Assignment - 1

Time Series Decomposition: To achieve accurate forecasting, we dissected the yy series into trend, seasonality, and error components through time series decomposition. Subsequently, we applied Holt-Winters filtering with various configurations, adjusting trend and seasonality factors (beta and gamma), to smooth the series and extract insightful components.

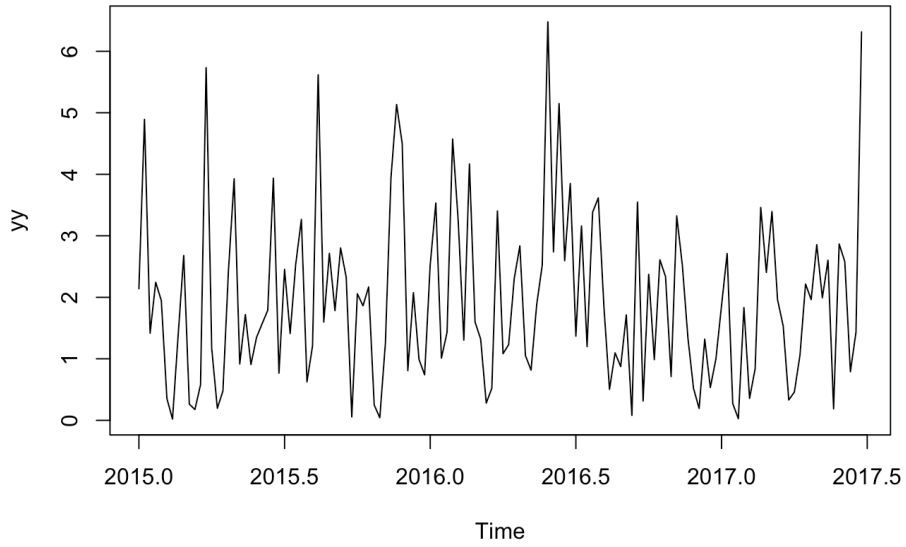
- plot1: Holt-Winters with no trend (Beta) and additive seasonality (Gamma).
- plot2: Holt-Winters with trend (Beta) and additive seasonality (Gamma).
- plot3: Holt-Winters with trend (Beta) but without seasonality (Gamma).
- plot4: Holt-Winters with neither trend (Beta) nor seasonality (Gamma)

Each of these models would provide a different perspective on the data, with *plot1* and *plot3* capturing the seasonal patterns. In contrast, *plot2* and *plot4* would provide a more generalized view by not accounting for seasonality.

Model Output and Fitted Values: We examined the fitted values which are the model's best guess for the time series data, considering the model's smoothing parameters.

Forecasting and Plotting: We performed out-of-sample forecasts using each of the four Holt-Winters models for a 26-week horizon, and specified confidence intervals at 68% and 95%.

Findings:



Interpretation: We noticed that there are spikes in Rainfall on average halfway through the year that are consistent and prominent, which strengthens the case for a seasonal pattern. In addition, we noticed that in the June spikes, the data seems quite volatile, with the magnitude of the peaks and troughs varying significantly. I wouldn't say there are any obvious long-term increases or decreases in the rainfall levels which could imply that the overall climate pattern in terms of rainfall has not changed significantly.

We think the first model where beta = False, and gamma = True is the best model for predicting future rainfall. That is, using only the seasonality but not trend to predict. The two models that predict trends shoot off to a high level of rainfall indefinitely are clearly not desirable predictions. The last model predicts using only the mean of historical data has too much bias, not capturing any fluctuations in the data.

The graphs below are inline with findings.

