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EZ Forecast 2.0: A System of Univariate Models

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Abstract—Forecasting is a process of analysis that is performed using past and present data. It involves the analysis of trends for predictions of the future and helps organizations to cope with future uncertainties. However, forecasting techniques involve complex tasks. In EZ FORECAST 2.0, data forecasting is made easy since the system is developed to be user friendly where the user only needs to key in the data set and the analysis will be done automatically by the system. An upgraded version of EZ FORECAST 1.0, a system of univariate modelling techniques is introduced to forecast and evaluate the best techniques identified by the time series model. This new system is proposed to recommend the best model of the data. This system assists the decision-maker in forecasting the time series data accurately and systematically. The objectives of this system are: (1) to monitor the performance of the time series data set using a univariate model, (2) to forecast the time series data set one step ahead, and (3) to propose the best model based on minimum error measures. There are five methods used in this system which are Naïve Forecast, Naïve with Trend Forecast, Single Exponential Smoothing, Double Exponential Smoothing, and Holt's Method. Real-life data from a Food and Beverages (F&B) company is used to demonstrate the effectiveness of the system. The findings show that the system is able to recommend the best model with forecasting values which have minimum error measures. This system benefits an organization by providing valuable information that helps the top management to make decisions on the future direction of the company.

Keywords—forecasting, time series, univariate model

I. INTRODUCTION

Decision making is a complex task. Many forecasting techniques have been developed to handle the complexity of decision-making problems. Choosing the appropriate forecasting technique is crucial. This study proposes a time series forecasting system of univariate modelling techniques to assist the decision-maker in forecasting the time series data accurately and systematically. Univariate analysis is concerned with the forecasting technique based on past data of one variable without taking into consideration the effect of the other variables. EZ FORECAST 2.0, an upgraded version of EZ FORECAST 1.0, is introduced to forecast the future and to evaluate the best techniques identified by the time series model. The objectives of this system are: (1) to monitor the performance of the time series data set using a univariate model, (2) to forecast the time series data set one step ahead, and (3) to propose the best model based on minimum error measures.

Empirical data for a sample of time series observations of the closing price of a Bursa Malaysia Food and Beverages (F&B) listed company was used to assess the effectiveness of the system. The system is expected to estimate the best model to forecast the future price of the company one-step ahead with minimum error measures. The forecasting techniques involved in this experiment are Naïve Forecast, Naïve with Trend Forecast, Single Exponential Smoothing, Double Exponential Smoothing, and Holt's Method. These methods are based on the inclination of the development of a situation in the past, which are then extrapolated into the future with an assumption that the regularities that happened in the past will continue in the future [1]. This system is user friendly, simple in application, efficient and can minimize human error. The system can provide valuable information to the top management and future investors or the shareholders of the company. This paper is organized as follows: (1) Introduction, (2) Literature review, (3) Methods, (4) Results and Discussion, (5) Conclusions.

II. LITERATURE REVIEW

In many areas, decision-making is essential and often based on forecasting and making predictions. The areas that have gained benefits from the use of forecasting approaches are economics, business, engineering, science and many more [2]. Today, the accessibility to statistical packages or software has simplified the process of developing statistical models, based on data such as cross-section, time-series, cross-section over time, and panel data [3]. Software packages such as Microsoft Excel, Statistical Package for the Social Sciences (SPSS), SAS, Eviews, and R have shown the ability to perform statistical analysis. Deciding which of these software packages is better for data analysis is based on the number of variables, size of data, and the advantages and disadvantages of each statistical software [3,4]. Microsoft Excel is a popular and powerful spreadsheet program that is used to perform mathematical and statistical calculations. The most popular free add-ins in Excel are the Analysis Toolpak and Solver, while MegaStat includes a cost. Free add-ins can perform data analysis, develop a forecasting model, and present the results [5].

On the other hand, users would have to subscribe to use SPSS, SAS, and Eviews. The SPSS software is widely used in social sciences and offers a statistics base, advanced statistics, custom tables, decision trees, forecasting, and many more [4]. Forecasting time-series data involves the study of components such as trend, seasonality, cycle, and irregular changes in the data [6]. If users are looking for specific tools to manipulate time series data or econometric data, Eviews is one of the options. The program allows users to easily add or upload data series, construct new series from existing ones, view and print data series, perform statistical analyses of series relationships, and manipulate results and output [7].

SAS and R are programming languages designed for intermediate and advanced users because they are extremely powerful, can handle very large data sets, and can perform complex and advanced analyses. SAS has functional packages built-in for many sectors, including health care, banking, insurance, retail, utilities, sports, and more. It also works well with advanced statistical techniques like forecasting, time series analysis, and many others. SAS provides comprehensive online documentation, specialist technical assistance, advanced training courses, and a community on the internet. With many choices of software packages in the market, however, there are limited findings on the decision support system that can suggest the best model from a single interface. Decision-makers still have to decide which model is the best. Thus, EZ Forecast 2.0 was developed to propose the best model from a variety of models based on minimum error measures.

III. METHODS

The system uses five methods which are Naïve Forecast, Naïve with Trend Forecast, Single Exponential Smoothing, Double Exponential Smoothing, and Holt's Method. Figure 1 shows the interface of the system.

