ISYE 6501, Week 4 HW - Yoganand Mandali

Question 1

Describe a situation or problem from your job, everyday life, current events, etc., for which exponential smoothing would be appropriate. What data would you need? Would you expect the value of α (the first smoothing parameter) to be closer to 0 or 1, and why?

Response –

In hospitals, some inventory items are crucial and should be carefully controlled. An exponentially smoothed forecast could be useful to forecast the demand for surgical gloves. These items are also used in many other departments where a temporary shortage would not lead to crisis. Hospital supply could easily apply exponential smoothing to forecast demand for linen, disposable syringes and other commonly used items.

The smoothing parameter α would be close to zero as demand of crucial items in a hospital remain standard during a typical time period based on the number of staff working at the hospital, and the number of beds for patients.

Question 2

Using the 20 years of daily high temperature data for Atlanta (July through October) from Homework 3 Question 3, build and use an exponential smoothing model to help make a judgment of whether the unofficial end of summer has gotten later over the 20 years. (Part of the point of this assignment is for you to think about how you might use exponential smoothing to answer this question.)

Response –

Exponential smoothing is implemented using HoltWinters method in R. Multiple scenarios are tested using manual alpha, beta values and finally HoltWinters is run without any alpha and beta values assigned.

CUSUM analysis is performed on the seasonal factors to find if there is a pattern of shift in unofficial end of summer for the 20 years in the input data. C and T values are chosen as half the standard dev of July data and 4 times the standard deviation of July data respectively.

Multiple iterations are run varying alpha, beta values and the results are illustrated as follows:

Case 1 – alpha =0.03

Holtwinters is performed with a hard-assigned value of alpha and "seasonal" set as additive. The outcome of CUSUM analysis is shown below.

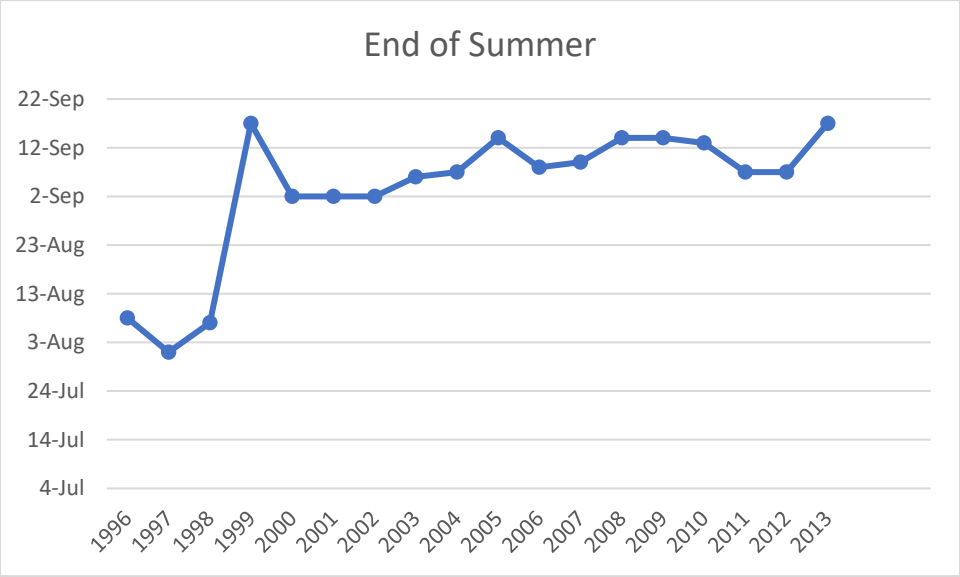


Figure 1 – CUSUM output for assigned alpha=0.03

Case 2 – alpha =0.03, beta=0.06

Holtwinters is performed with a hard-assigned value of alpha and beta and "seasonal" set as additive. The outcome of CUSUM analysis is shown below.

