The Social Sciences 12 (12): 2370-2374, 2017
ISSN: 1818-5800

Forecasting Model Holt's for the Zakat Collection in Indonesia, Malaysia and Brunai

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Abstract: The present study was aimed to investigate the trend of Zakat collection from Islamic Social Finance Report 2014 in Indonesia, Malaysia and Brunai by using exponential smoothing models. Among the models, Simple Exponetial Smoothing (SES) model is the best model for characteristic data with constant level and no seasonaility like Zakat collection in Brunai. However, Holt's Exponential Smoothing (HES) model showed a better fit to the actual data in comparison to the SES model for characteristic data with increasing or decreasing trend and no seasonality like Zakat collection in Indonesia and Malaysia. The findings from this work supported that the HES model was found to give the best fit with the lowest Sum of Squares Errors (SSE) and could be used to precisely predict the future trends in order the future planning and to prepare the proper strategies for the counties.

Key words: Forecasting, holt's winter, Zakat, trend, SSE, exponetial

INTRODUCTION

Since 1999, research on Zakat has been increased in numbers. However, there is less study which focuses on the prediction of the Zakat collection. Previous studies related to the calculation method of Zakat potential are not that many. Many of the past studies on this issue has been discussing on the management of Zakat institution. This includes the strategy on how to make people more aware on paying Zakat, how to distribute Zakat through various programs which lead to the empowerment of the low level income earner, approaches in managing Zakat (Hudayati and Tohirin, 2010). In Malaysia, there is study done on the Zakat payer and Zakat collection potential which include Zakat on income, Zakat on trading and other Zakat. In an attempt to do so, three steps were taken; firstly, it is to get the numbers of muslim population in Malaysia, Secondly, it is to identify the muslim who are eligible to pay Zakat. Thirdly, it is to calculate the potential of Zakat that can be collected (Osman, 2007).

Forecasting is an extremely important tool in planning effective, especially in economics and business organizations in decision-making are very significant. Forecasting the basis for planning short-term and long-term for the company. In the functional areas of finance, forecasting provides the basis for determining the budget and cost control. In the marketing department, forecasting needed to plan for new product sales, compensations and some other important decisions. In the production and operation using forecasting data for capacity planning, facilities, production, scheduling and controlling supply. To establish economic policies such as the level of economic growth, inflation, unemployment and others can be done using the method of forecasting and measurement of forecasting error. Forecasting involves making estimates of the future values of variables of interest using past and current information. Generally speaking, forecasting is not an easy task and therefore it has attracted many researchers to explore it. There are many forecasting methods usually employed. They are Auto-Regressive Integrated Moving Average (ARIMA), Exponential smoothing, Artificial Neural Network (ANN) and Logistic Regression (Shamsuddin *et al*., 2008). Lately, ANN has found increasing consideration in forecasting theory and has successfully applied in various forecasting domains including economic, business financial and many more (Yao, 2002). ANN can learn from examples, recognize a hidden pattern in historical observations and use them to forecast future values. Therefore, the objective of this study is to develop a forecasting model to predict the

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'Zakat' collection for Islamic Social Finance Report 2014 using some Holt's winters models. Two different model namely Simple exponential smoothing and Holts exponential smoothing are applied in this study.

This study attempts to propose methods of calculating the Zakat collections in Indonesia, Malaysia and Brunai Darussalam. The basis of our method lies on the univariate analysis whereby the past Zakat collections will be our important data input. The reason of adopting this univariate method is that other important data which may determine the Zakat collections such as how much income earn by muslims, how many muslim who pay tax and in what amount etc are not available. Even worst, there is no institution which collects all data on Zakat collection in the monthly form. Due to these limitations, we rely on the basis of the past data. This study examines the available data on the Zakat collections to be used with various statistical tools such as accommodating seasonality, growth, etc., to come up with the best prediction for the future Zakat collections based on the available data.

MATERIALS AND METHODS

This data was obtained from Islamic Social Finance Report 2014 (Islamic, 2014). After the data was collected, the data will be analyze using R programming to fit the curve for some Holt's Winters model that is simple exponential smoothing and Holt's Exponential smoothing. In this study, the Zakat collection is the object of the some Holt's Winters model adjustment studied. Data taken in this study is the type of collection Zakat Indonesian Rupiah (IDR) against the Malaysian Ringgit (RM) and the Brunai (BND). Using R programming, two types of models which are the Simple exponential smoothing model and Holt's exponential smoothing model for evaluated the data.