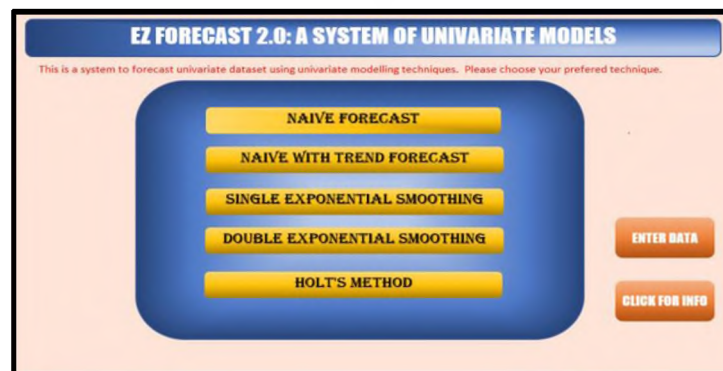


Fig. 1 Interface of the system

A. Naïve Forecast

$$F_{t+m} = y_t \text{ for } m = 1, 2, 3, 4, \dots \quad (1)$$

where m refers to the number of periods into the future for which the forecast is desired and y is the actual value at time t .

B. Naïve with Trend Forecast

The one-step ahead forecast is represented as

$$F_t = y_t \frac{y_t}{y_{t-1}} \quad (2)$$

where y_t is the actual value at time t and y_{t-1} is the actual value in the preceding period.

C. Single Exponential Smoothing

The model requires only one parameter, which is the smoothing constant, α , to generate the fitted values and hence forecast. The advantage of this procedure over the moving average is that it considers the most recent forecasts. The general equation is as follows:

$$F_{t+m} = \alpha Y_t + (1-\alpha)F_t \quad (3)$$

where

F_{t+m} is the single exponentially smoothed value in period $t+m$ for $m = 1, 2, 3, 4, \dots$

Y_t is the actual value in period t .

α is the unknown smoothing constant to be determined with value lying between 0 and 1, i.e. ($0 \leq \alpha \leq 1$),

D. Double Exponential Smoothing

This technique is useful for a series that exhibits a linear trend characteristic. The following are five main equations used in this method.

$$S_t = \alpha Y_t + (1-\alpha)S_{t-1} \quad (4)$$

$$S'_t = \alpha S_t + (1-\alpha)S'_{t-1} \quad (5)$$

$$\alpha_t = 2S_t - S'_t \quad (6)$$

$$b_t = \left(\frac{\alpha}{1-\alpha} \right) (S_t - S'_t) \quad (7)$$

$$F_{T+m} = a_T + b_T xm \quad (8)$$

where S_t be the exponential smoothed value Y_t of at time t and S'_t be the double exponentially smoothed value of Y_t at time t .

E. Holt's Method

This technique not only smooths the trend and the slope directly by using different smoothing constants, but also provides more flexibility in selecting the rates at which the trend and slopes are tracked.

$$S_t = \alpha Y_t + (1-\alpha)(S_{t-1} + T_{t-1}) \quad (9)$$

$$T_t = \beta(S_t - S_{t-1}) + (1-\beta)T_{t-1} \quad (10)$$

$$F_{t+m} = S_t + T_t xm \quad (11)$$

where α and β are the parameters to be determined with values from 0 to 1.

F. Mean Square Error (MSE)

Error measures are used to differentiate between a poor and a good forecast model. The error measures are employed to find the best model where the smallest error is said to be the best model. MSE is chosen as an error measure because it is easy to understand and to calculate, and generally the outside-sample criteria tally with the within-sample criteria where the summation of square errors is divided with the total number of samples.

IV. RESULTS AND DISCUSSION

The proposed system was developed using Excel to identify the best model that suits the data by measuring the error measure, namely Mean Square Error. The proposed system of EZ Forecast 2.0 can be seen using an example of Naive forecast as shown in Fig. 2.



Fig. 2. Example of Naive forecast in proposed system

In the EZ Forecast 2.0 system, users can enter the raw data in specific columns as stated in the system. The EZ Forecast 2.0 system can automatically display the trend of the data using the line chart and provide the value of Mean Square Error (MSE) for the estimation and evaluation parts. Not only that, but this system also helps the users to generate the forecast value for the data itself. Based on Fig. 2, the forecast value for one-step ahead of the data is 63.10. Once users have entered the data in five different methods, the EZ Forecast 2.0 system compares the value of the MSE evaluation part, and the best model with the minimum value of the MSE evaluation is displayed at the finding and analysis sheet as shown in Fig. 3.

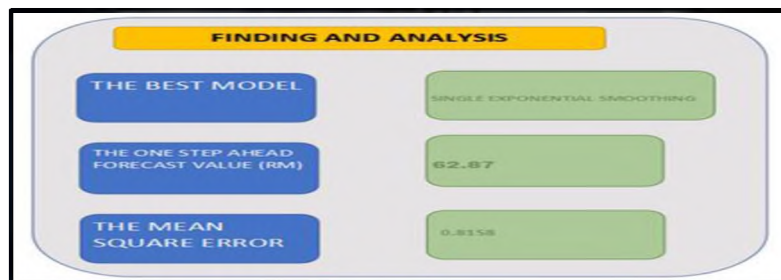


Fig. 3. Finding and analysis of EZ Forecast 2.0

V. CONCLUSIONS

The EZ Forecast 2.0 system, which has been upgraded from the previous system, has benefits such as helps the users to calculate a large number of data in a short period of time. Apart from that, this system is user friendly as such that the users just enter the raw data and the system would calculate and give the results of the MSE estimation and evaluation part as well as generate the forecast value for each method. Hence, this system has proved that it assists the users by providing an accurate and systematic calculation in order to monitor the performance of the time series data set using univariate models. The EZ Forecast 2.0 would help decision-makers to smoothly run their businesses by implementing this system. However, the method is only applied for univariate methods. Therefore, for further research, it is suggested to consider another method in time series forecasting rather than the univariate methods.

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