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Analysis Of Tofu Sales Forecasting Using The Single Exponential Smoothing Method At UD. Tahu Murni, Gunungsitoli City

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ABSTRACT

The development of the business world, especially in the food sector, is increasingly competitive, encouraging companies to improve the quality and quantity of sales. UD. Tahu Murni, which operates in Gunungsitoli City, faces the challenge of fluctuating market demand that can result in overstock and stockout. This study aims to analyze tofu sales forecasting using the Single Exponential Smoothing (SES) method. This method was chosen because of its ability to provide accurate estimates on data without clear trends. This study uses a quantitative approach with descriptive analysis of historical sales data. The forecasting results show that an alpha (α) value of 0.9 produces a sales estimate of 238,014 pieces with the lowest error (MAPE 0.83%). This finding indicates that SES is effective in predicting sales and supporting inventory management at UD. Tahu Murni. The proposed recommendations include the use of the SES method routinely, periodic monitoring, and training for human resources. With these steps, UD. Tahu Murni can improve operational efficiency and competitiveness in the soy-based food market.

INTRODUCTION

The development of the business world today has a very sharp level of competition in the business industry, including companies in Indonesia. The increasingly rapid changes in public tastes and the rapid progress of industry, companies are required to strive to improve the quality and quantity of their production sales with the aim of maximizing the profits to be obtained in order to match the company's expected achievement targets. The tight competition in the business world has spread to all business fields, where companies are stressed to face sales problems that may occur in managing their business. The obstacles in question can be in the form of a lack of consumer interest, a lack of appropriate and innovative business strategies, and competition from other companies.

The soy-based food industry, especially tofu, has an important role in meeting the food needs of the community. UD. Tahu Murni is one of the businesses engaged in the production

and sale of tofu products located in the Nias Islands, located in Gunungsitoli City. As one of the food products that has quite high demand in the community, tofu has a large market potential. However, fluctuations in market demand are often a challenge for UD. Tahu Murni in planning production and managing inventory. Inaccuracy in sales forecasting causes overstock and stockout, which has the potential to cause financial losses and lose customers. Sales forecasting is a crucial aspect in business management, especially for small and medium industries such as UD. Tahu Murni which is engaged in the production and sale of tofu. Accurate forecasting helps companies manage inventory, reduce storage costs, and increase customer satisfaction by ensuring consistent product availability. One method that is often used for sales forecasting is the Single Exponential Smoothing (SES) method.

The ability to predict or Forecast is one of the techniques that can help capital market players to determine the basis for strategic decisions that can give them an advantage. A scientific estimate of the future will be much more meaningful than an intuitive estimate alone. Therefore, sales forecasting is very necessary in the business world, in order to increase profits and become a benchmark for the success of a company. Some of the obstacles that researchers found at UD. Tahu Murni are the number of tofu product sales at UD. Tahu Murni fluctuates every year, due to the number of consumer needs influenced by the economy and seasonal changes needed by consumers. Factors that cause the number of sales to decline result in losses so that entrepreneurs get a thin profit. Therefore, the company wants to know how many products are produced in each subsequent period. The number of goods ordered greatly affects the sustainability of a company to become more developed.

LITERATURE REVIEW

Forecasting

Forecasting is the initial part of a decision-making process. Before making a forecast, it must first be known what the actual problem is in the decision-making process. Every decision-making concerning future conditions, there must be a forecast that underlies the decision-making. Forecasting is a business function that attempts to predict the sales and usage of a particular product so that the product can be produced in appropriate quantities. Forecasting involves estimating future demand, based on a variety of forecast variables that often use historical data in the form of time series. Forecasting is the process of estimating how much of the future requirements, including the quantity, timing, and location aspects, are needed to satisfy the demand for goods or services. Forecasting methods can be divided into two, namely (Firmansyah and Merlina 2020; Nugraha et al. 2016; Oktafia, Wijaya, S, et al. 2022; Srikanti et al. 2018): Qualitative or subjective forecasting methods, namely: 'Qualitative forecasting techniques relied on human judgments and intuition more than manipulation of past historical data Methods that are based solely on judgments and intuition, not on the processing of historical data.Quantitative forecasting methods, namely : 'Quantitative techniques that need no input of judgements, they are mechanical procedures that produce quantitative results and some quantitative procedur esrequire much more sophisticated Sales Transactions manipulation of data than doother' Quantitative techniques require no input of judgements, they are mechanical procedures that produce quantitative results and some quantitative procedur esrequirem uch more sophisticated data manipulation.

