Data Pattern DNDNG160

Based on the figure above, the conclusion is that the sales data pattern for DNDNG160 products is classified as a seasonal data pattern, in which the highest sales occur in March 2023, which is the month of Ramadan to Eid al-Fitr.

The following is the Forecasting result of dendeng balado kering pedas kriuk (DNDNG160) product using 5 Time Series method:

Table 10. Product Forecasting Result DNDNG160 Jul 2022 – Sep 2023

Period	Actual Data DNDNG160	MA	SES	Holt's	Winter	Trend
Jul-22	0	*	0	955,175	0	955,175
Aug-22	687	*	656,66	933,103	861,42	942,750
Sep-22	1106	*	716,33	918,097	780,53	930,325
Oct-22	1409	948,00	1482,74	907,449	1409,00	917,900
Nov-22	1180	1143,63	1337,71	899,989	1180,00	905,475
Dec-22	1072	1135,63	1027,52	890,341	1072,00	893,050
Jan-23	657	1027,00	1115,00	879,727	657,00	880,625
Feb-23	989	1077,00	214,20	865,048	989,00	868,200
Mar-23	2000	1204,88	1738,08	853,847	2000,00	855,775
Apr-23	1275	1198,88	2253,23	852,983	1275,00	843,350
May-23	406	1121,63	329,24	844,921	406,00	830,925
Jun-23	622	892,38	480,21	828,204	622,00	818,500
Jul-23	533	597,13	759,09	813,795	533,00	806,075
Aug-23	380	522,88	314,42	798,611	380,00	793,650
Sep-23	707	522,88	443,40	782,007	707,00	781,225
MAPE		37	31	41	3,92	41
MAD		272	308	379	35,71	376
MSD		137017	175525	228187	9739,75	225849

Source: Processed using Minitab 22 software

Description: MA = Moving Average Model
SES = Single Exponential Smoothing Model
Holt's = Double Exponential Smoothing Model (Holt's Method)
Winter = Linear Exponential Smoothing Model (Winter Method)
Trend = Trend Linear Model

Forecasting results showed that the smallest error value of the six methods above is the error value of the Winter Method, including the MAPE value of 3.92%, the MAD value of 35.71, and the MSD value of 9739.75. Thus, based on the smallest MAPE, MAD, and MSD values, the Winter Method is the best method for Forecasting DNDNG160 product sales.

To evaluate the accuracy of the Winter forecast, the writer compared the forecast again using actual data in the following month, October 2023, to see how properly the Winter model can predict behavior in actual data in the following Table 11:

Table 11. Actual Data Comparison and Product Forecasting of DNDNG160

Period	Data Actual DNDNG160	MA	SES	Holt's	Winter	Trend
Oct'23	549	522,875	961,847	768,832	620,128	768,8

Source: Processed using Minitab 22 software

Description: *MA = Moving Average Model*
SES = Single Exponential Smoothing Model
Holt's = Double Exponential Smoothing Model (Holts Method)
Winter = Linear Exponential Smoothing Model (Winter Method)
Trend = Trend Linear Model

Forecasting results showed that the Winter and Moving Average methods are close to the actual data. Still, a Forecasting with a MAPE value below 5% is more advisable, even though the actual data is close to the forecast with MAPE value above 5%. This is because a low MAPE indicates a higher level of accuracy in predicting the actual value. Although a Forecasting with a MAPE above 5% is closer to the actual data, the Forecasting still has a higher error rate than a forecast below 5%. Therefore, the writer can prove that the Winter method works appropriately for the product characteristics of DNDNG160.

Forecasting Method Recapitulation

Based on the results of data processing that has been conducted using Minitab 22 software on five item codes, namely RNDG700, KB0001, KB0002, RNDGMINI, and DNDNG160, they are recapitulated in the following Table:

Table 12. Forecasting Time Series Method Recapitulation Result

No	Item Code	Method	MAPE	MADE	MSE
1	RNDG700	<i>Moving Average</i>	39	697	856401
		<i>Single Exponential Smoothing</i>	56	960	1519052
		<i>Double Exponential Smoothing (Holts Method)</i>	57	984	1622701
		<i>Linear Exponential Smoothing (Winter)</i>	1,16	15,37	2090,63

