Marketing Research: The Application of Auto Sales Forecasting Software to Optimize Product Marketing Strategies

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Abstract

The aims of this study is to apply the Auto Sales Forecasting software to predict sales transaction data. The Auto Sales Forecasting software consists of two main features namely descriptive analysis and forecasting features along with its visualization. Forecasting methods contained in the Auto Sales Forecasting application are forecasting methods of Simple Moving Average, Robust Exponential Smoothing, Auto ARIMA, Artificial Neural Network, Holt-Winters, and Hybrid Forecast. The Auto Sales Forecasting software can intelligently choose the best forecasting method based on RMSE values. The results showed that the Auto Sales Forecasting software successfully analyzed the sales transaction data. From the analysis it was found that there were 43 types of products produced and sold by the Futry Bakery & Cake Store. Three of them are the types of products that are most in demand by consumers, namely Sweet Bread, Maros Bread, and Traditional Cakes 3500. The best selling product type, Sweet Bread, is used to build forecasting models. The best forecasting method is the Robust Exponential Smoothing method with the smallest RMSE value of 0.83 on the variable number of sold out products. Forecasting results using the Robust Exponential Smoothing method show that the average number of products to sell for the next seven days ranges from 116 products with a certain confidence interval value.

Keywords: Computational Intelligence Website; Auto Sales Forecasting; shinydashboard package; Marketing Strategies;

1. Introduction

In the digital era, business people try to build ecosystems to achieve increased productivity and high efficiency as well as better product quality through the use of the latest technology. In the Food and Beverage Industry sector, it often needs optimization marketing management in the form of goods availability, capital adequacy, and price management to achieve optimal profits. Marketing management is needed by business people to optimize sales

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regulations. In this context, businesses must think about marketing their products such as stock, selling prices, capital and profits. According to Assouri, marketing management is an activity of analyzing, planning, implementing, and controlling programs designed to form, build, and maintain profits from exchanges through market targets to achieve organizational goals (companies) in the long term [1]. To optimize marketing management, appropriate strategies are needed and utilize the availability of sales transaction data to conduct more complex analyzes. One of the techniques of analysis that can be utilized by business people is sales forecasting, which is forecasting quantitative data on variables related to sales transactions [2]. According to Swastha, sales forecasting is the level of sales expected to be achieved in the future by basing on real sales data that has been collected in the past [3]. Common forecasting methods used to forecast sales data include Simple Moving Average (SMA) [4], Robust Exponential Smoothing (RES) [5], Autoregressive Integrated Moving Average (ARIMA) [6], Artificial Neural Network (ANN) [7], Holt-Winters [8], and Hybrid Forecast [9]. But the problem that is often encountered by business people in forecasting quantitative data is the difficulty in choosing the right method for forecasting because these forecasting methods have advantages and disadvantages in various specific cases. Auto Sales Forecasting software is a software that was built using the R programming language and can be accessed online through the page http://bakrizal.com/AutoSalesForecasting. The advantages of this software is that it can forecast various current methods and is equipped with intelligence computation features that can choose the best method.

2. Methods

This research is applied research that is applying the Auto Sales Forecasting software for sales transaction data of Futry Bakery & Cake Stores. The stages of this research are explained as follows:

2.1. Data and variable

The first step in this research is to collect data along with several variables related to sales forecasting. The data used in this study are transaction data obtained in the Futry Bakery & Cake store database. Transaction data exported is data of product sales transactions for 2 years, from January 2018 to October 2019. Variables used in this study are the price of product capital, product stock, selling price, and the number of sold out products.

2.2. Descriptive Analysis

The second step is to conduct a descriptive analysis of sales transaction data. Descriptive analysis is used to see the number of products most sought after by consumers and can also see some products that are least desirable by consumers. This stage also shows the amount of sales profit of each product in a certain time span. In addition, descriptive analysis is also used to see the size of concentration, distribution, and fluctuations in data on each variable of the sales transaction data based on a particular product.

2.3. Forecasting Model

The third step in this research is to build a forecasting model using all of the following forecasting methods, namely:

- **Simple Moving Average**

  Simple moving average is a forecasting method with the main concept is to add all observational data then divide it by a certain number of periods [4,10].