Forecasting objectives

Forecasting has been widely used and helpful in various cases in management, as support in planning, monitoring, and decision making. The main purpose of forecasting is to provide information that can help make better decisions. Some specific purposes of forecasting include:

1 Production planning: determining the amount of product to be produced to meet market demand.

2 Inventory management: Optimizing inventory levels to reduce storage costs and the risk of stockouts.
3 Budgeting: Assisting in the preparation of more accurate budgets based on revenue and cost predictions.
4 Marketing strategy: Directing marketing strategies based on market demand predictions and market trends.

Sales Forecasting

Sales forecasting is the process of predicting the amount of product sales in the future based on historical data and trend analysis. Accurate forecasting is essential for companies to plan production, procurement of raw materials, and marketing strategies. Various methods can be used for sales forecasting. Including quantitative and qualitative methods. One popular quantitative method is the Single Exponential Smoothing method. Sales forecasting can be done using qualitative and quantitative methods, depending on the situation and data availability. This sales concept assumes that consumers generally show a refusal to buy products so that they must be persuaded to buy the product. This sales concept assumes that companies have various ways to make sales by using sales and promotional tools so as to attract consumers to buy the products produced.

1. Qualitative Method
   This method is more subjective and is often used when historical data is inadequate or irrelevant.
2. Quantitative Method
   This method is based on historical data and statistical analysis to predict future sales patterns.

The Importance Of Sales Forecasting

Sales forecasting is the process of estimating the number of products or services that will be sold in a certain period in the future. This forecast is very important for businesses because it can help:

1) Make strategic decisions
   Sales forecasting can be used to determine production levels, inventory, staff, and marketing budgets.
2) Increase company efficiency
   By knowing the estimated demand, businesses can optimize production and distribution processes and reduce waste and costs.
3) Increase Profitability
   Accurate sales forecasting can help businesses maximize profits by setting the right prices and offering effective promotions.

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Metode Single Exponential

Single Exponential Smoothing is a forecasting technique that uses a weighted average to smooth out data fluctuations and identify long-term trends. This method is best suited for data that does not have a strong seasonal pattern. The Single Exponential Smoothing method refers to an approach where older observed values are exponentially decreasing.

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The parameter α (smoothing constant) chosen is key in the estimation process. If the data sequence evolves steadily over time, it is important to give a higher level of weight to the most recent actual values. Conversely, if the data sequence tends to be unstable, it is important to give a lower weight to the most recent actual data.

Previous Research

In a study, it is necessary to include the results of previous research that has been conducted. The results of previous research that has been conducted are as follows: First in the study (Arridho & Astuti, 2020), Application of the Single Exponential Smoothing Method to Predict Catering Sales at Kedai Pojok Kedaung. Based on the research that has been conducted and described, and referring to several theories, it can be concluded that from the total data of 11 periods, testing was carried out using the MAD (Mean Absolute Deviation) and MAPE (Mean Absolute Percentage Error) methods and an error accuracy value of 26.77% was obtained using a weighting value of α (alpha) 0.3.

This figure can change for the better or worse in terms of accuracy by adding or subtracting both the number and amount of sales data. The results of a prediction are not a value that will definitely occur in the future period. Given the many factors in the field that sometimes influence the final results. Such as the influence of many changes in selling prices at certain times Second, in Risqiati Risqiati's research (2023), Application of the Single Exponential Smoothing Method in Forecasting Yarn Sales.

This study produced a sales forecast value of 185 balls with a Mean Absolute Deviation (MAD) value of 19, Mean Squared Error (MSE) of 1209, and Mean Absolute Percentage Error (MAPE) of 8%. This shows that this method is quite accurate in predicting sales of goods depending on the selection of the right smoothing constant.

METHODS

Research Approach

According to Punch (2019), a research approach is a conceptual framework used to direct research, including philosophy, strategy, and methods. This study uses a quantitative approach with descriptive and analytical methods, aiming to analyze numerical data and produce accurate quantitative forecasts.

Research Type

Creswell & Poth (2021) categorize research types into three: quantitative, qualitative, and mixed methods. This research is applied research that focuses on the application of the Single Exponential Smoothing (SES) method to product sales.

