Comparative Analysis Method Single Exponential Smoothing Method and Holt's Recovery in Hospital Services in General Hospital

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Abstract—The quality health services are one of the basic necessities of any person or customer. To predict the amount of goods, can be done in a way predicted. Comparison Method of Single Exponential Smoothing and Holt's method is used to predict the accuracy of inpatient services will be back for the coming period. Single Exponential Smoothing the forecasting methods used for data stationary or data is relatively stable. Holt's method is used to test for a trend or data that has a tendency to increase or decrease in the long term. The outcome of this study is the Single Exponential Smoothing method is more precise than Holt's method because of the history of hospitalized patients do not experience an increase or no trend. In addition, the percentage of error (the difference between the actual data with the forecast value) and MAD (Mean Absolute Deviation) to calculate the forecast error obtained from Single Exponential Smoothing method is smaller compared to Holt's method.

Keywords—Hospital services, hospitals, pelanggang, Meotde Single Exponential Smoothing and Holt's method, MAD.

1 Introduction

Utilization of services hospitalization is the most important thing in the hospital for using forecasting hospital can predict how many patients will come back and eventually affect the continuity of the development of the hospital itself cannot be separated from the interaction of three main elements, namely customer service officer and management[1][2]. Because of these interactions, raised the output of a process of delivering services in the form of service to be revalued by its customers as a quality and satisfactory service[3]. Understanding the needs of patients is an important thing that affects patient satisfaction. Patients who are satisfied is a very valuable asset, because the patient satisfaction will provide information to people close (relatives, family and neighbor), that the services provided by the public hospitals very satisfying[4]. Hospital as a referral service units of health care units under it such as: health center, private

physician practices, pharmacies and others, are also part of the output of hospital services required to foster good cooperation and mutual benefit with emphasis on patient satisfaction[5]. By using the method of Single Exponential Smoothing and Holt's method, we can estimate the number of patients who will return to the hospital[6].

2 Literature Review

Researchers linked, Anggi Hartono, Djoni Dwijana, Wimmie Handiwidjojo, Method Single Exponential Smoothing average percentage error (the difference between the actual data with the forecast value) smaller than Holt method has a greater percentage of error. exponential smoothing (Exponential Smoothing)[7] is a forecasting method based on the calculation of average (smoothing) past data exponentially with continuously repeating calculations using the latest data. Any data will be weighted, with more recent data are given greater weight[8]. According to Spyros et al, Exponential Smoothing Methods the moving-average method which gives stronger weight on recent data than the initial data. Single exponential smoothing will always follow every trend in real data[9], because they can do no more than regulate the upcoming forecast by a percentage of the last error. Past forecast errors are used to correct for the next forecast in the opposite direction to the error[10].

3 Method

3.1 Method of single exponential smoothing

Single Exponential Smoothing method is a method that shows weighting decreases exponentially with observed values older[11]. Value is later given relatively greater weight than the value of observation is longer[12]. This method gives an exponential weighted moving average of all values of previous observations. In this method is not affected by this trend and the season. The formula is as follows:

$$\hat{Y}t+1 = \alpha Yt + (1-\alpha)\ \hat{Y}t \quad (1)$$

Information:
$\hat{Y}t+1$ = value forecast for the next period
Yt = demand for period t
$\hat{Y}t$ = forecast value for period t
α = smoothing weighting factor ($0 < \alpha < 1$)
In the formula (1), to predict the value of the next period, the necessary demand data from previous periods and forecasting the previous period.

3.2 Method of Holt's

This method is often referred to Holt's Method[13]. This method is used when the demand is influenced trend but is not influenced by the seasons[14]. According

Makridakis, Wheelwright and Hyndman This method paved the trend values with different parameters of the parameters used in the original series. To forecast the demand in the next period, should be known to forecast the level or the value of new refining and estimate trends. Here's the formula to determine the level forecast and estimates of the trend:

$$Lt = \alpha Yt + (1-\alpha)(Lt-1 + Tt-1) \quad (2)$$

$$Tt = \beta (Lt - Lt-1) + (1-\beta) Tt-1 \quad (3)$$

In the formula (2), the value of smoothing all t need the data requests that all t, the value of smoothing the previous period and the value of the previous trend. Having in mind the value of smoothing all t, then you can get the value t trend that all formula (3). The forecast level and trend estimates have been obtained, then can know the real demand forecasting period in the future with the following formula:

$$\hat{Y}t+p = Lt+pTt \quad (4)$$

Information:
Lt = the estimated level (new smoothing value)
Yt = demand in period t
Tt = trend estimate for the period t
$\hat{Y}t+p$ = the forecast for future periods p
P = the numbers of periods to forecast future
α = smoothing weighting factor for the level ($0 < \alpha < 1$)
β = a weighting factor for the trend smoothing ($0 < \beta < 1$)