		Method)			
2	KB0002	<i>Trend Linear</i>	58	1057	1506636
		<i>Moving Average</i>	40	623	751141
		<i>Single Exponential Smoothing</i>	53	870	1715470
		<i>Double Exponential Smoothing (Holts Method)</i>	50	895	1347110
		<i>Linear Exponential Smoothing (Winter Method)</i>	8	230	528729
3	KB0001	<i>Trend Linear</i>	50	888	1333454
		<i>Moving Average</i>	55	1572	4440333
		<i>Single Exponential Smoothing</i>	66	2065	7211290
		<i>Double Exponential Smoothing (Holts Method)</i>	64	2041	6348710
		<i>Linear Exponential Smoothing (Winter Method)</i>	5	189	543931
4	RNDGMINI	<i>Trend Linear</i>	63	2026	6283967
		<i>Moving Average</i>	62	640	1443460
		<i>Single Exponential Smoothing</i>	55	793	1573589
		<i>Double Exponential Smoothing (Holts Method)</i>	78	799	1549998
		<i>Linear Exponential Smoothing (Winter Method)</i>	25	444	424688
5	DNDNG160	<i>Trend Linear</i>	213	986	19999072
		<i>Moving Average</i>	37	272	13701
		<i>Single Exponential Smoothing</i>	31	308	175525
		<i>Double Exponential Smoothing (Holts Method)</i>	41	379	228187
		<i>Linear Exponential Smoothing (Winter Method)</i>	3,92	35,71	9739,75
		<i>Trend Linear</i>	41	376	225849

Based on the results of data processing with Minitab 22 software, it showed that item code RNDG700 has the most minor percentage error in the Winter Method of Forecasting method in which the resulting MAPE value is 1.16%, while for methods KB0001, KB0002, RNDGMINI, and DNDNG160 resulted in the most minor percentage error through the Winter Method.

Conclusion

The results of ABC analysis showed that the five products with the highest rank in class A are those with item codes RNDG700, KB0001, KB0002, RNDGMINI, and DNDNG160. The percentage of these five product variants contributed 65.68% of the total investment value, in which these five product variants are the top products of PT Mama Fuji Group. This underscores the significant role these products play in our operations. Implementing the Winter Method is the best method with the most minor percentage error for all items. The MAPE value generated by each item is RNDG700 at 1.16%, KB0002 at 8%, KB0001 at 5%, RNDGMINI at 25%, and DNDNG160 at 3.92%.

Suggestions

Based on the results of the conducted research, the suggestions are as follows:

1. PT Mama Fuji Group should consider the analysis of the results, which indicates that the Winter Method, with its consistently low percentage error across all items, is the most effective Forecasting tool. It is recommended to implement this method widely in the Forecasting process for the products of PT Mama Fuji Group. The Winter Method has proven its worth by consistently producing low MAPE values for our superior products, such as RNDG700, KB0001, KB0002, RNDGMINI, and DNDNG160, potentially leading to improved Forecasting accuracy and reduced inventory costs.
2. In addition to improving Forecasting methods, PT Mama Fuji Group should consider promotional strategies to increase sales of slow-moving products. Appropriate promotional activities help reduce the risk of excessive inventory accumulation and improve product liquidity.

References

- Alfiani, T. (2020). *Perbandingan metode Double Exponential Smoothing dan Trend Analysis: Studi kasus peramalan pada jumlah penduduk Kota Samarinda*. Universitas Islam Negeri Maulana Malik Ibrahim.
- Arrajiy, A. (2022). *Aplikasi Minitab untuk Statistisi Pemula*. Gemala.
- Bimantoro, F. A., Madelan, S., & Saluy, A. B. (2021). Forecasting With Time Series Method at PT RSM in Bekasi Jawa Barat. *Dinasti International Journal of Economics, Finance & Accounting*, 2(3), 273–282.
- Chopra, S., & Meindl, P. (2015). *Supply Chain Management: Strategy, Planning, and Operation* (6 ed.). Pearson Education Ltd.
- Doddy, A. (2019). *Pengendalian Persediaan Parts dengan Analisis Klasifikasi Persediaan, Forecasting, Safety Stock & Maksimum Stock Level beserta Analisis Dampaknya terhadap Inventory KPI di PT KMS*. Universitas Mercu Buana.
- Heizer, J., & Render, B. (2015). *Manajemen Operasi*. Salemba Empat.
- Hidayatullah, M. C., & Yudoko, G. (2016). Demand Forecasting analysis using time series methods at Ayam Lodho Pak Yusuf restaurant. *ICEBESS*, 375–381.
- Hyndman, R. J., & Athanasopoulos, G. (2018). *Forecasting : Principles and Practice* (2 ed.). O Texts.