Holt-Winters with no trend(Beta) and additive seasonality(Gamma).

```
plot(out1)                                    # graph of actual (black) vs fitted (red)
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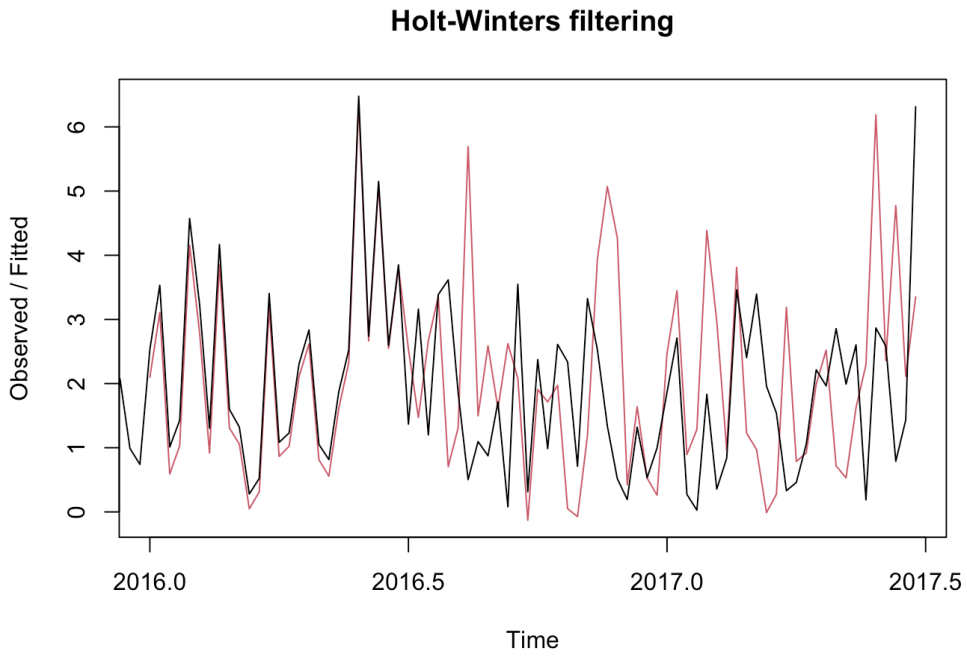
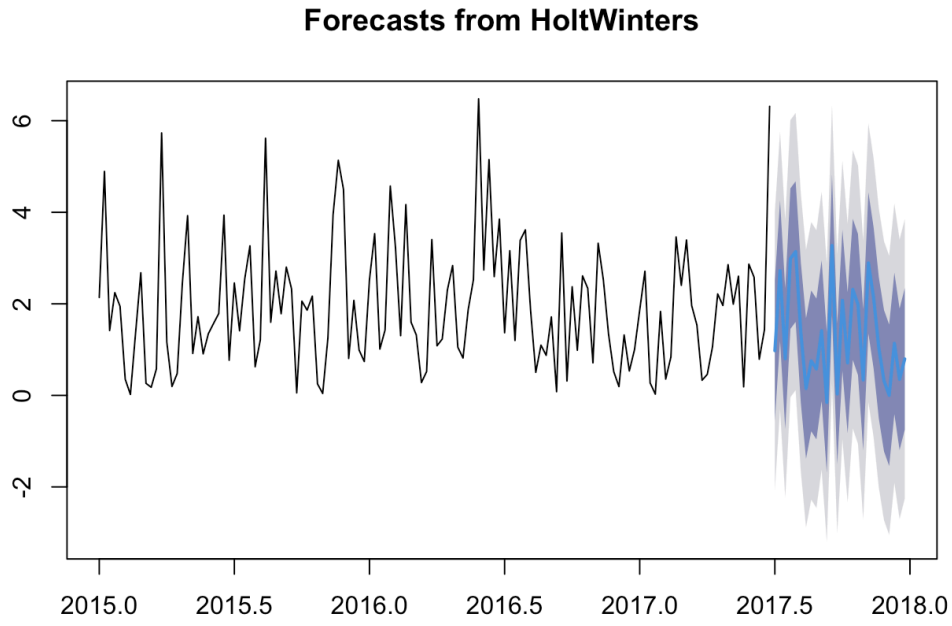



```
plot(out1)
```



The plot1 with no trend Beta = False and Gamma = True can forecast the actual values better when compared to the other 3 models.

The first model where beta = False, and gamma = True is the best model for predicting future rainfall. That is, using only the seasonality but not trend to predict. The two models that predict trends shoot off to a high level of rainfall indefinitely are not desirable predictions. The last model predicts using only the mean of historical data has too much bias, not capturing any fluctuations in the data.