Exponential Smoothing Forecasting

Forecasting with Exponential Smoothing

- Single ES: constant level (no trend) and no seasonality

- Holt's Exponential Smoothing (Using double ES): has trend and no seasonality.

- Holt-Winters Exponential Smoothing (Using triple ES): has trend and seasonality.
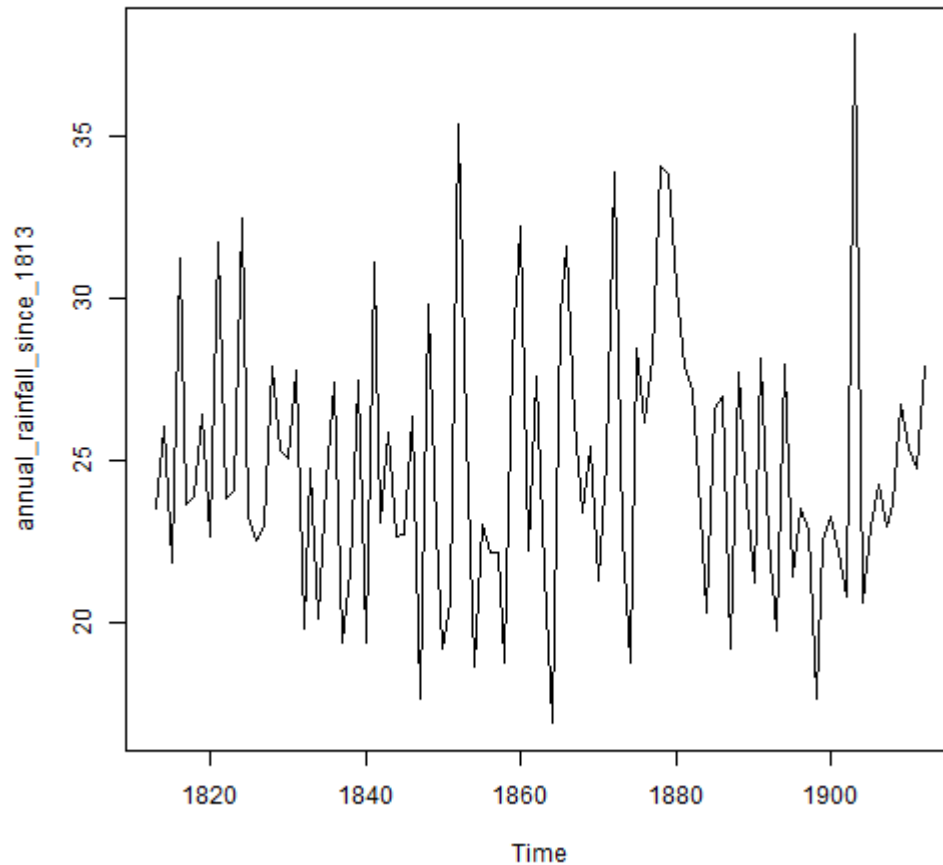
Forecasting with Single Exponential Smoothing

- constant level (no trend) and no seasonality

Forecasting with Single Exponential Smoothing

```
library(forecast)
rain <- read.csv('rainfall_london.csv')
ts1 <- ts(rain,start=c(1813))
plot(ts1)
```