- **Robust Exponential Smoothing**

  Robust Exponential Smoothing is a new forecasting method that was developed with the aim of smoothing every aspect of the variance in parameters estimation of the Exponential Smoothing method. This method can be used in trend and seasonal data as well as robust against outliers of data series [5,11].

- **Auto ARIMA**

  The ARIMA / SARIMA model is a popular and flexible forecasting model that utilizes historical information to make predictions [6,12].

- **Artificial Neural Network**

  Artificial Neural Network (ANN) is a new method that was developed in the case of forecasting. ANN can

model complex relationships between inputs and outputs with the aim of finding patterns in data [7].

● **Holt-Winters**

Holt-Winters is one of the forecasting methods used to model data with seasonal patterns that contain trend data or not. There are two types of Holt-Winters methods, namely Multiplicative Holt-Winters (MHW) and Additive Holt-Winters (AHW) [8,13].

● **Hybrid Forecast**

Hybrid forecasting methods are forecasting method which is combining several methods with certain weights including Auto ARIMA method forecast, Exponential smoothing state space model, Theta method forecast, Neural Network Time Series Forecasts method, Seasonal and trend decomposition, and TBATS model [9,14].

2.4. Model Evaluation

The next stage is to choose the best forecasting method after building the previous forecasting model. A good model is a model that provides a high degree of accuracy in making predictions. Some methods that are often used in measuring the accuracy of forecasting models are Mean Square Error (MSE), Mean Absolute Percentage Error (MAPE), Mean Absolute Deviation (MAD), and Root Mean Square Error (RMSE) [15].

2.5. Forecasting using The Best Method

The last stage is doing forecasting. The auto sales forecasting software has been created intelligently to choose the best forecasting method based on the smallest RMSE value. Furthermore, these methods can be used to forecast sales transaction data.

3. Results and Discussion

Auto sales forecasting software can be accessed online through the page http://bakrizal.com/AutoSalesForecasting. This software has been used to predict the number of sold out products at the Futry Roty Bakery & Cake store. The results of data analysis can be seen as follows:

3.1. Summary analysis

Descriptive analysis provides an overview of sales transaction data. There are 43 product items available at the Futry Bakery & Cake Shop. Figure 1 shows the three most popular products that are in demand by consumers (sold), they are Roti Manis, Roti Maros, and Kue Tradisional for 3,500. The total number of Roti Manis Products sold was 57,724 products, the total number of Roti Maros products sold were 55,025, and the total products for 3500 Kue Tradisional were 20,669. The analysis results in Figure 1 also show the number of selling prices. The highest selling price is a Roti Maros product that is equal to Rp. 82,888,480 with a total capital (value) of Rp. 66,310,790. The sales price for Roti Manis products is Rp. 28,874,750 with a total capital of Rp. 2,309,980. While the total sales price for 3500 Kue Tradisional products is Rp 7,293,610 with a capital of Rp. 5,834,890.
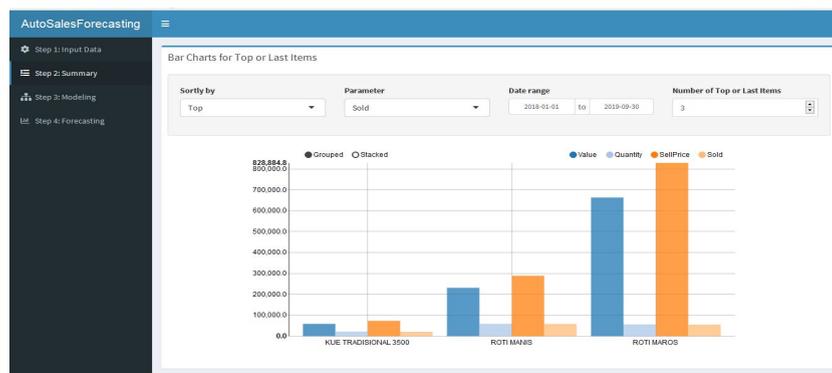
Fig. 1. Barchart for top three product