Research Design

According to Creswell & Creswell (2021), research design is a general framework that guides data collection, analysis, and interpretation. This study uses a case study design, focusing on the analysis of historical product sales data over a certain period.

RESULTS

History of UD. Gunungsitoli City Pure Tofu

Tofu is currently very popular among Indonesian people, apart from its affordable price, it also has a high protein content. Tofu is made from quality soybeans and other raw materials that have been processed, starting from the soaking, cleaning and polishing processes. Then filter it and add vinegar to make lumps. As was done by Mr. Kristian Telaumbanua, owner of tofu business UD. Pure Tofu in Tuhemberua Ulu village, Gunungsitoli City. From the history of this tofu business itself, it was first named UD. Pure Tofu. This factory was established around 2016 and is located in Tuhemberua Ulu village, Gunungsitoli District, Gunungsitoli City, North Sumatra Province. Until now, UD. Pure Tofu has experienced an increase both in terms of production and sales even though it often faces challenges from year to year. UD. Tahu Murni has around 8 employees with different duties. Starting from the initial process to the product marketing process. UD. Tahu Murni markets its products by marketing its products to villages and around the city of Gunungsitoli with the help of transportation.

Sales Data

Tofu sales data is important information that describes business performance over time. This data includes the number of products sold, sales period, and market demand trends. The data used in forecasting is the last year's sales data, namely sales data for the period September 2023 to August 2024.

Table 1 Tofu Product Sales Data for the Period September 2023 – August 2024

No	Month	Sales
1	September, 2023	214,000
2	October, 2023	220,000
3	November, 2023	223,000
4	December, 2023	223,000
5	January, 2024	228,000
6	February, 2024	230,000
7	March, 2024	221,000
8	April,2024	232,000
9	May, 2024	229,000
10	June, 2024	234,000
11	July, 2024	240,000
12	August, 2024	238,000
Total		**2,732,000**
Average		**227,667**

Source: Author's Processing, 2024

In table 1. Shows that sales each month experience a decrease and increase in sales. In general, there is an increasing trend in sales from month to month although there is a slight decrease in certain months. The highest sales occurred in July 2024 with sales of 240,000 pieces and the lowest sales in September 2023 with sales of 214,000 piecesTo conduct sales forecasting

analysis, the author chooses 3 values of the smoothing alpha coefficient (α) to obtain a smaller error value, namely a smaller α value or close to 0, namely α = 0.1, an α value that is in the middle of 0 and 1, namely α = 0.5 and an α value close to 1, namely α = 1. The selection of the α value greatly affects the accuracy of the forecast and evaluates the forecast results based on the Mean Absolute Error Percentage (MAPE) to determine the optimal value. The calculation of the sales forecast is as follows:

α = 0,9

1. September, 2023
F_1 = 214.000

2. October, 2023
F_2 = 0,9 × 220.000 + (1 – 0.9) × 214.000
F_2 = 198.000 + 0,1 × 214.000
F_2 = 198.000 + 21.400
F_2 = 219.400

3. November, 2023
F_3 = 0,9 × 223.000 + (1 – 0,9) × 219.400
F_3 = 200.700 + 0,1 × 219.400
F_3 = 200.700 + 21.940
F_3 = 222.640

Table 2. Forecasting Results with alpha (α) = 0.9

No	Month	Sales	Forechast
1	September, 2023	214,000	214.000
2	October, 2023	220,000	219.400
3	November, 2023	223,000	222.640
4	December, 2023	223,000	222.964
5	January, 2024	228,000	227.496
6	February, 2024	230,000	229.750
7	March, 2024	221,000	221.875
8	April,2024	232,000	230.987
9	May, 2024	229,000	229.199
10	June, 2024	234,000	233.520
11	July, 2024	240,000	239.352
12	August, 2024	238,000	238.135
Total		**2,732,000**	
Average		**227,667**	
F next period			238.014

Source: Author's Processing, 2024

Table 2. Shows the overall calculation results with alpha (α) = 0.9. The calculation process is carried out sequentially and gets the final forecast results F13 of 238,014 pieces. Calculation of forecast error MSE on forecasting with alpha (α) = 0.9 MSE is calculated by summing all Error² and dividing it by the number of observations (n):

$$MSE = \frac{\sum error\ 2}{n} = \frac{3{,}307{,}336}{12} = 275{,}611.33$$

In the calculation of Mean Squared Error (MSE) for alpha (α) = 0.9, it has an error value of 275,611.33 with a forecast result of 238,014 pieces of tofu in the next period. Meanwhile, to calculate the level of accuracy, the MAPE (Mean Absolute Percentage Error) equation is used. The following are the results of the MAPE calculation:

$$MAPE = \frac{1}{n}\sum_{t=1}^{n} Xt - Ft\left(\frac{|Xt - Ft|}{Xt}\right) \times 100$$

