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Salt Sales Prediction Using the Moving Average Method (A Case Study of Madura-Indonesia Salt)

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ABSTRACT

Forecasting is a term used to forecast or estimate the business we run to see its future direction using historical data as the main reference. The right strategy is needed to manage the production of salt raw materials well, namely through sales forecasting. PT Budiono Madura Bangun Persada is a company engaged in salt processing with the brands "Anak Pintar (AP)" and "Kapal Container (KC)" where the amount of production experiences uncertainty, namely increasing or decreasing, this results in an uncertain amount of raw materials. This research aims to predict the exact amount of salt production in a certain period. Because falling production is of course not good for business development. So that salt production continues to grow at a good rate, studying the patterns is important so that we can anticipate early if there is a decline in production. The amount of data used is the period November 2020 – April 2021. Moving average (MA) calculates the average price of salt production in a certain time period, the data used is historical data so the MA is an indicator. The final result of this forecasting model is the best using predictions on day 6 for both AP salt and KC salt, with an MSE value of 290.71 for KC salt and an MSE value of 843.08 for AP salt.

Keywords*:* forecast, salt, moving average.

INTRODUCTION

Salt is one of the indispensable needs in human life. Salt can be used directly to mix cooking spices. In addition, salt can also be used as a mixture of ingredients. Salt is produced from the remaining evaporation of brine [1][2]. The filtered sea water is put into the pond. Then it is allowed to evaporate naturally. After evaporation for several days, the salt will be left in the pond [3][4]. Salt-producing areas are in locations close to the sea [5]. This is because it will make it easier to obtain sea water as the basic ingredient for making salt. Madura Island is the largest salt producer in East Java and nationally. So Madura Island is synonymous with Salt Island. Salt is an important commodity because many industries use salt as an additive, from the food and beverage industry to the chlorine and alkali chemical (CAP) industry [6] and [7]. Some of the salt-producing areas in Pamekasan Regency include Polagan village, Pagagan village, Tanjung village and Waru village which are located in the northern part of Pamekasan [8] and [9]. For these areas, being a salt farmer is the main source of income. So, the selling value of salt will affect their welfare. With good environmental conditions, the salt produced in Pamekasan Regency has good quality [10]. However, because the amount of salt production is very large, the price of salt is very low. So, it will be detrimental to the salt company [11] and [12].

This phenomenon can be reduced if the amount of salt demand is matched appropriately with the amount of available salt [13] and [14]. Therefore, an analysis is needed to be able to predict the amount of salt sales in Pamekasan Regency. There are several cases of forecasting such as Forecasting the Number of Sim Card Damage [15] and[16], Predicting National exam results [17], predicting the number of patients [18] and [19]. Forecasting the amount of salt sales can be done using the scientific method, namely Double moving average [20] and [21]. Moving averages perform forecasting by taking a group of observed values, finding the average, and then using that average as a forecast for the

next period [22] and [23]. The term moving average is used, because each time new observational data is available, a new average is calculated and used as a forecast [24]. Moving averages have the advantage of being able to forecast data that does not have a trend and is not influenced by seasons. It is hoped that this application will make it easier to find out the amount of salt sales so that they can prepare themselves to use salt in other fields or sell directly to factories [25]. The formulation of the problem in this study is how to design and build a system that can predict salt sales in Pamekasan Regency using the moving average method [26] and [27]. The purpose of this study is to design and build a system that can predict salt sales in Pamekasan Regency using the moving average method [28]. The benefits obtained from this research can predict future sales.

Madura is an island known as the Salt Island because Madura has the largest salt producer in Indonesia. Madura Island can produce up to 1,2 million tons per year with the largest salt-making area in Indonesia reaching 15,349 hectares [29] and [30]. Thus, the island of Madura contributes 60% of the total national salt production. Salt is the main ingredient for food processing that is needed by the population. Moving average in Indonesian, is a simple and commonly used forecasting method to predict future conditions through past data types (historical data) [31]. In production and operations management, the record here may be the company's historical sales volume. The period of data collection can be yearly, monthly, weekly or even daily. An example of this time series model is the moving average. The problem in this study is the result of the moving average method to predict the total salt production in Madura, aiming to obtain the moving average comparison results to predict the total salt production in Madura.

