

USING R TO FORECAST SYSTEM DEFECTS OF ALBANIAN FIXED TELEPHONE NETWORK

Msc. Alvin ASIMI¹, Prof. Dr Lulëzim HANELLI²

¹ *Department of Mathematics Engineering, Polytechnic University of Tirana, Tirana, Albania*

² *Department of Mathematics Engineering, Polytechnic University of Tirana, Tirana, Albania*

ABSTRACT

The main goal of fixed telephone operators is the maintenance and the management of the entire telephone network in order to improve the quality of service. Determining the best models for processing defects data is a very good approach to achieve this goal. Time series models are very helpful for this problem. Based on them we can build good models for predicting the number of network defects. This will help a lot in organizing various management politics and intervention in this primary problem for any telephone operator.

Keywords: Time series, Exponential smoothing, Holt Winters model, Forecasts, fixed telephony, R-software.

I. INTRODUCTION

We present a Holt Winters smoothing model for forecasting system breakdowns of a fixed telephone company in Albania. Collected data consists in 853 measurements (Excel format .xlsx) which are daily collected all over the Albanian Network. The period covered is: 1 January 2014 to 30 April 2016. We will use the Holt Winters model for forecasting system breakdowns for the period 1 May- 31 December 2016.

We will use R to manipulate with the data and built the forecasting model. For this propose, we convert data from .xlsx format to csv (*comma separated delimited*) – format. This conversion is done with Excel. R is open source statistical software and can be downloaded at <http://cran.r-project.org>. All the commands used for this purpose are included with *expsmooth* and *forecast* packages. Figure 1 presents the data.

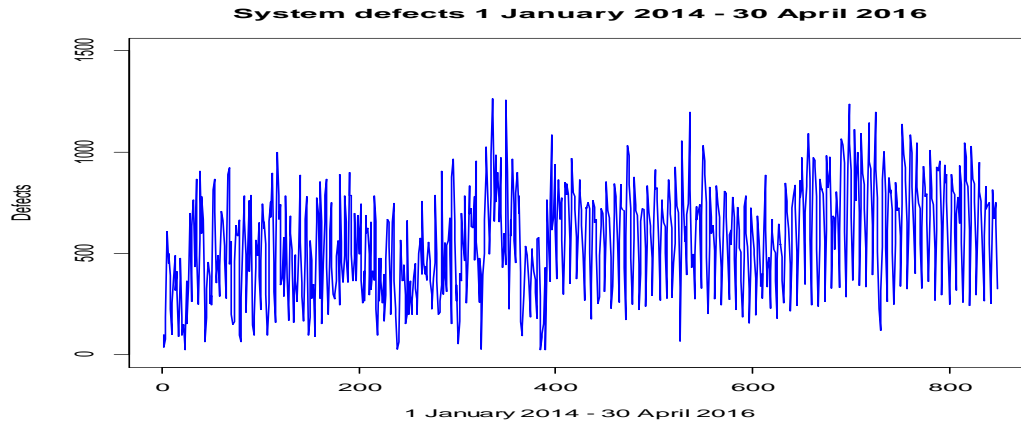


Fig 1. Data collected from 1 January 2014 to 30April 2016.

II. MODEL ESTIMATION

Based on Fig 1, we can see that collected data exhibit an alternate trend component. In some periods the number of system defects shows a decreasing trend and in some others a growing one. In order to have a better view of the trend component and the seasonal component we decompose our time series.

This could be done with R-command *decompose()*. Figure 2 shows the time series components.