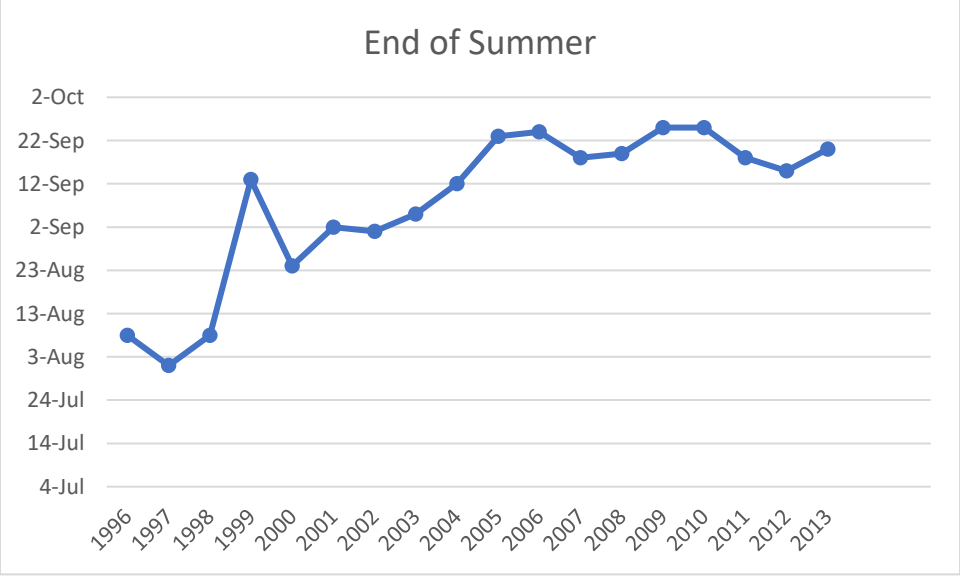
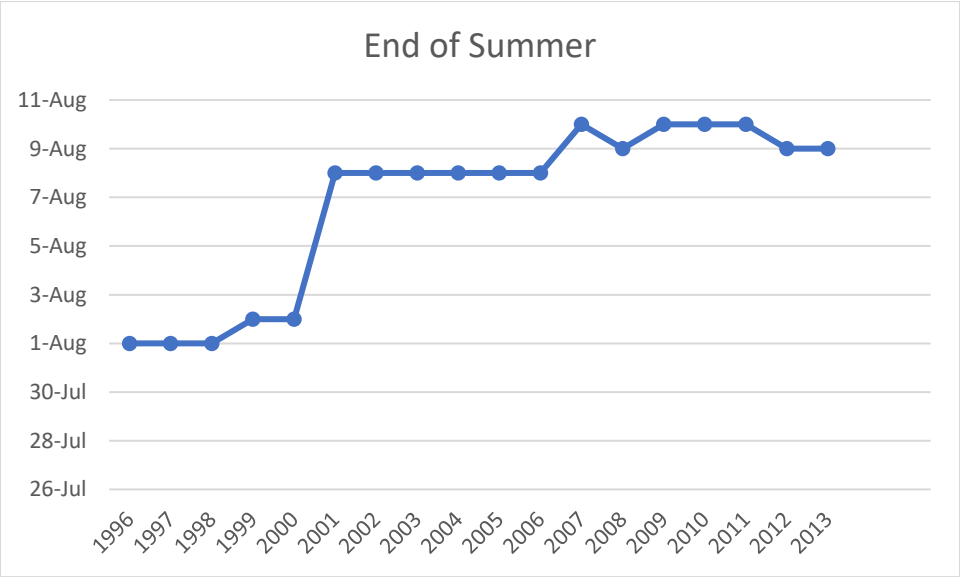


Figure 2- CUSUM output for alpha=0.03, beta=0.06

Case 3 – No parameters provided

Holtwinters is performed with no hard-assigned values and only “seasonal” is set to additive. The outcome of CUSUM analysis is shown below.



It can be observed that for all the 3 cases, the unofficial shift of summer is being shifted to a later date from year 1996 to 2015. Case 1 and Case 2 appear very similar with slight changes in the shift of summer end dates. Whereas, Case 3 maintains constant trend for a couple of years but trend appears to be shifting to a later date overall.

This anomaly in different cases might be due to different alpha, beta and gamma values. Also, selection of C and T while performing CUSUM analysis has a significant impact on the trends that are observed in this analysis.

The conclusion of this exponential smoothing model is that the unofficial end of summer has gotten later over the 20 years.