Based on the background that has been presented, the contribution of this research is to predict salt production using the Moving Average model for a certain time period, which produces the smallest error value so that its use can be used as a benchmark for companies in producing the right amount of salt. Because falling production is of course not good for business development. So that salt production continues to grow at a good rate, studying the patterns is important so that we can anticipate early if there is a decline in production.

METHODOLOGY

Personal computer-based system that can provide case resolution and communication for cases using semi-structured and unstructured conditions is a Decision Support System (DSS) [32]. This system is applied to help make decisions in conditions for decisions to be made or taken. The method of forecasting (forecasting) used by several decision support systems. What is applied for forecasting is data that does not contain trends or seasonal factors. To obtain the Moving Average value, determine the total period (T) first. The preprocessing stage is the stage to prepare the data so that it can be used for the mining process as needed

A. Data collection

The data used in this study is from PT Budiono Madura Bangun Persada, which is 181 data from November 2020 - April 2021. The data is based on records from PT Budiono during the covid 19 pandemic. Production data held is daily, so in this study using a time period of 6 or in other words predicting on the 6th day.

B. Literature Review

Some related research regarding predictions includes:

1. Prediction of consumer price index (CPI) data for seven cities in West Java using the Single Moving Average method. The data used for this research is CPI data for seven cities in West Java from January 2020 - August 2021 obtained from BPS Bandung city. The results of this research for 3 periods for September 2021 decreased from the actual data for August 2021 and the

error value using the MAPE method was quite small [33].

2. In research, monthly palm oil production is not always stable or increasing, but experiences ups and downs which are influenced by many factors. One of the goals is to predict harvest results in the following month, so that we can anticipate earlier if there is a decline in production. This research discusses several results from four moving average (MA) based prediction methods, namely simple MA, double MA, exponential MA, and weighted MA. The test results on PTPN V's monthly production data for 5 years show that the weighted moving average method is the method that has the smallest error based on the mean absolute percentage error (MAPE) parameter with an average error percentage of 12.53% [34].

From these two studies, we tried to apply patterns in predicting salt production by making predictions with trials of 3, 6 and 12 periods. As well as applying the MA method in making predictions.

C. Moving Average Method

Simple Moving Average does not apply old data continuously, every time there is new data is used and the oldest observation value is no longer used because the use of the number of periods is always constant.[1] The simple moving average method is a prediction method that uses a new set of actual demand data to produce a forecast value of future demand. The moving average method is suitable for long-term data [2]. The moving average can be written into an equation using the following equation[11]:

$$FT + 1 = \frac{x1+x2+\cdots+xT}{T} = \frac{1}{T}T \sum T\ i{=}1\ xi \quad (1)$$

Information:

FT + 1 = Forecast for the period to T+1.

Xi = Data in period i , i = 1,2, …….., T

T = Period of moving average

After the prediction is made, an evaluation is carried out using various calculations to determine the forecasting method by determining MAPE (Mean Absolute Error), and MSE (Mean Square Error), which predicts the turnover of the month with 3 movements, the results of both methods are compared and precision values with error values are used smallest [11].

Meanwhile, MSE takes into account the square of all forecast errors in each period and divides it by the total forecast period. MSE can be formulated systematically in equation 3.

$$MSE = \sum (At - Ft)\ 2\ n \quad (4)$$

The following is the flow of the system process. Salt production data of PT. Budiono Madura Builds Persada for 6 months starting from November 2020 - April 2021 with a total of 181 data.