Forecasting with Single Exponential Smoothing

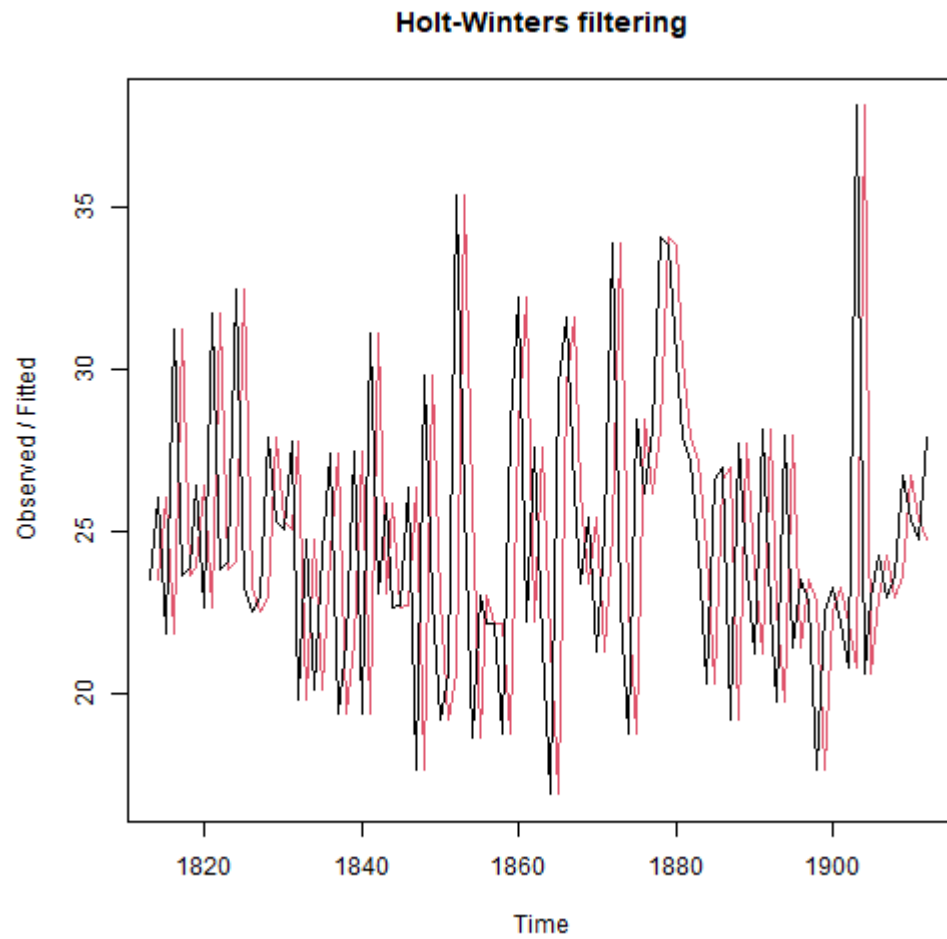# Making Forecast

```
ts1_forecast <- HoltWinters(ts1, alpha=TRUE,
                                  beta=FALSE,
                                  gamma=FALSE)
ts1_forecast
```

```
## Holt-Winters exponential smoothing without trend and without seasonal comp
##
## Call:
## HoltWinters(x = ts1, alpha = TRUE, beta = FALSE, gamma = FALSE)
##
## Smoothing parameters:
##  alpha: TRUE
##  beta : FALSE
##  gamma: FALSE
##
## Coefficients:
##    [,1]
## a 27.88
```

```
plot(ts1_forecast)
```