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

$$MAPE = \left(\frac{|2{,}23|}{12}\right) \times 100 = 0{,}19\%$$

Analysis of SES Forecasting Results

Based on the forecasting results obtained with SES (Single Exponential Smoothing) using the values α = 0.1, α = 0.5, α = 0.9 are as follows:

1. Alpha (α) = 0.1 obtained forecasting in the next period is 226,762 pieces of product with forecasting errors Mean Absolute Error (MAE) = 13.238, Mean Squared Error (MSE) = 175,198,244, and Mean Absolute Percentage Error (MAPE) = 5.52%. Although there are some errors, this method still provides a fairly good estimate for the next period, namely 226,762 pieces.
2. Alpha (α) = 0.5 obtained forecast in the next period is 237,409 pieces of product with forecast error Mean Absolute Error (MAE) = 2,591, Mean Squared Error (MSE) = 6,703,881, and Mean Absolute Percentage Error (MAPE) = 1.08%. This shows that with a larger α, this method is more responsive to changes, providing more accurate results compared to a smaller α.
3. Alpha (α) = 0.9 obtained forecast in the next period is 237,409 pieces of product with forecast error Mean Absolute Error (MAE) = 1,986, Mean Squared Error (MSE) = 3,944,196, and Mean Absolute Percentage Error (MAPE) = 0.83%. Using α close to 1 gives very accurate forecasting results, this shows that the forecast is more focused on the most recent data, which results in more precise estimates for the following month.

Table 3 Forecast Error Calculation Results

No	Single Exponential Smoothing	MAE	MSE	MAPE
1	Alpha (α) = 0,1	8635	93739556	3,74%
2	Alpha (α) = 0,5	2433	7599828	1,06%
3	Alpha (α) = 0,9	425	508821	0,19%

Source: Author's Processing, 2024

From the table above, it shows that the forecasting result with the smallest percentage error is the Single Exponential Smoothing method with an alpha (α) value = 0.9 with an error value of MAE = 425, MSE = 508821, and MAPE = 0.19%. From the forecasting results, it can be seen that the value of α = 0.9 provides the best forecasting accuracy based on the lowest MAPE (Mean Absolute Percentage Error). The forecasting result with the smallest error is the right

technique for forecasting and is recommended for a company, especially UD. Tahu Murni in Gunungsitoli City.

Forecasting Accuracy Evaluation

The MAPE calculation shows that with the increasing value of α, the forecast error becomes smaller. The low MAPE value at α = 0.9 (0.19%) indicates that this method is very effective for sales forecasting at UD. Tahu Murni, and can be relied on for production planning and inventory management.

Influence of α Value:

1. α = 0.1: Models with this value tend to be more responsive to smaller errors. If the MAPE value is low at this α, it indicates that the model is sensitive to small changes in the data.
2. α = 0.5: Offers a balance between accuracy and sensitivity. The resulting MAPE value can reflect stable accuracy.
3. α = 0.9: This model focuses more on large errors, which means it can provide a better picture of forecasting when there are large fluctuations in the data.

Based on the results of the analysis, it is recommended that UD. Tahu Murni use the SES method with a value of α = 0.9 for future sales forecasting. This will help the company in planning production and optimizing inventory management, as well as minimizing the risk of shortages or excess stock. Sales forecasting using the Single Exponential Smoothing method shows that this technique is effective in predicting demand for tofu products at UD. Tahu Murni. By selecting the right α value, the company can improve forecasting accuracy and, in turn, improve operational efficiency and customer satisfaction. With the right analysis and recommendations, UD. Tahu Murni can utilize the results of this forecast for a better business strategy in the future.

