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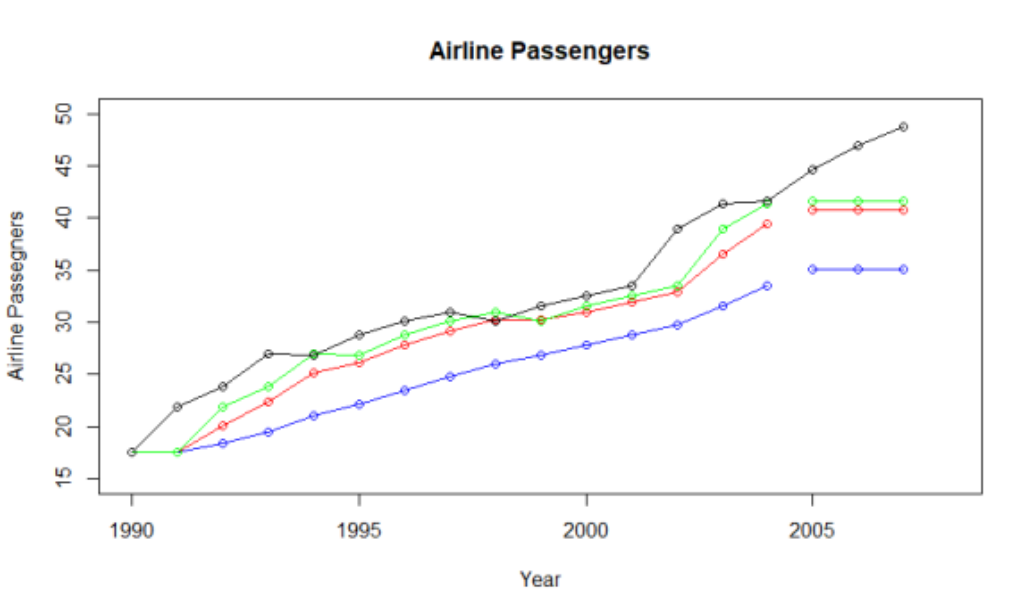
Activity One: SES



Blue line: alpha = 0.2, which means ***more weight*** on the historical data

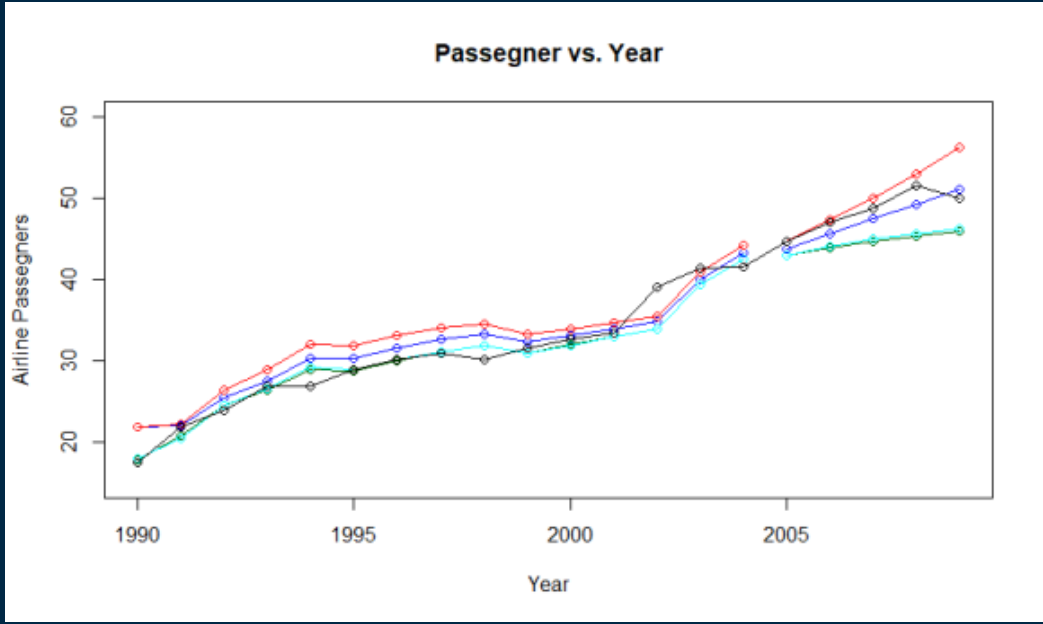
Red line: alpha= 0.6 which means **less weight** on the historical data

Green line: alpha = default, 0.8, **significantly less weight** on historical data, more weight on current data.