Holt-Winters filtering

Forecasting

```
ts1_forecast2 <- forecast(ts1_forecast, h=8)
ts1_forecast2
```

```
##      Point Forecast     Lo 80    Hi 80      Lo 95    Hi 95
## 1913          27.88 19.965161 35.79484 15.7752977 39.98470
## 1914          27.88 16.686727 39.07327 10.7613658 44.99863
## 1915          27.88 14.171096 41.58890  6.9140405 48.84596
## 1916          27.88 12.050321 43.70968  3.6705953 52.08940
## 1917          27.88 10.181881 45.57812  0.8130627 54.94694
## 1918          27.88  8.492682 47.26732 -1.7703442 57.53034
## 1919          27.88  6.939303 48.82070 -4.1460321 59.90603
## 1920          27.88  5.493453 50.26655 -6.3572684 62.11727
```

```
plot(ts1_forecast2)
```
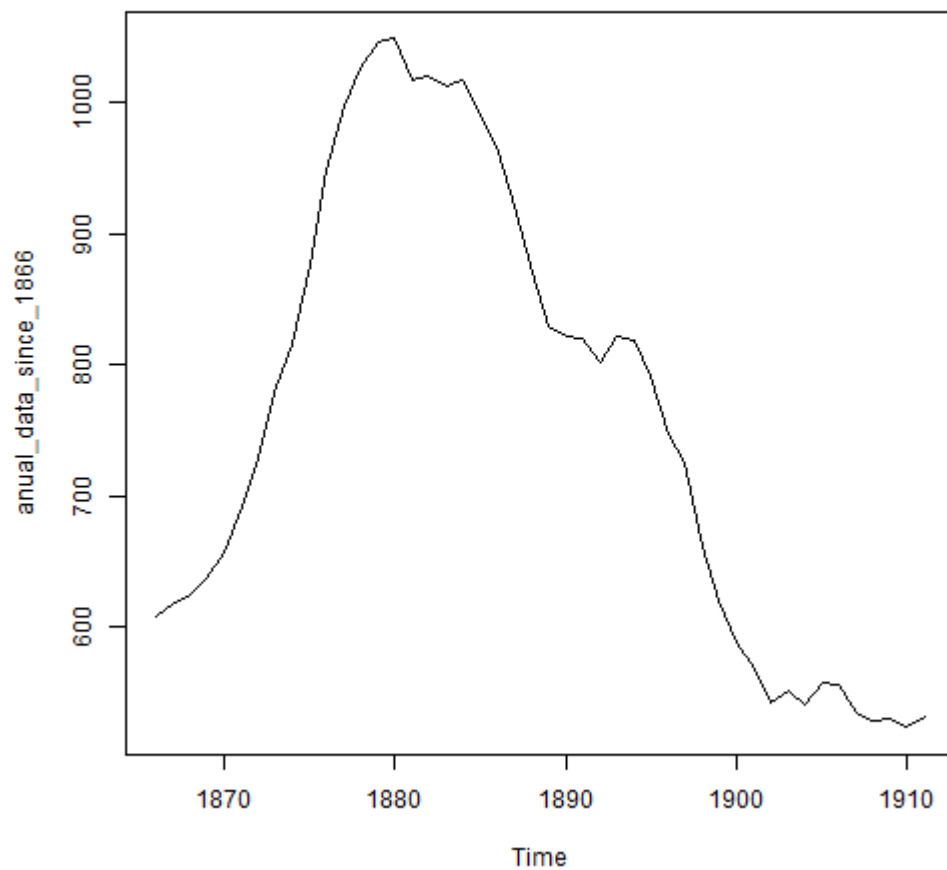

Forecasts from HoltWinters
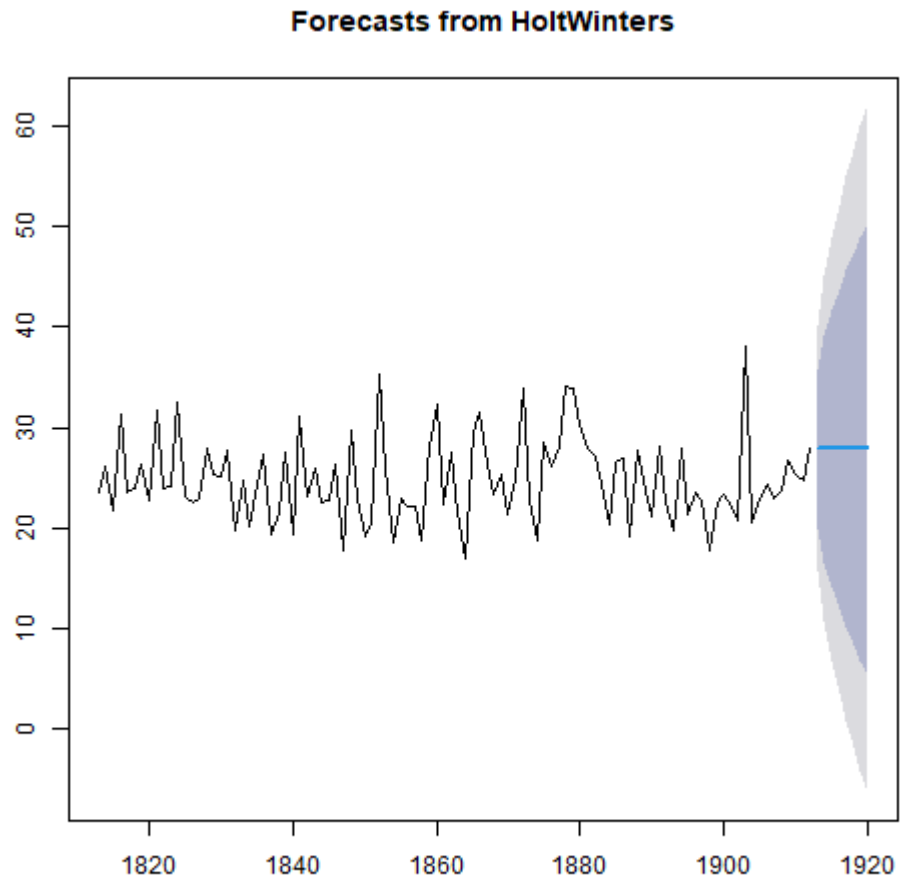
Holt's Exponential Smoothing