Simple Exponential Smoothing (SES): This forecasting method is used when data pattern is usually based on the premise that the level of time series should change slowly over the time or fluctuate about a constant level.

Let an observed time series be $Y_1, Y_2, Y_3, ..., Y_n$. Generally, the SES model may be expressed as Ostertagova and Ostertag (2012):

$$\hat{Y}_{i+1} = \alpha Y_i + (1-\alpha)\hat{Y}_i \quad (1)$$

Where:

$\hat{Y}_{i+1}$ = The forecast value for time period i +1
α = The smoothing constant
Y_i = The actual, known series value for time period i
$\hat{Y}_i$ = The forecast value of the variable Y for time period i

To get started the algorithm we need an initial forecast, an actual value and a smoothing constant. Since, $\hat{Y}_i$ is not known we can:

- Use the average of the first few observations for the initial smoothed value
- Set the first estimate equal to the first observation. Thus we can use $\hat{Y}_i = Y$

With $0 < \alpha < 1$ when $\alpha = 0$, the series is smoothed flat. At the other extreme when $\alpha = 1$, the original and smoothed version of the series are identical.

The Holt's Exponential Smoothing (HES): Let $Y_1, Y_2, ..., Y_n$ be a set of observatioans on a non-seasonal time series. The Holt's exponential smoothing forecast is based on the assumption of a model consisting of a trend. We use the following procedure to forecast non-seosonal series (Jere and Siyanga, 2016; Akbarizan *et al*., 2016). The first step is to obtain the level estimate and trend estimate represented by $\hat{Y}_t$ and T_t, respectively as:

$$\hat{Y}_t = Y_2, \quad T_2 = Y_2 - Y_1 \quad (2)$$

These can also be estimated by fitting a least squares trend line to haf of the historical data. Here y intercept is A_0 and slope is T_0:

$$A_t = \alpha Y_t + (1-\alpha)(A_{t-1} + T_{t-1}) \; (0 < \alpha < 1; t = 1, 2, \cdots, n) \quad (3)$$

$$T_t = \beta \; (A_t - A_{t-1}) + (1-\beta)T_{t-1} \; (0 < \beta < 1; t = 1, 2, \cdots, n) \quad (4)$$

The value of α and β that minimizes the Mean Square Error (MSE) is preferred and these values will be calculated using the solver in R. The forecast of future values $\hat{Y}_{t+p}$ of the series can be obtained by:

$$\hat{Y}_{t+p} = A_t + pT_t \; (p = 1, 2, 3, \cdots, k) \quad (5)$$

where, p is the number of periods in the future. In this study, we can use the error measures such as Mean Absolute Percentage Error (MAPE), Root Mean Square Error (RMSE) or Mean Square Error (MSE). The lowest RMSE or MSE are selected to estimate as the best model:

$$RMSE = \sqrt{MSE} \quad (6)$$

$$MSE = \frac{1}{n}\sum_{t=0}^{n}(Y_t - \hat{Y}_t)^2 \quad (7)$$

$$MAPE = \frac{100}{n}\sum_{t=0}^{n}\frac{|Y_t - \hat{Y}_t|}{Y_t} \quad (8)$$

RESULTS AND DISCUSSION

There are two Holt's Winters models being used to describe the Zakat collection in Indonesia from 2002 to 2012 are Single Exponential Smoothing (SES) Model and Holt's Exponential Smoothing (HES) Model as shown in Fig. 1. It is shows Zakat collection versus year from 2002-2012 in Indonesia. Zakat collection data is indicated by black line meanwhile HES Model is indicated by blue line. From Fig. 1, it shows clearly that the trend of Zakat collection is increasing yearly. Table 1 shows Zakat collection data and estimated data for 2002-2012 in Indonesia. From the SES and HES Model, the calculation for this model is applied in R programming. Using the SES and HES generated the estimated data. The calculation for the SES and HES are using the equation obtained from the graph and then the SSE was calculated. The Sum of Squares Error (SSE) is used to show whether the model is suitable to predict the data or not. The comparison of SSE between two models for Zakat collection in Indonesia. The most suitable model to be used in this study is HES. From Table 1, it shows clearly that the HES Model is the best model to predict the amount of Zakat collection in the next 5 years. It is because obtained the smallest value of SSE for HES.