3.3 MAD (Mean Absolute Deviation)

MAD is one formula for calculating the forecast error[15]. MAD is the median absolute deviation. Its use is by calculating all the deviation (difference between demand and forecasting) and absolutize all negative into a positive value is then divided by the amount of data that there is a formula (5). The formula is as follows:

$$MADn = (Sum\ (t= 1\ to\ n)\ [A\ t])\ /n \quad (5)$$

Information:
At = absolute deviation for period t = | Et |
n = amount of data
To calculate Et, required data is present period is reduced by the present value of the forecast period as specified in the formula (6)

$$Et = Yt - \hat{Y}t \quad (6)$$

Information:
Et = forecast error in period t
Yt = the real value in period t (request)
$\hat{Y}t$ = forecast value for period t

4 Discussion and Analysis

4.1 Analysis

The dataset is processed using the application of Olives to predict or forecast time series against the re-utilization of inpatient services by using a dataset from 2000 to 2015, hospital and (1) hospital Makassar.

4.2 Sample and population

Population: The population was inpatients more than one day at the General Hospital Makassar.
Sample: The number of samples to be taken using the following formula

$$n = \frac{N.Z^2.pq}{d^2(N-1) + Z^2.p.q}$$

Information :
n = large sample
N = Large Population (2157 in patients)
P = The proportion of inpatients = 0.5
q = 1 – P = 1 – 0,5 = 0,5
D = The level of accuracy is used 0.1
Z = Standard deviation is appropriate, it is used in accordance with the degree of prosperity 1.96 or 95%

$$n = \frac{2157.\ 1,96^2\ .\ 0,5.\ 0,5}{0,1^2\ (2157 - 1) + 1,96^2.\ 0,5.\ 0,5}$$

$$n = \frac{207,158,2800}{962,556}$$

n = 2152,1686 = 2152 Inpatients

4.3 Methods of analysis

$$\mathbf{Y = B0 + B1X1 + B2X2 + B3X3 + B4X4 + B5X5 + ei}$$

Where:
Y = Interests reuse inpatient services
X1 = Medical facilities and medicine (Availability)
X2 =Responsiveness (Responsiveness)
X3 = Reliability and accuracy (Reliability)

X4 = Assurance (Assurance)
X5 = Concern (Empathy)
B0 = constants
B1 – B5 = The regression coefficient X
ei = Error term (error factor)

1. Hospital Makassar

Table 1. Hospital

Alpa = 0,2	**Alpa = 0,5**
Mean Absoulute Error (MAE) = 215.300667	126.746436
Sum Squared Error (SSE) = 9922953.594179	6723962.7198835
Mean Squared Error (MSE) = 162671.370396	110228.897047