Descriptive analysis also shows product items that are less attractive to consumers. Figure 2 shows the three products that have the lowest sales amount, namely Donat per biji, Kue Tar 300rb-an, and Kue Tar Lapis Surabaya products. The number of sold out products for Donat per Biji is only 7 products, this is because these products are only produced in June 2019. Then the number of sold out products for the Kue Tar 300rb-an is only 1 product, because this product was only produced in April 2018. Furthermore, the number of sold out products for the Kue Tar Lapis Surabaya is only 3 products which are only sold for 3 months, namely in January 2019 to May 2019.
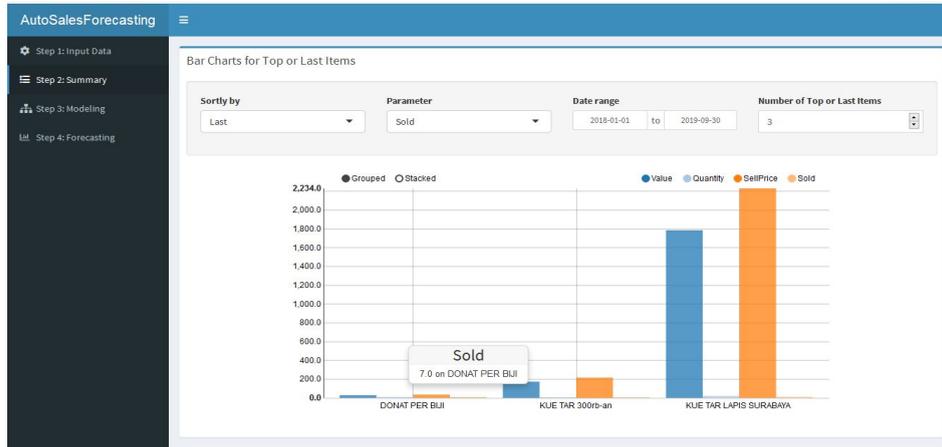
Fig. 2. Barchart for last three products
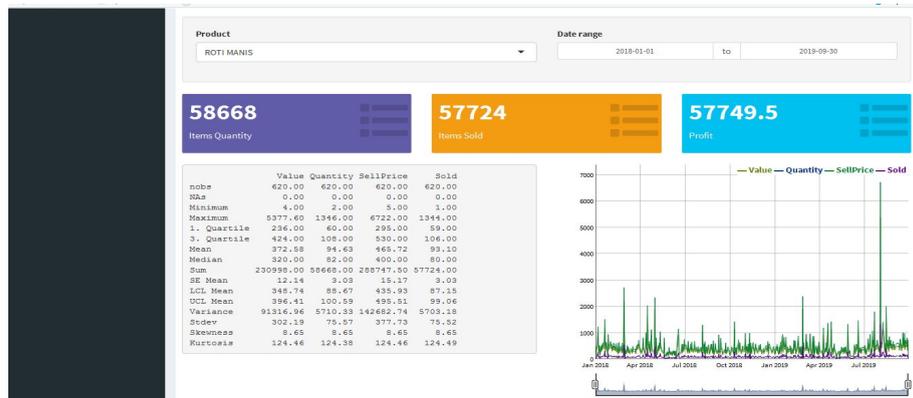
Fig. 3. Descriptive analysis for top product

Figure 3 shows a descriptive analysis of the products that are most in demand by consumers, namely the Roti Manis products which is 58.583 unit in total where 57,646 units were sold with a total profit of Rp. 5,767,150. The result of analysis also shows the concentration value and data distribution on each variable. This output also shows fluctuations in the Roti Manis product data illustrated in the plot section. In the plot, it can be seen that there are certain days that the sales value of Roti Manis products jumps very high. This shows that Roti Manis is the best-selling product and provides many advantages.

3.2. The Best Forecasting Method

The next analysis is to forecast quantitative data using various forecasting methods. Figure 4 shows the MSE, MAD, MAPE, and RMSE values of each forecasting method. The best forecasting model is the Robust Exponential Smoothing method with an RMSE value of 0.8294149, the MAPE value of 0.7051596, the MAD value of 0.4059156, and the MSE value of 0.6879291 for the Roti Manis product. This happens because the Robust Exponantial Smoothing method is more muscular against fluctuating data that spreads.