Figure 2 shows Zakat collection versus year for Malaysia. Zakat collection data is indicated by black line meanwhile the HES is indicated by blue line and SES Model is indicated by red line. From Fig. 2, it shows clearly that the trend of Zakat collection is increasing annually. Table 2 shows Zakat collection data in Malaysia. From the some Holt's Winters Model equation is first parameter (SES) and doble parameters (HES). The calculation for this models is applied using R programing for produce the estimated data. The calculation for the SES and HES are using the Eq. obtained from the graph and then the SSE was calculated. The comparison of SSE between two models for Zakat collection. For Malaysia, the most suitable model to be used in this study is HES. Referring to Table 2, it shows clearly that the HES Model is the best model to predict the amount of Zakat collection. This is because obtained the smallest value of SSE for HES.

Figure 3 shows Zakat collection versus year for Brunai. The trend of Zakat collection is increasing annually. Table 3 shows Zakat collection data for Brunai Darussalam. The calculation of SES and HES Models is applied using R programming for produce the estimated data. The calculation for the SES and HES are using the equation obtained from the graph and then the SSE was calculated. The comparison of SSE between two models for Zakat collection. Table 3, it shows clearly that the SES model is the best model to predict the amount of Zakat collection. This is because obtained the smallest value of SSE for SES. After the comparison between two models in three countries that has been used to predict the data, the results are as shown in Table 4. In this study, comparison of the best models made by looking at the value of the smallest MAPE and MSE. Table 4 shows

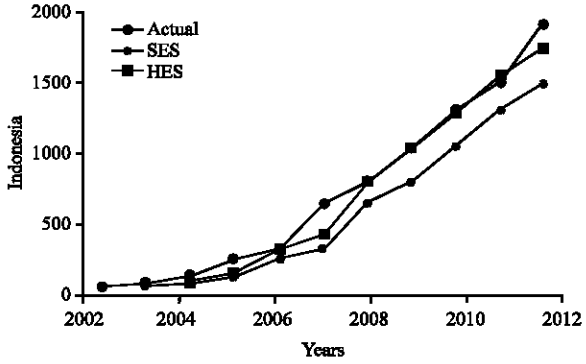

Fig. 1: The graph of SES and HES for Zakat collection from 2002-2012 in Indonesia

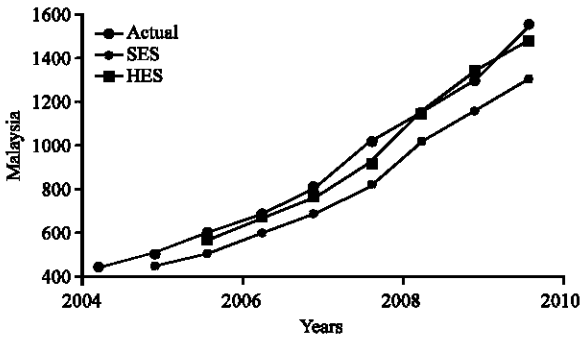

Fig. 2: The graph of SES and HES for Zakat collection from 2003-2011 in Malaysia

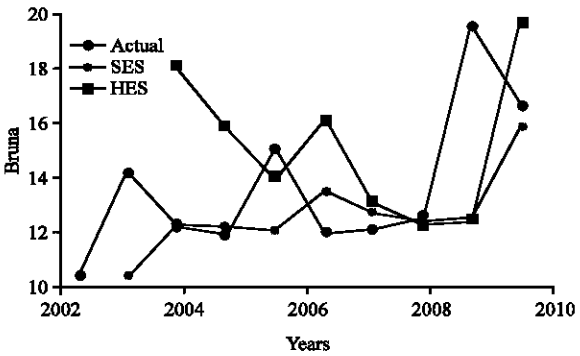

Fig. 3: The graph of SES and HES for Zakat collection from 2001-2010 in Brunai

Table 1: SSE and the prediction Zakat collection in Indonesia (Billion Rp.)