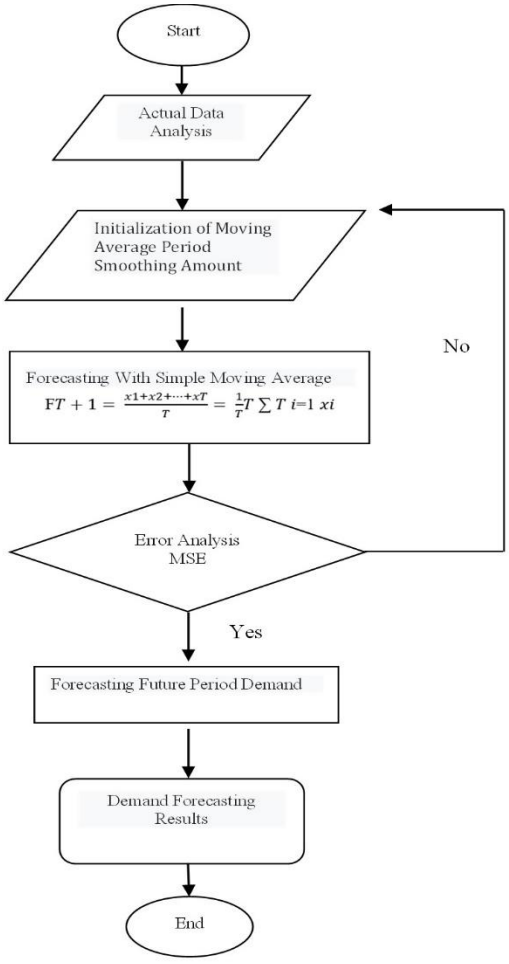

Figure 1. Double Exponential Smoothing system flowchart

The flowchart of the Moving Average (MA) method in Figure 1 above can be explained as follows:

1. Conducting actual data analysis for 6 months starting from November 2020 – April 2021.
2. Initialize the period in the moving average using 3, 6, and 12 periods.
3. Perform forecasting calculations using the moving average (MA) method.
4. Analyze error results using MSE.
5. Forecasting future period demand.
6. Get the results of the demand for forecasting the amount of salt production.

RESULTS AND DISCUSSION

The data used to prodction for 6 month and show other periods with a total of 181 data, the moving average results as shown in Table 1. Table 1 shows the trial scenario for salt production using MA with different prediction periods, namely 3, 6 and 12 for two salt productions, namely AP and KC. The prediction model from MA can measure its error level using the MSE method, so that the smallest error value will appear from the trials that have been carried out.

Table1. Moving Average Results

Method	Merk	MSE	Merk	MSE
MA 3 Periode	AP	804.01	KC	300.42
MA 6 Periode	AP	843.08	KC	290.71
MA 12 Periode	AP	983.08	KC	312.97

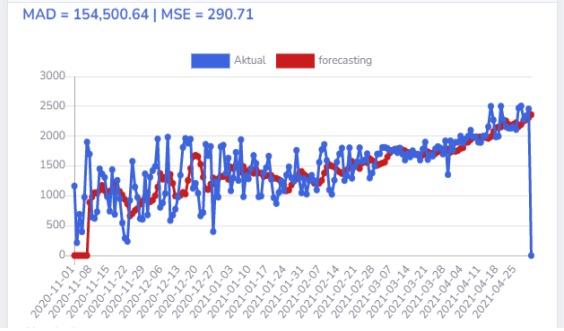

Figure 2. Moving Average Forecasting Results Graph

Figure 2 is a forecasting graph of the salt production of “Kapal Container” which shows the comparison between the actual data and the predicted results from November 2020 - April 2021. The blue graph shows the actual data, while the red one is the prediction result. The x-axis shows the time period from November to April 2021, while the y-axis shows the amount of production. This graph uses predictions with the 6th period which has the smallest MSE value of 290.71.

This research is able to implement the MA method in predicting the amount of salt production with the aim of making it easier for companies to determine the amount of production within the specified time period.

CONCLUSION

Based on the descriptions and reviews that have been used for training and testing data, there are 181 salt production data for PT. Budiono Madura Bangun Persada then concluded:

1. By analyzing the smallest error rate on the forecast results using periods 3, 6, and 12, the system can provide information about the demand for salt production.
2. The Moving Average method can be applied to estimate sales data for sales of "Anak Pintar" and "Kapal Container" salt using the data used from November 2020 - April 2021.
3. Determination of moving average affects accuracy by using a moving average of period 6 with the brand "Kapal Container" which has a good value (smallest error rate), namely MSE of 290.71.

Based on the conclusions obtained from the results of this research, the suggestions for developing this system cannot be said to be perfect. Therefore, future research on the same topic should be able to develop a system with the following additions:

1. It is hoped that in the future there will be data sources or scraping sources

not only the amount of salt production but parameters related to salt production such as the use of NaCl, Iodine and the number of packages in order to maximize yields

2. It is hoped that we can use classification methods in making predictions so that prediction results are maximized.

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