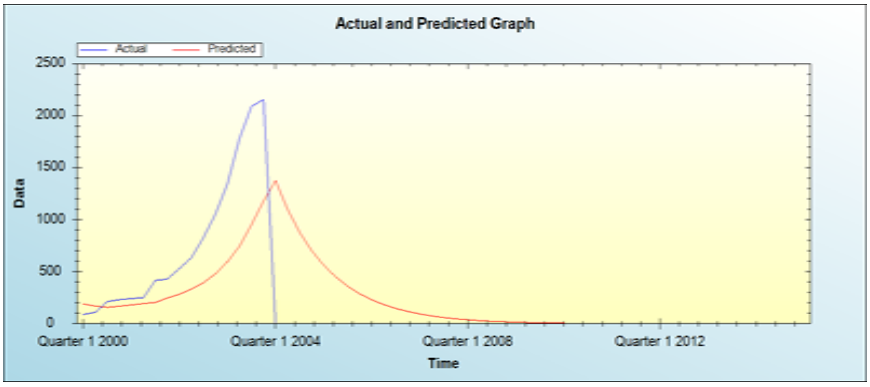

Fig 1. Actual and Predicate Graph

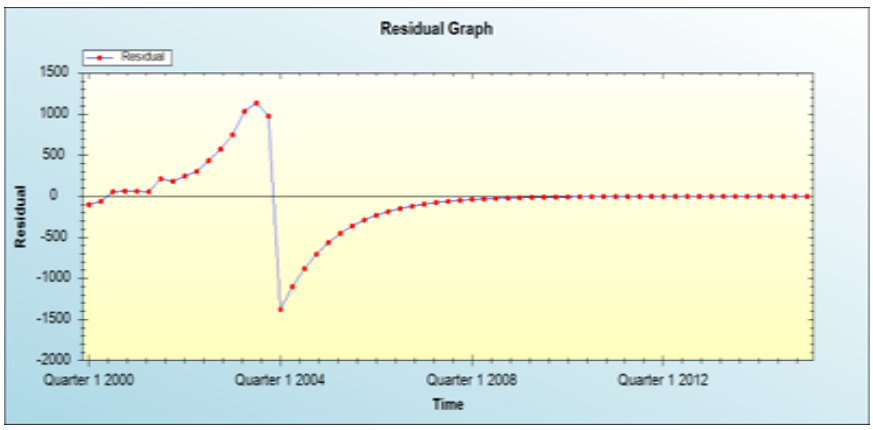

Fig 2. Residual Graph

2. Hospital Makassar (1)

Table 2. (1) Hospital Makassar

Alpa = 0,2	**Alpa = 0,5**
Mean Absoulute Error (MAE) = 57.188027	26.209626
Sum Squared Error (SSE) = 513266.581997	267712.070253
Mean Squared Error (MSE) = 8414.206262	4388.722463

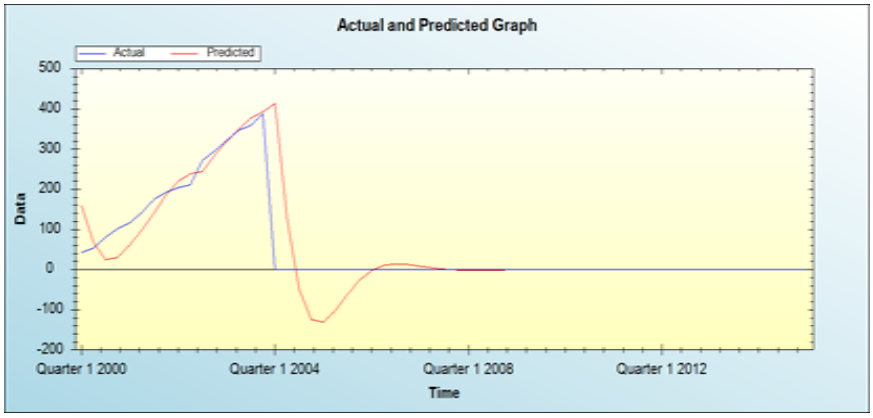

Fig 3. Actual and Predicate Graph

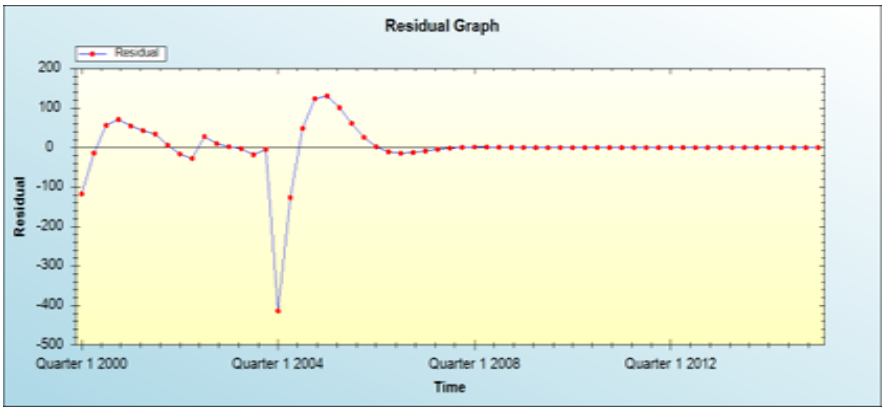

Fig 4. Residual Graph

4.4 Discussion

Table 3. Comparison of Alpha 0,2

(2)	(1)
α = 0,2	α = 0,2
MAE = 215.300667	MAE = 57.188027
SSE = 9922953.594179	SSE = 513266.581997
MSE = 162671.370396	MSE = 8414.206262

Table 4. Comparison of alpha 0,5

(2)	(1)
α = 0,5	α = 0,5
MAE = 126.746436	MAE = 26.209626
SSE = 6723962.7198835	SSE = 267712.070253
MSE = 110228.897047	MSE = 4388.722463

5 Conclusion

Based on the results Discussion and Analysis can be concluded that with α = 0.2 at (1) hospital MAE 57.188027 better than MAE hospital Makassar, while the SSE (1) hospital is better that 513266.581997 and MSEnya also better that is equal to 8414.206262. for α = 0.5 (1) hospital MAEnya 26.209626 better than MAE hospital for SSE 267712.070253 also better than (1) hospital while MSEnya better at 4388.722463.

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