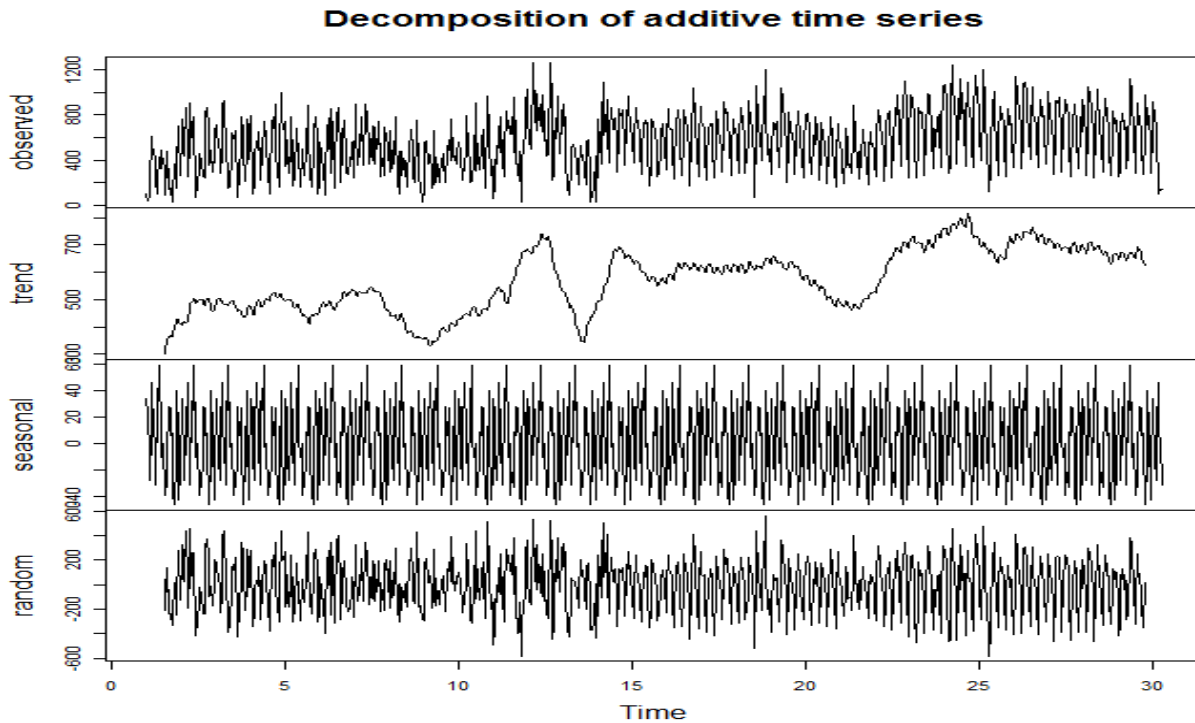


Fig 2. Decomposition of time series (From Top: 1.Data collected, 2. Trend

component, 3. Seasonal component, 4. Noise component)

As we can see from figure 2, our series exhibit a general growing trend but there are some stationary periods and also some periods when defects number decrease. For a better view of the seasonal component we present the defects number per month in the following figure.