- Increasing or decreasing trend and no seasonality

Holt's Exponential Smoothing

```
skirts <- read.csv('skirts.csv')
ts2 <- ts(skirts,start=c(1866))
plot(ts2)
```

```r
ts2_forecast <- HoltWinters(ts2, alpha=TRUE,
                                  beta=TRUE,
                                  gamma=FALSE)
ts2_forecast
```

```
## Holt-Winters exponential smoothing with trend and without seasonal compone
##
## Call:
## HoltWinters(x = ts2, alpha = TRUE, beta = TRUE, gamma = FALSE)
##
## Smoothing parameters:
##  alpha: TRUE
##  beta : TRUE
##  gamma: FALSE
##
## Coefficients:
##    [,1]
## a  531
## b    8
```

```
plot(ts2_forecast)
```


Holt-Winters filtering
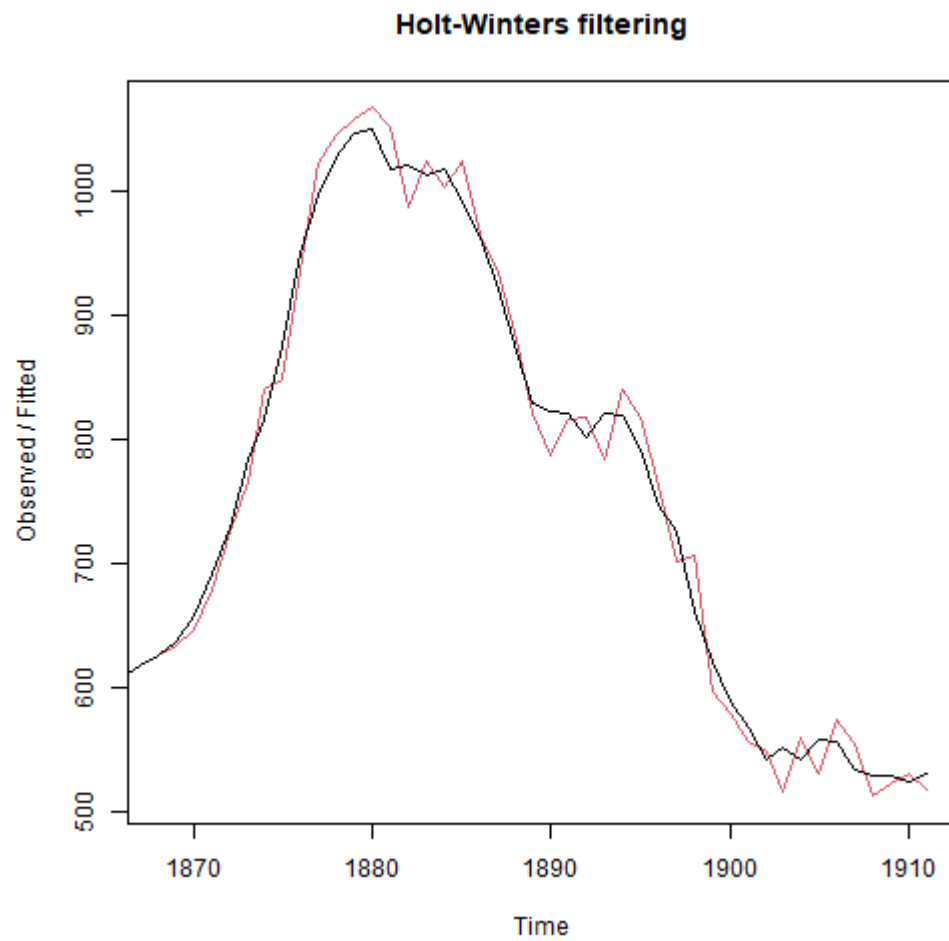
```
ts2_forecast2 <- forecast(ts2_forecast, h=19)
plot(ts2_forecast2)
```