Years	Actual	SES ($\alpha = 0.99993$)	HES ($\alpha = 0.61691$; $\beta = 0.999$)
2002	68.39	-	-
2003	85.28	68.39	-
2004	150.09	85.28	102.17
2005	295.52	150.08	178.18
2006	373.17	295.51	369.41
2007	740.00	373.16	492.89
2008	920.00	739.98	918.94
2009	1200.00	919.99	1193.85
2010	1500.00	1199.98	1475.70
2011	1729.00	1499.98	1783.73
2012	2200.00	1728.98	2009.25
SSE	-	641,365.60	117,155

Table 2: SSE and the prediction Zakat collection in Malaysia (Million RM)

Years	Actual	SES $\alpha = 0.999948$	HES ($\alpha = 0.641783$; $\beta = 0.999$)
2003	408.4	-	-
2004	473.3	408.40	-
2005	573.1	473.30	538.20
2006	670.7	573.09	647.90
2007	806.3	670.70	764.46
2008	1038.1	806.29	920.10
2009	1196.9	1038.09	1200.34
2010	1363.8	1196.89	1400.44
2011	1641.1	1363.79	1555.72
SSE	-	225,802.3	2,6057.89

Table 3: SSE and the prediction Zakat collection in Brunai Darussalam (Million BND)

Years	Actual	SES $\alpha = 0.480099$	HES ($\alpha = 0.74530$ $\beta = 0.38021$)
2001	10.18	-	-
2002	14.59	10.1800	-
2003	12.28	12.3000	19.0000
2004	11.94	12.2900	16.5000
2005	15.53	12.1200	14.3200
2006	11.90	13.7600	16.7800
2007	12.11	12.8600	13.3200
2008	12.65	12.5000	12.2500
2009	20.76	12.5700	12.5000
2010	17.38	16.5000	20.9400
SSE	-	103.0184	173.8396

Table 4: The comparison MAPE and MSE between two model for three country

	MAPE		MSE	
Countries	SES	HES	SES	HES
Indonesia	28.01	13.35	64,136.56	1,3017.22
Malaysia	15.90	4.89	28,225.29	3,722.56
Brunai Darussalam	13.64	26.89	11.45	21.73

Table 5: The prediction data of the fit model fot Zakat collection for the next 6 years

	Indonesia		Malaysia		Brunai Darussalam	
Years	Actual	HES	Actual	HES	Actual	SES
2001	-	-	-	-	10.18	-
2002	0068.39	-	-	-	14.59	10.18
2003	0085.28	-	0408.4	-	12.28	12.30
2004	0150.09	0102.17	0473.3	-	11.94	12.29
2005	0295.52	0178.18	0573.1	0538.20	15.53	12.12
2006	0373.17	0369.41	0670.7	0647.90	11.90	13.76
2007	0740.00	0492.89	0806.3	0764.46	12.11	12.86
2008	0920.00	0918.94	1038.1	0920.10	12.65	12.50
2009	1200.00	1193.85	1196.9	1200.34	20.76	12.57
2010	1500.00	1475.70	1363.8	1400.44	17.38	16.50
2011	1729.00	1783.73	1641.1	1555.72	-	16.92
2012	2200.00	2009.25	-	1844.10	-	16.92
2013	-	2503.88	-	2077.69	-	16.92
2014	-	2880.84	-	2311.28	-	16.92
2015	-	3257.80	-	2544.87	-	16.92
2016	-	3634.76	-	2778.46	-	16.92
2017	-	4011.71	-	3012.05	-	-
2018	-	4388.67	-	-	-	-

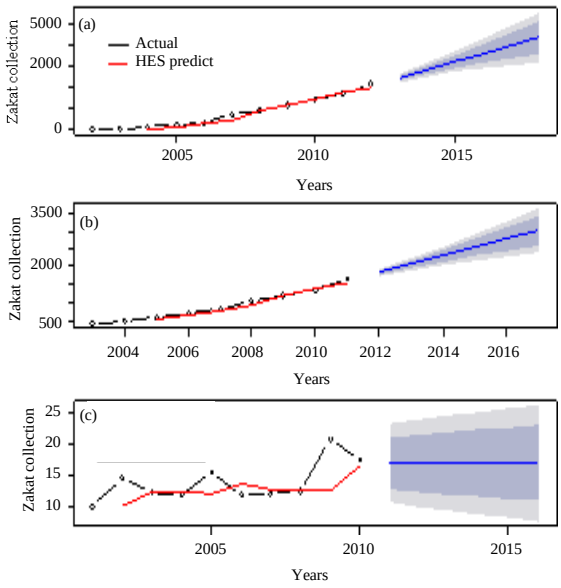

Fig. 4: The graph of the fit models and prediction for Zakat collection in Indonesia, Malaysia and Brunai; a) The predicition Zakat collection in Indonesia; b) The predicition Zakat collection in Malaysia and c) The predicition Zakat collection in Brunai Darussalam