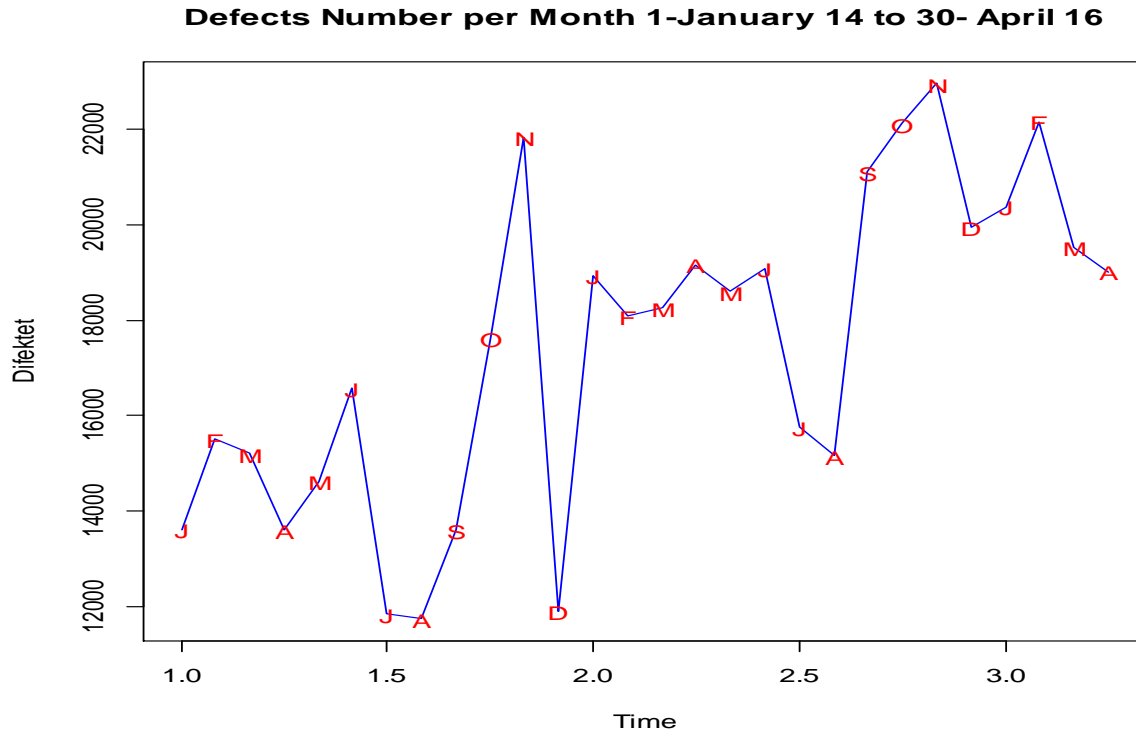


Fig 3. Defects Number per month 1-January 14 to 30- April 16

Figure 3 shows the seasonal component of our series. We can see the same behavior of the defects number for the period August – September – October – November. This is the period with the biggest number of defects of the entire year. We also notice a decreasing defects trend for the period June to August and a stationary period from January to June. The peak is reached in November and the smallest number of defects is reached in August.

Now we estimate the Holt Winter smoothing model using R. For this purpose we use the R-function *Holt-Winters()*.

The developed model (using R) is:

Holt-Winters exponential smoothing with trend and additive seasonal component with parameters:
 alpha: 0.09420494 (for the model)
 beta : 0.006476297 (for the trend component)
 gamma: 0.1775641 (for seasonal component)

In the figure below we present the estimated model.

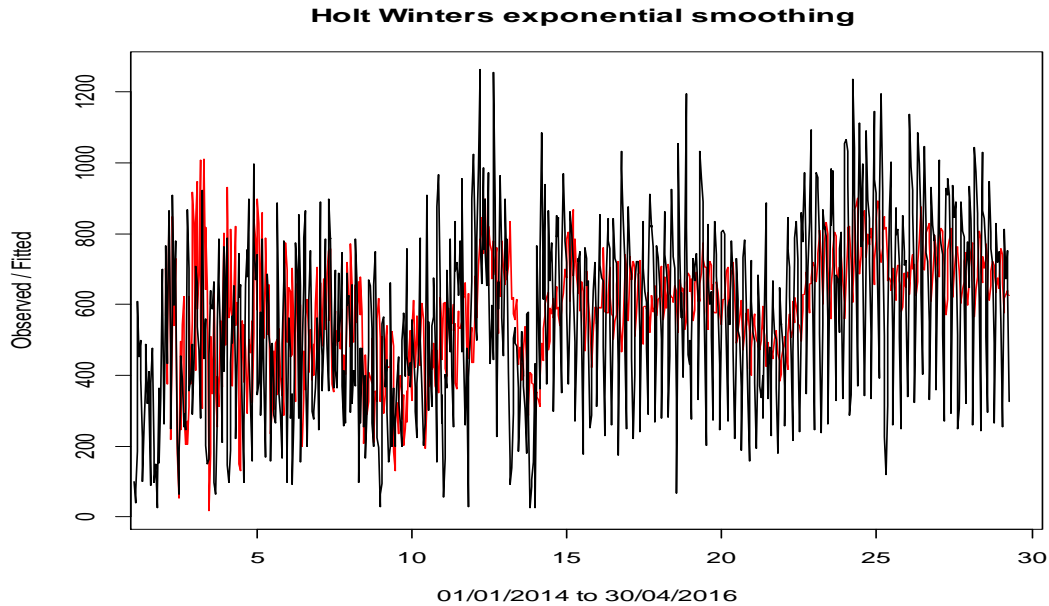


Fig 4. Holt Winters exponential smoothing for network defects

We will use the estimated model to forecast system defects for the rest of 2016. The forecasts are shown in figure 5.