Takeaway: Using simple exponential smoothing, the forecast are the moving averages of the most recent data, therefore the next forecast is just a straight line. (not sure if I am 100% correct)

The green line has the least amount of RMSE of 5.44, therefore it is the best fitted line out of three models.

Activity Two: Holt Linear



Blue line: Addictive model using Holt linear trend model.

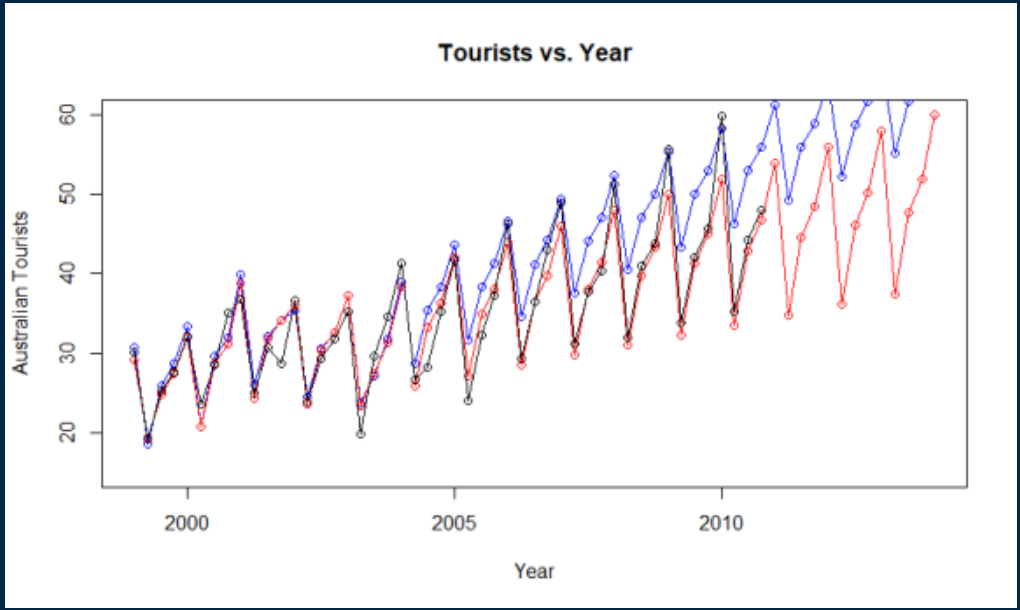
Red line: Multiplicative model using Holt linear trend model.

Green line: Damped addictive model using Holt linear trend model

Cyan line: Damped multiplicative model using Holt linear trend model

The blueline has the lowest RMSE of 1.44, therefore it is the best fitted line.

