ISYE-6501
Fall 2024

Homework 4

Question 7.1
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 a (the first smoothing parameter) to be closer to 0 or 1, and why?

As a quality data analyst in a hospital, exponential smoothing would be appropriate for predicting patient admissions. Predicting patient admissions correctly is crucial for accurately assigning staffing and resources. I would need patient days data for a couple years to determine a good historical average. I would also need to determine a time index which would be monthly. I would also need to know external factors or events, such as if the month is in the flu season or if there are any public health emergencies in action during that month. I would expect the value of a to differ based on external events. Let's say during the flu season I would choose an α value close to 1 so that the forecast would align more to recent events and patterns. If there are no public health emergencies or flu season during that month, I would choose an α value closer to 0 to align more to historical data which would help reduce influence from short term outlier events. I would also chose a higher seasonality coefficient due to the fact that flu season (fall and winter) tend to increase the amount of patient admissions.

Question 7.2
Using the 20 years of daily high temperature data for Atlanta (July through October) from Question 6.2, 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.

ANALYSIS:

After running the HoltWinters method on the temps.txt data, here are my findings along with my R code and output, along with notes.

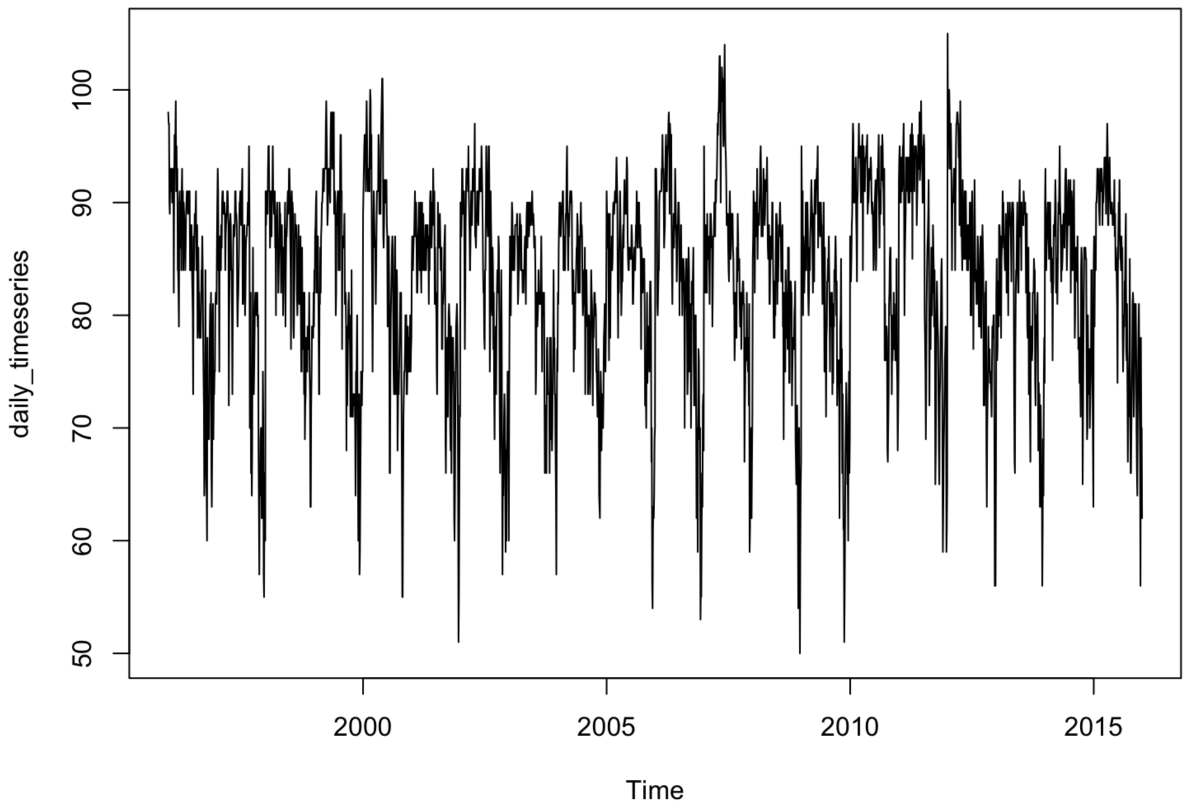
I decided to use the multiplicative method rather than the additive method due to seasonality changes in the data. Temperatures tend to decrease as the summer ends and increase again as the summer starts.

The alpha value of 0.615 is closer to 1 meaning that the most recent observations have more impact that the farther previous historical observations. The **beta value of 0** proposes that there is not a statistically significant increase in temperatures over the last few years. And the gamma value of 0.55 which is slightly closer to 1 than 0 suggests that there are slightly more important trends in seasonality in the more recent times.
With these three values calculated, there is not enough significant change in the temperatures over time to deduce that the summers have gotten longer.