the comparison of MAPE and MSE between two models for Zakat collection. In this case, the most suitable model to be used in Indonesia and Malaysia is HES model. From the comparison in Table 4, it shows clearly that the HES model is the best model to predict the amount of Zakat collection in the next 6 years. This is because from the MAPE and MSE for HES is obtained the smallest value. Howaver, In Brunai case, the most suitable model is SES model. Therefore, HES Model is the best model in prediction Zakat collection data in Indonesia and Malaysia and SES model for Brunai.

Figure 4 and Table 5 display the time plot of the actual fitted and 6 years forecast for Zakat collection in Indonesia and Malaysia using the HES model with 95% confidence interval. It can be seen that all the forecasted values fall within the confidence interval

which shows the level of accuracy. However, in Brunai case, fitted and 6 years forecast for Zakat collection using the SES Model with 95% confidence interval. Furthermore, the assumption that the 80 and 95% prediction intervals were based on are probably valid.

CONCLUSION

In this study, yearly Zakat collection of Indonesia, Malaysia and Brunai 2014 are analyzed and used to forecast Zakat collection. The some Holt's winters models was used to forecasts Zakat collection. Based on the forecasted results summarized in Table 4 and Fig. 4. Results show is an adequate model which best fits the Zakat time series data and is therefore suitable for forecasting Zakat. However, the choice of fit model the some Holt's Winters Model is good considering the smaller deviations in the MAPE and RMSE. As a conclusion, HES is the best model to be use due the smallest amount of SSE comparing to the SES models for characteristic data with increasing or decreasing trend and no seasonality like Zakat collection in Indonesia and Malaysia. However, Simple exponential smoothing models is the best model for characteristic data with constant level and no seasonaility like Zakat collection in Brunai. Thus, the parties responsible for collecting Zakat on this can put a reasonable target for the collection of Zakat to be obtained in the future. In addition, they can make plans to distribute alms they get based on the number of goals that have been recommended distribution. Next, the information supplied is also indirectly increase the efficiency of management in managing the collection of Zakat.

ACKNOWLEDGEMENTS

Researchers are thankful to Department of Mathematics and Statistics, Faculty of Scient and Tecnology, Universitas Islam Negeri Sultan Syarif Kasim Riau (UIN Suska) for support.

REFERENCES

Akbarizan, M.M., S. Hertina, M. Abdi, R. Yendra and A. Fudholi, 2016. Utilization of holt's forecasting model for Zakat collection in Indonesia. Am. J. Appl. Sci., 13: 1342-1346.

Hudayati, A. and A. Tohirin, 2010. Management of zakah: Centralised Vs decentralised approach. Proceedings of the 7th International Conference on Tawhidi Epistemology: Zakat and Waqf Economy, (ZWE'10), January 6-7, 2010, Institut Islam Hadhari, Bangi, Malaysia, ISBN:978-983-44351-2-7, pp: 351-374.

Islamic, 2014. Islamic social finance report 2014. Thomson Reuters, New York, USA.,.

Jere, S. and M. Siyanga, 2016. Forecasting inflation rate of Zambia using holt's exponential smoothing. Open J. Stat., 6: 363-372.

Osman, A.H.A., 2007. Potential Payers and Zakat Collections in Malaysia. Utusan Publications, Kuala Lumpur, Malaysia,.

Ostertagova, E. and O. Ostertag, 2012. Forecasting using simple exponential smoothing method. Acta Electr. Inf., 12: 62-66.

Shamsuddin, S.M., R. Sallehuddin and N.M. Yusof, 2008. Application of grey relational analysis for multivariate time series. J. Sci., 35: 1-16.

Yao, J.T., 2002. Towards a better forecasting model for economic indices. Proceedings of the 6th Joint Conference on Information Science, March 8-13, 2002, Research Triangle Park, North Carolina, USA., pp: 299-303.