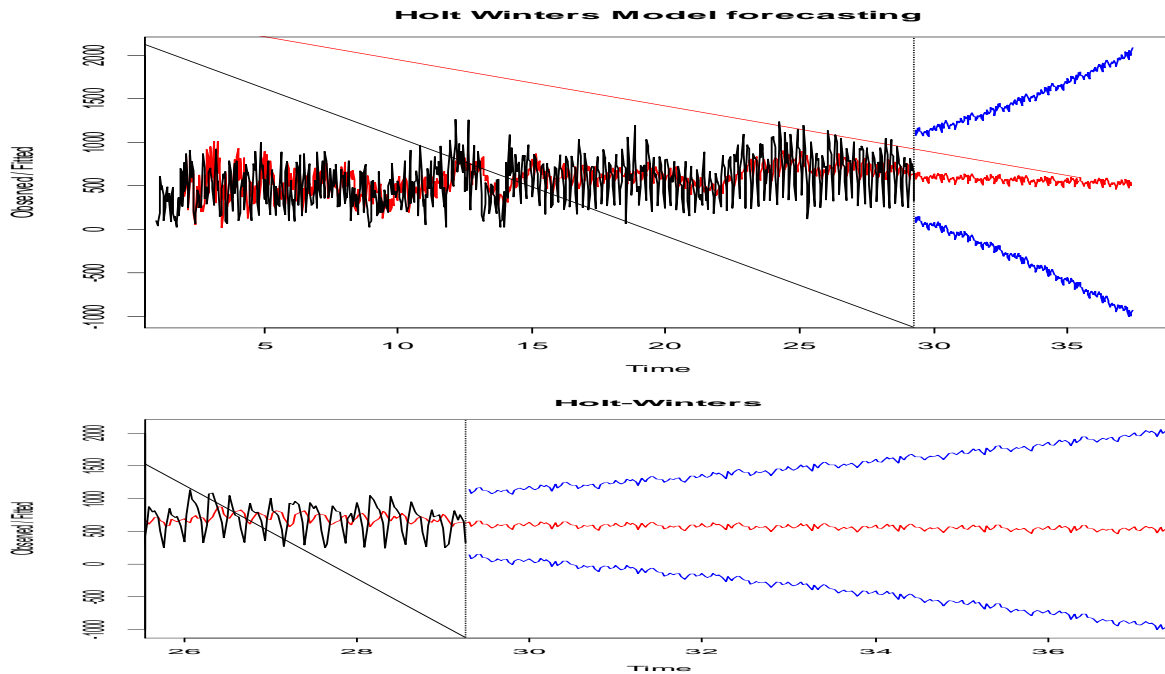


Fig 5. System defects forecasts for entire 2016 year using Holt Winters model. (black line- data collected, red line- forecasts , blue line – forecasting intervals)

Based on the forecasts, we will not expect any increase in the number of defects reported for the

rest of 2016.

III. CONCLUSIONS

- The main goal of fixed telephone operators is to improve the quality of service.
- Using Time Series we can build good models for predicting the number of network defects
- Managing defects help a lot in organizing various management politics and intervention in this primary problem for any telephone operator.
- Based on the forecasts, we will not expect any increase in the number of defects reported for the rest of 2016.
- The largest number of defects occurs during October-November.
- We used R for the forecast models
- R is a open source statistical software

REFERENCES

- [1] *Forecasting with Exponential Smoothing The State Space Approach* - Rob J. Hyndman, Anne B. Koehler, J. Keith Ord and Ralph D. Snyder (2008)
ISBN 978-3-540-71916-8 e-ISBN 978-3-540-71918-2
- [2] *A state space framework for automatic forecasting using exponential smoothing methods* Rob J. Hyndmana, Anne B. Koehler, Ralph D. Snyder, Simone Grose
International Journal of Forecasting 18 (2002) 439–454
- [3] *Time Series Analysis With Applications in R Second Edition*-Jonathan D. Cryer • Kung-SikChan (2008)
ISBN: 978-0-387-75958-6 e-ISBN: 978-0-387-75959-3