Activity Three: Holt Seasonal



Blue line: Using Holt Winter Addictive model

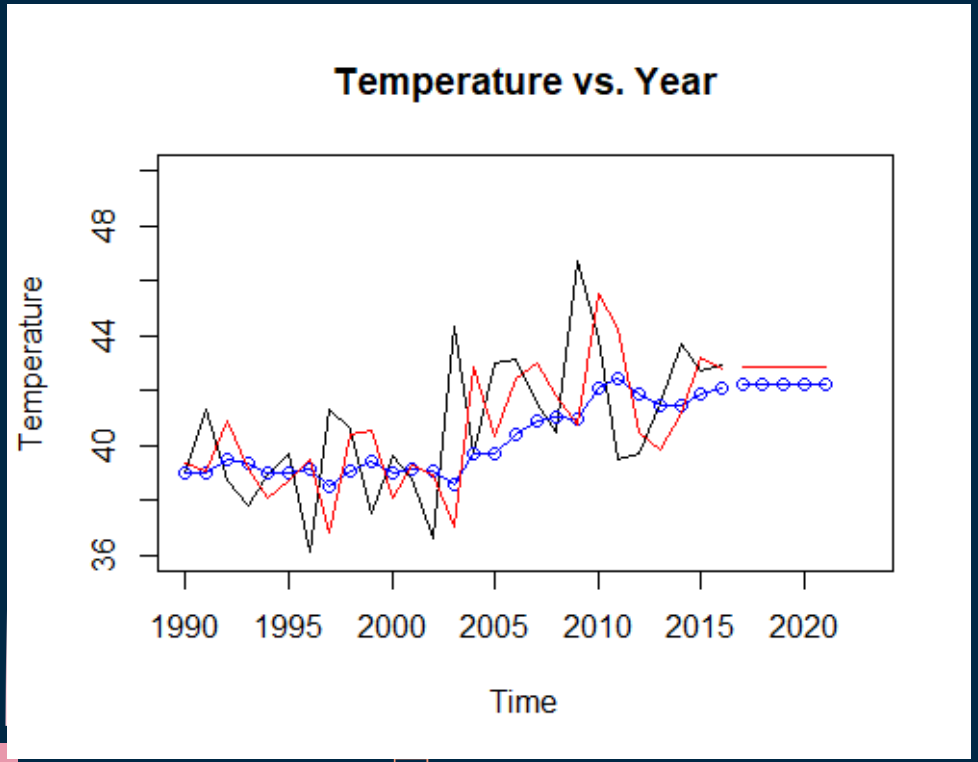
Red line: Using Holt Winter Multiplicative model

Takeaway: The addictive model only takes the "addition" into account, as of trend line is adding the same amount every given period.

The multiplicative model takes the expansion of the slope into account, and the expansion of the slop is growing each year,

Comparing the RMSE, the red line has much less RMSE of 2.62.

Activity Four: Full Analysis



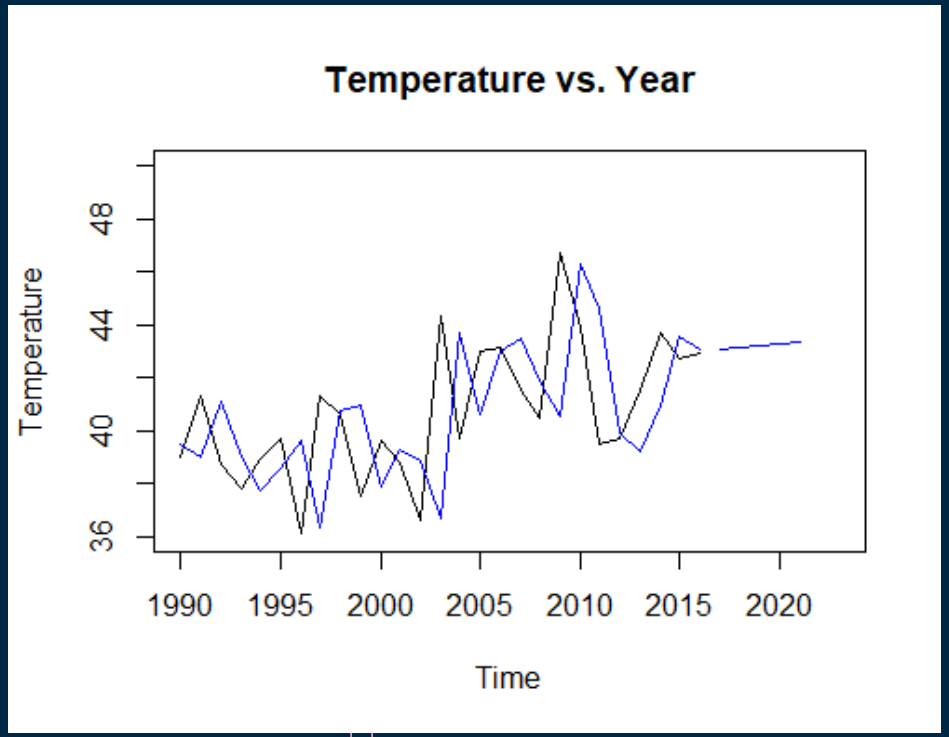
1)Blue line indicates the model using SES, when alpha equals to 0.2, which means more significance to the historical data, red line indicates the line of alpha equals to 0.8.

```
> fit1$model
Simple exponential smoothing

Call:
 ses(y = maxtemp1990, h = 5, alpha = 0.2)

  Smoothing parameters:
    alpha = 0.2

  Initial states:
    l = 39.3687

  sigma:  2.4146

     AIC     AICc      BIC
138.5116 139.0116 141.1032
```

```
                    ME     RMSE      MAE      MPE     MAPE      ACF1
Test set 0.5286836 2.323412 1.779979 1.011113 4.306832 -0.08179753
           Theil's U
Test set 0.7709936
```