Best Model
Robust Exponantial Smoothing

RMSE
0.829414926886507

Evaluation Models	Fitted Plot			
Methods	MSE	MAD	MAPE	RMSE
Robust Exponantial Smoothing	0.6879291	0.4059156	0.7051596	0.8294149
Neural Network	1460.8395542	23.3699742	39.6576892	38.2209308
Hybrid Forecast	4462.1939170	33.0325637	58.5287951	66.7996551
Auto ARIMA	5595.5900045	36.4844772	65.6781875	74.8036764
Simple Moving Average	5640.6918164	36.1806677	64.8792574	75.1045393
Holt Winters	6842.0677341	43.9410245	76.3719772	82.7167923
Methods	MSE	MAD	MAPE	RMSE

Show 25 entries   Search:

Showing 1 to 6 of 6 entries   Previous 1 Next

Fig. 4. Forecast Modeling for top product

3.3. Sales Forecasting

The next analysis is to predict the stock of products that will sell for the next few days. For example, the product to be forecasted is the product most sought after by consumers, namely Roti Maros. Figure 5 shows a graph of fluctuations in sales data and forecasting data for Roti Maros products. The results show that in 2019 there was an increase in product sales which occurred the most on April 8, 2019 by 1344 products. Figure 5 also shows the movement of forecasting data for Roti Maros products. It can be seen that forecasting data fluctuation is constant.
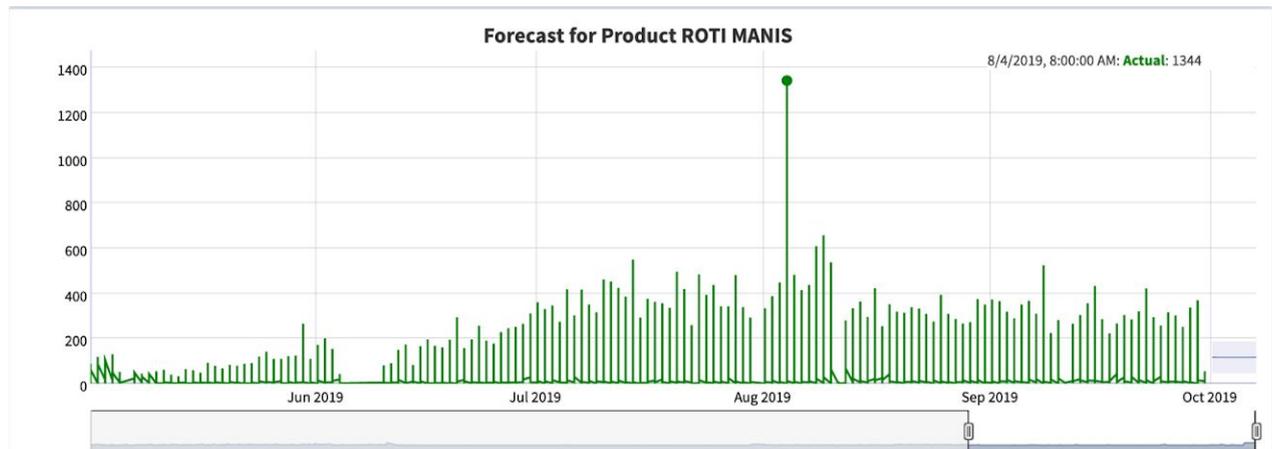
Fig. 5. Plot Series for top product

Forecasting results of Roti Maros products can be seen in Figure 6 with the number of forecasting days of seven days. The forecast value obtained is the same for all days, which is around 116 products with different confidence intervals. The number of product sales for the next seven days is between the Lo_95 to Hi_95 confidence intervals. In Figure 6 it can be seen that the more days of forecasting the longer the confidence interval.

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date	Forecast	Hi_95	Lo_95
2019-10-01	116.8391	187.6246	46.05363
2019-10-02	116.8391	187.6916	45.98664
2019-10-03	116.8391	187.7585	45.91971
2019-10-04	116.8391	187.8254	45.85282
2019-10-05	116.8391	187.8922	45.78599
2019-10-06	116.8391	187.9590	45.71921
2019-10-07	116.8391	188.0257	45.65248
date	Forecast	Hi_95	Lo_95

Showing 1 to 7 of 7 entries   Previous 1 Next

Fig. 6. Forecasting for top product

4. Conclussion

The Auto Sales Forecasting software is a new application that has the advantages of intelligent computing to choose the best forecasting method. This software has been used to predict the number of sold out products (sold) on Futry Bakery & Cake store online through the page http://bakrizal.com/AutoSalesForecasting. The results show that the robust exponential smoothing method is the best forecasting method with the lowest root mean square error (RMSE) value.

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