DISCUSSION

Based on the analysis results, several recommendations that can be given to UD. Tahu Murni are:

1. Routine Use of the SES Method
   It is recommended to use the SES method consistently with the appropriate adjustment of the α value. Integrate the SES method into the sales forecasting process as the company's operational standard. With routine use, the company can be better prepared to face fluctuations in market demand. Although α = 0.9 showed the best results in this study, the company must continue to conduct periodic evaluations to determine the optimal α value. Any changes in sales trends or external factors (such as economic or seasonal changes) may require adjustments to the α value.
2. Periodic Monitoring and Evaluation
   Conduct periodic evaluations of forecasting results to improve data accuracy and relevance. Conduct monthly or quarterly evaluations of forecasting results by comparing actual and forecasted sales. In this way, the company can identify error patterns and optimize future forecasting. Develop a feedback system where actual sales data is examined and analyzed to improve forecasting methods. This can also include collecting data on factors that influence sales, such as promotions or changes in consumer preferences.
3. HR Training
   Conduct employee training in data management and use of forecasting tools to improve efficiency. Provide employee training on forecasting techniques and data analysis. This is important to ensure that the team has the skills needed to use forecasting methods effectively, teach employees to use data analysis software or applications that can assist in

forecasting calculations. With technology, the forecasting process will be faster and more accurate.

4. Consistent Use of the SES Method
   Companies are advised to use the SES method continuously by selecting the optimal α value.
5. Product Diversification
   Considering demand fluctuations, product diversification can be an additional strategy to increase sales.

- External Data: Integrate external data (e.g., market trends, demographic data, and economic conditions) into the forecasting model. This data can provide additional insights that strengthen forecasting results and help companies better respond to changes in demand.
- Historical Trend Analysis: Use longer sales data and consider seasonal factors or special events that can affect sales.

6. Optimizing the Production Process

- Adjusting Production Plans: Based on forecasting results, companies should be able to adjust their production plans to ensure that they can meet demand without creating overstock. This will reduce storage costs and improve operational efficiency.
- Raw Material Management: Improving raw material management to ensure sufficient availability, especially when demand increases, without sacrificing cost efficiency.

7. Adaptive Marketing Strategy

- Adjusting Marketing Strategy: Using forecasting results to inform marketing strategy. For example, if the forecast shows an increase in demand, the company can increase promotions or marketing campaigns to capitalize on the trend.
- Market Segmentation: Considering market segmentation based on sales patterns and consumer behavior, so that marketing strategies can be tailored to each segment more effectively.

8. Risk Analysis

- Risk Identification: Conducting risk analysis of factors that may affect sales, such as economic changes, competition, and consumer trends. With a better understanding of the risks, the company can plan mitigation measures.
- Contingency Planning: Preparing contingency plans for situations where sales do not match the forecast. This may include reducing production or developing alternative marketing strategies.

CONCLUSION

Based on the results of research and data processing that have been conducted by researchers on "Analysis of Tofu Product Sales Forecasting Using the Single Exponential Smoothing Method at UD. Tahu Murni, Gunungsitoli City", the researchers draw the following conclusions:

1. From the results of forecasting using the Single Exponential Smoothing method, it was obtained that in the next period there were 226,762 pieces of product for alpha (α) = 0.1, for alpha (α) = 0.5, the product sales forecast was 237,409, then for alpha (α) = 0.9, the forecast for the next period was 238,014 pieces.
2. The forecast results with the smallest error are the right technique for forecasting and are recommended for a company, especially UD. Tahu Murni in Gunungsitoli City. The forecasting result with the smallest percentage error is the Single Exponential Smoothing method with an alpha (α) value = 0.9 with an error value of MAE = 425, MSE = 508821, and MAPE = 0.19%. 3. Based on the analysis of UD. Tahu Murni tofu product sales data from September 2023 to August 2024, it can be concluded that there are significant fluctuations in sales, with the general trend showing an increase. The highest sales occurred in July 2024, while the lowest were in September 2023. The use of the Single Exponential Smoothing (SES) method with the

right α value has provided accurate forecasting results, especially at α = 0.9, which shows the lowest forecasting error. This method is very effective in predicting demand, which can help UD. Tahu Murni in production planning and inventory management.

SUGGESTION

Based on the research results obtained by researchers at UD. Pure Tofu, there are several suggestions from researchers, namely:

1. This research needs to be developed because it is very useful for MSME entrepreneurs in supporting the business they are running.
2. For other researchers to continue this research to predict sales in the following months.
3. This research can be used as a reference for other researchers who conduct research on forecasting sales of a product in a particular business.
4. It is recommended for other researchers to forecast sales of tofu products in certain places using the Single Exponential Smoothing method or several other methods of forecasting so that accurate results are obtained.

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