CODE:

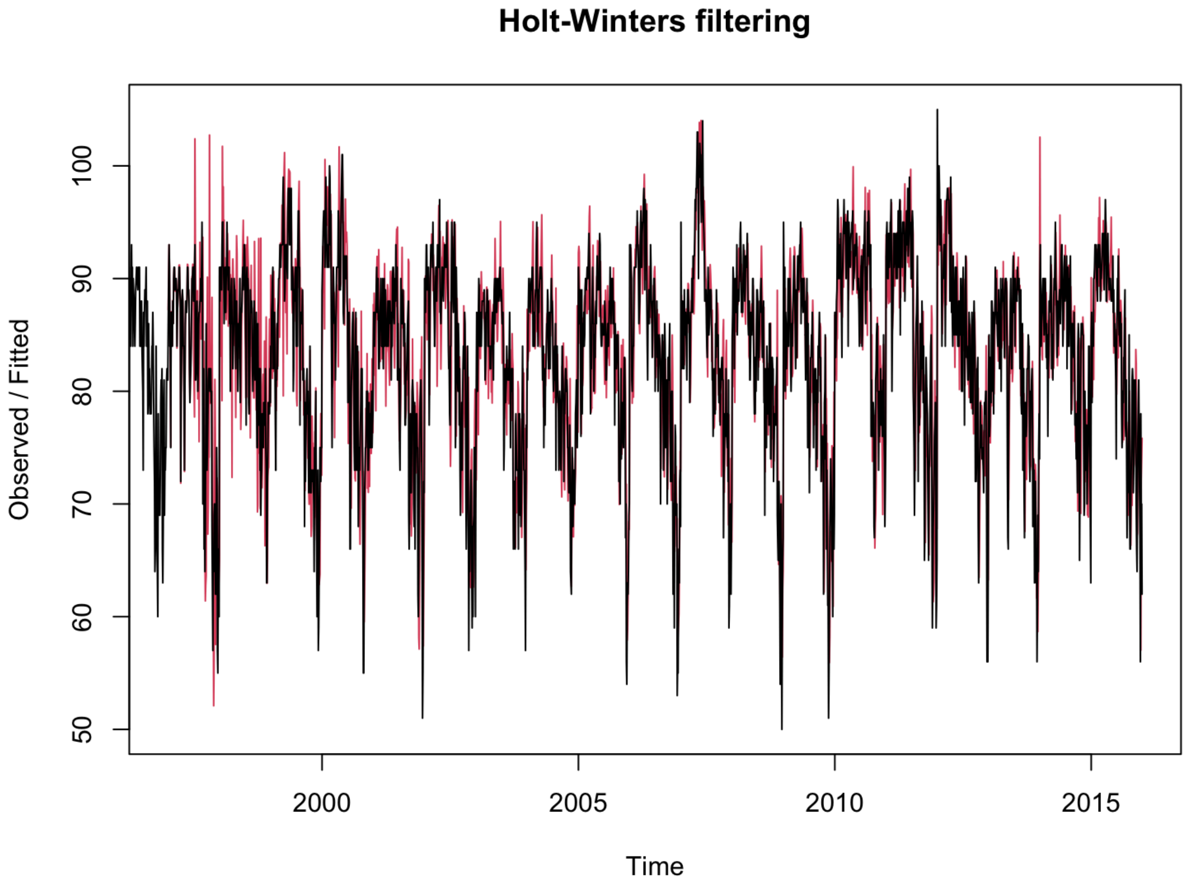
```
> library(forecast)
> data <- read.table("temps.txt", header = TRUE)
> daily_temps <- as.vector(unlist(data[,2:21]))
> daily_timeseries <- ts(data = daily_temps, frequency = 123, start=1996)
> plot.ts(daily_timeseries)
```

Find below the timeseries model of the daily temperatures.




```
> temps_HoltW<- HoltWinters(daily_timeseries, alpha = NULL, beta = NULL, gamma = NULL, seasonal = "multiplicative")
> temps_HoltW<- HoltWinters(daily_timeseries, alpha = NULL, beta = NULL, gamma = NULL, seasonal = "multiplicative")
> plot(temps_HoltW)
```

Please find below the Holt Winters smoothing model on the time series model using the multiplicative method rather than the additive method previously illustrated.




```
> holt_SSE = temps_HoltW$SSE
> holt_ovr = temps_HoltW$alpha
> holt_trend = temps_HoltW$beta
> holt_season = temps_HoltW$gamma
> print(paste0('Holt Winters SSE: ', holt_SSE))
[1] "Holt Winters SSE: 68904.5693317477"
> print(paste0('Holt Winters alpha: ', holt_ovr))
[1] "Holt Winters alpha: 0.615002994570597"
> print(paste0('Holt Winters beta: ', holt_trend))
[1] "Holt Winters beta: 0"
> print(paste0('Holt Winters gamma: ', holt_season))
[1] "Holt Winters gamma: 0.549525578453196"
```