Forecasts from HoltWinters
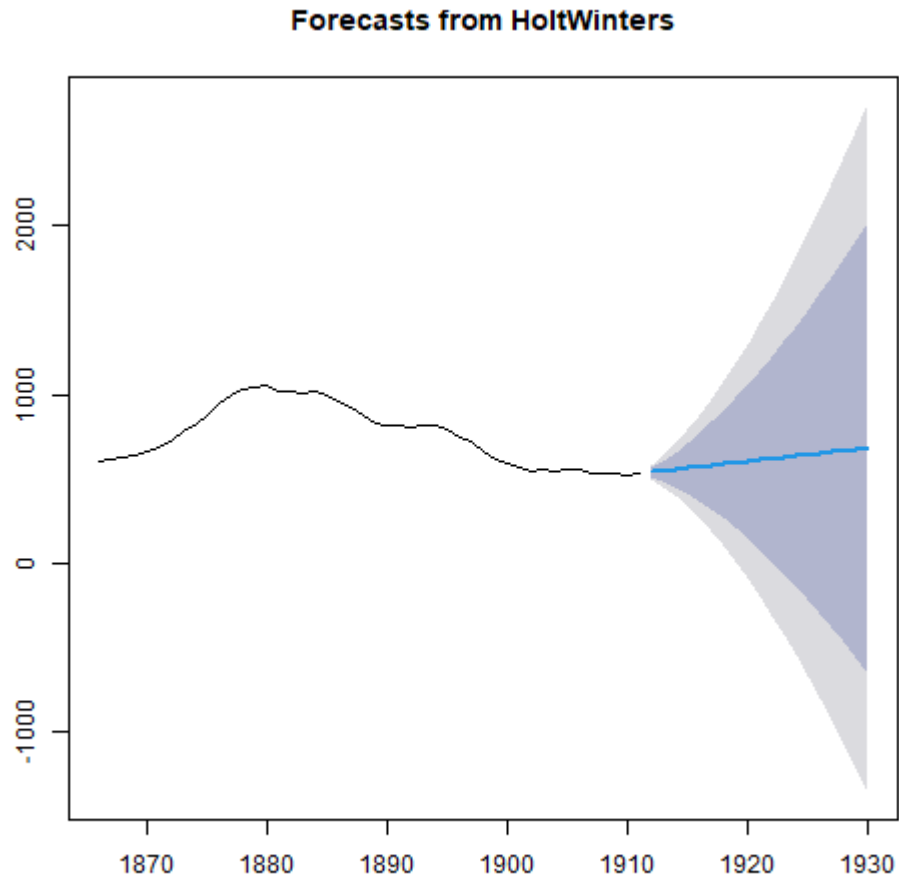
Holt-Winters Exponential Smoothing