We can also find the AICc of 139.0116 and BIC of 141.1032, with RMSE 2.32

Activity Four: Full Analysis



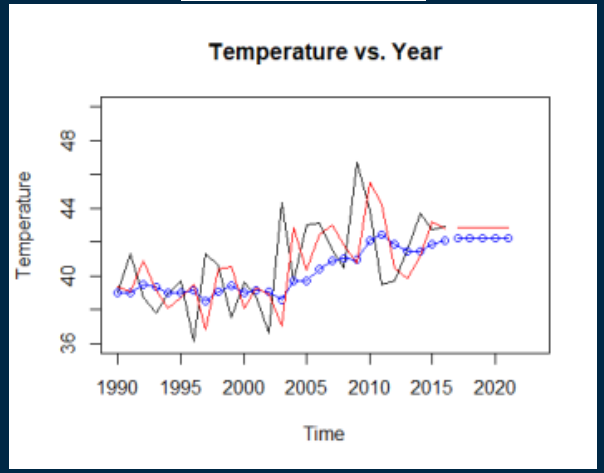
1)Blue line indicates the model using Holts linear model, when alpha = 0.8, beta = 0.2, this is by default the addictive model.

```
Call:
 holt(y = maxtemp1990, h = 5, damped = TRUE, initial = "optimal",

 Call:
     alpha = 0.8, beta = 0.2)

  Smoothing parameters:
    alpha = 0.8
    beta  = 0.2
    phi   = 0.8

  Initial states:
    l = 39.5644
    b = -0.0744

  sigma:  3.3142

     AIC     AICc      BIC
156.1621 157.9802 161.3454

                ME     RMSE      MAE          MPE     MAPE       ACF1
Test set 0.09841365 2.991645 2.318834 -0.03294519 5.652955 -0.3815895
         Theil's U
Test set 0.9924205
```

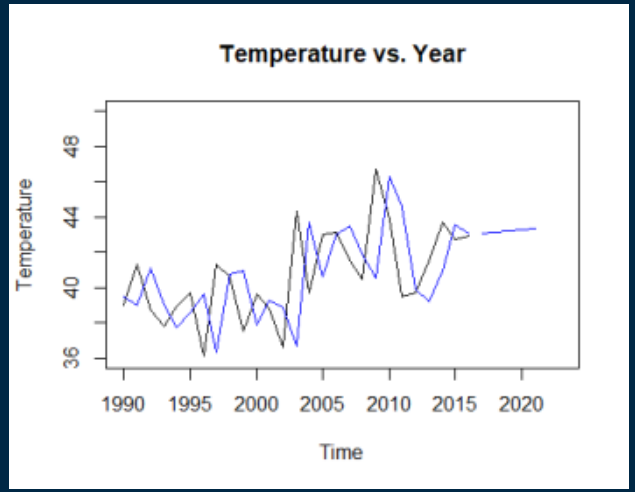
We can also find the AICc of 157.98 and BIC of 161.3454, with RMSE 2.99

Compare Holts linear model to SES model

SES Model



Holts Model



By looking at AICc and BICc, Holts linear model clearly has larger number, which indicates a better fitment, comparing the RSME, the SES model has 2.3 while Holts has 2.9, even though by looking the chart, Holts model clearly fits better but I do not know why SES model has lower RSME, maybe I did something wrong along the way.

TAKE AWAY

- Very intrigued by different time series model to predict the future, learned about about decomposing the model by trend, seasonality, and noise. I think it made a lot of sense to me.
- Question on the previous slide, I don't know why RMSE was lower on the SES model when Holts model clearly looked better.