- Indrasetyaningih, A., Damayanti, I., & Susanto, T. (2017). Analisis arima box jenkins untuk peramalan jumlah kunjungan wisatawan mancanegara di Indonesia. *Seminar Nasional Matematikadan Aplikasinya*.
- Izzatul, M. (2022). *Aktivitas Keseharian Bapak Edi Sebagai Satpam Palang Kereta Dalam FotoCerita*. Politeknik Negeri Media Kreatif.
- Jonnius, O., Fakultas, D., Hukum, I., Suska, U. I. N., Tahunan, P., Aktivitas, I., & Terpilih, E. (2012). Analisis Forecasting Penjualan Produk Perusahaan Pendahuluan. *kutubkhanah*, 15(2), 129–137. <https://doi.org/http://dx.doi.org/10.24014/kutubkhanah.v15i2.236>
- Kusnadi, E. (2009). *Analisis produktivitas terhadap penyeimbangan lintasan*. Universitas MercuBuana, Jakarta.
- Kusumawati, A., & Setiawan, dwi agung. (2017). Analisis Pengendalian Persediaan Bahan Baku Tempe Menggunakan Material Requirement Planning. *Journal Industrial Servicess*, 3(1),168– 173.
- Lailany, R. S., & Wicaksono, P. A. (2024). USULAN PERBAIKAN FORECASTING DEMANDPRODUK OBAT X DAN Y DENGAN METODE TIME SERIES (STUDI KASUS PT . PHAPROS Tbk.SEMARANG). *Industrial Engineering Online Journal*, 1–17.Machali, I. (2021). *Metode penelitian kuantitatif : panduan praktis merencanakan, melaksanakan, dan analisis dalam penelitian kuantitatif*. Fakultas Ilmu Tarbiyah dan Keguruan Universitas IslamNegeri (UIN) Sunan Kalijaga.
- Ngantung, M., Jan, A. H., Peramalan, A., Obat, P., Ngantung, M., & Jan, A. H. (2019). *AnalysisForecasting of Antibiotic Drug Request*. 7(4), 4859–4867.
- Reid, R. D., & Sanders, N. R. (2019). *Operations management: an integrated approach*. John Wiley & Sons.
- Riani, L. P., & Afandi, M. R. (2020). Forecasting demand produk batik di tengah pandemi COVID-19 studi pada Usaha Batik Fendy, Klaten. *Jurnal Nusantara Aplikasi Manajemen Bisnis*, 5(2), 122–132.
- Rosalin, F., & Kawedar, W. (2011). *Faktor-Faktor yang Mempengaruhi Keandalan dan Timeliness Pelaporan Keuangan Badan Layanan Umum (Studi pada BLU di Kota Semarang)*. UniversitasDiponegoro.
- Silalahi, F. D., Rozikin, K., Rutdjiono, D., & Setiawan, N. D. (2021). Pemanfaatan Metode Moving Average Dalam Sistem Informasi Pendukung Keputusan Pembelian Barang BerdasarkanPeramalan Penjualan Dengan Berbasis Web. *Elkom: Jurnal Elektronika dan Komputer*, 14(2),198–207.
- Siswanto, E., Wibawa, E. S., & Mustofa, Z. (2021). Implementasi Aplikasi Sistem Peramalan Persediaan Barang Menggunakan Metode Single Moving Average Berbasis Web. *Elkom: JurnalElektronika dan Komputer*, 14(2), 224–233.
- Sudarismiati, A., & Sari, M. T. (2019). Analisis Peramalan Penjualan Untuk Menentukan RencanaProduksi Pada UD Rifa'i. Growth. *Jurnal Ekonomi dan Bisnis Growth*, 14(2), 17–30.
- Sugiyanto, L. A. (2023). *Peramalan Permintaan Ditengah Pandemi Covid-19 pada Industri Automotive Tier 2 Menggunakan Metode Forecast Exponential Smoothing serta Pengaruhnya terhadap Penentuan Cost Produksi*. Universitas Mercu Buana Jakarta.
- Sugiyono. (2012). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. alfabeta.

- Tarwiyah, T., Irawan, A., Suryati, L., & Julfizar, J. (2022). Pelatihan Metode Pareto Bagi Siswa SMK Immanuel Untuk Meningkatkan Produktifitas Belajar. *Pubarama: Jurnal Publikasi Pengabdian Kepada Masyarakat*, 2(6), 13–15.
- Wahyuni, M. F. (2015). *Analisis Nilai Overall Equipment Effectiveness (Oee) sebagai Dasar untuk Perbaikan Efektivitas Kerja Mesin Cut Off di Plant X PT ABC*. Bakrie University.