- increasing or decreasing trend and seasonality.

```r
souvenir <- read.csv('souvenir.csv')
ts3 <- ts(souvenir, frequency=12, start=c(1987,1))
plot(ts3)
```
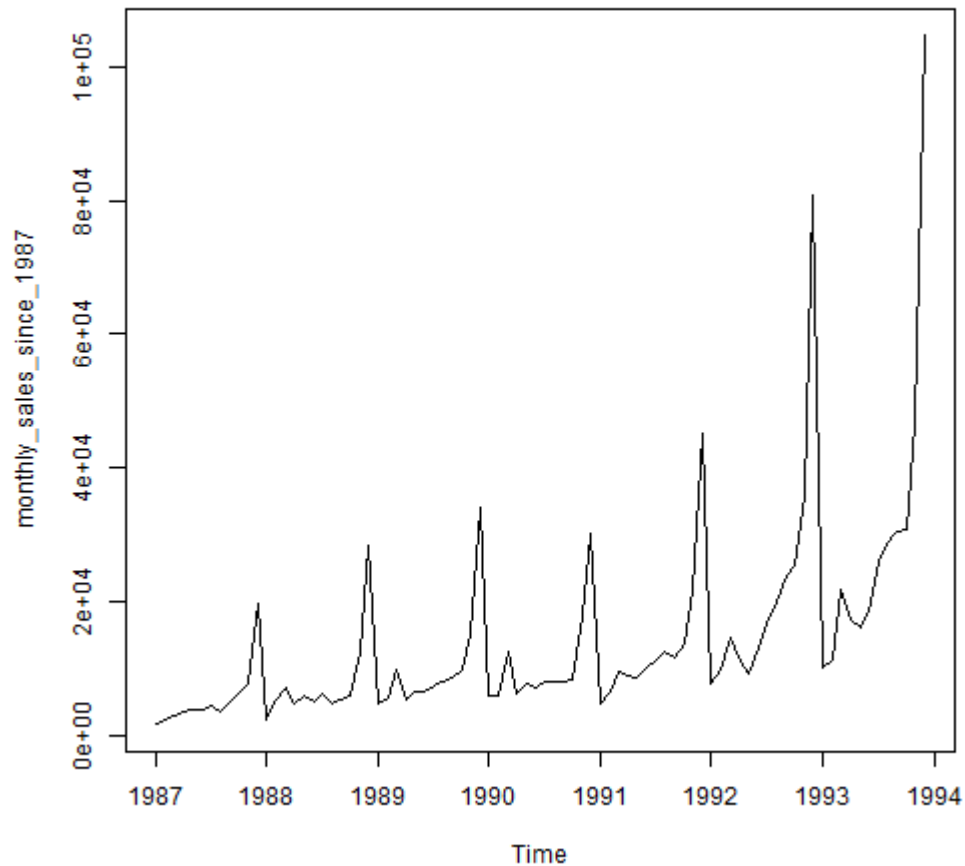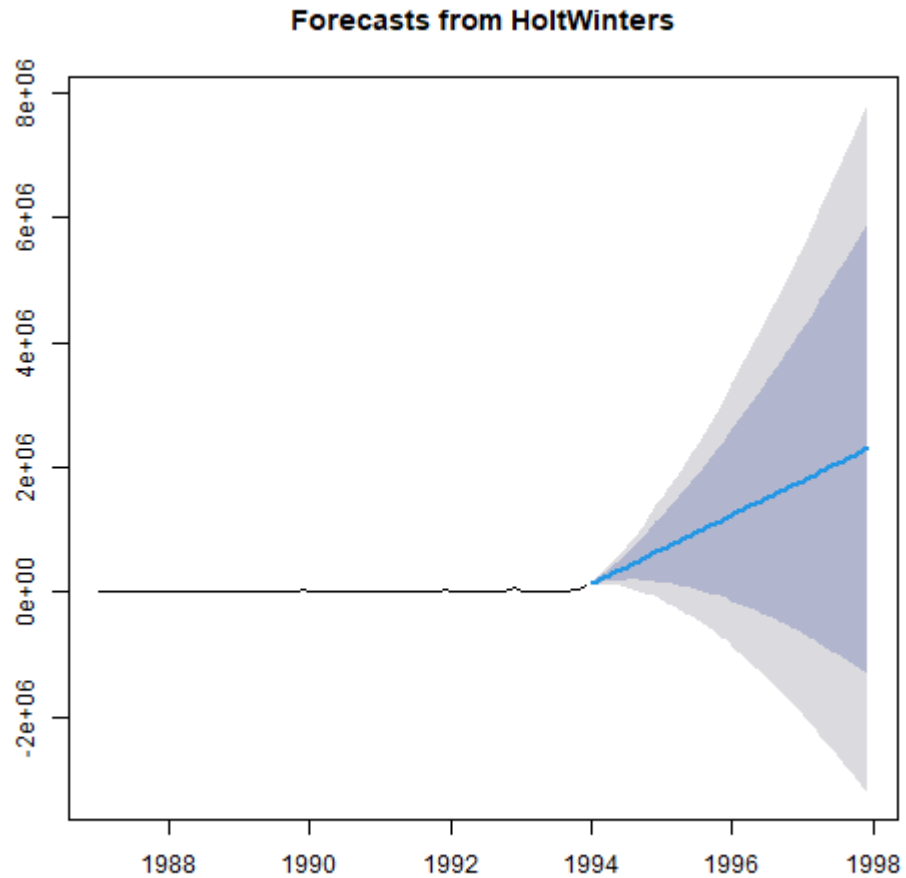
```
ts3_forecasts <- HoltWinters(ts3, alpha=TRUE,
                                 beta=TRUE,
                                 gamma=TRUE)
plot(ts3_forecasts)
```
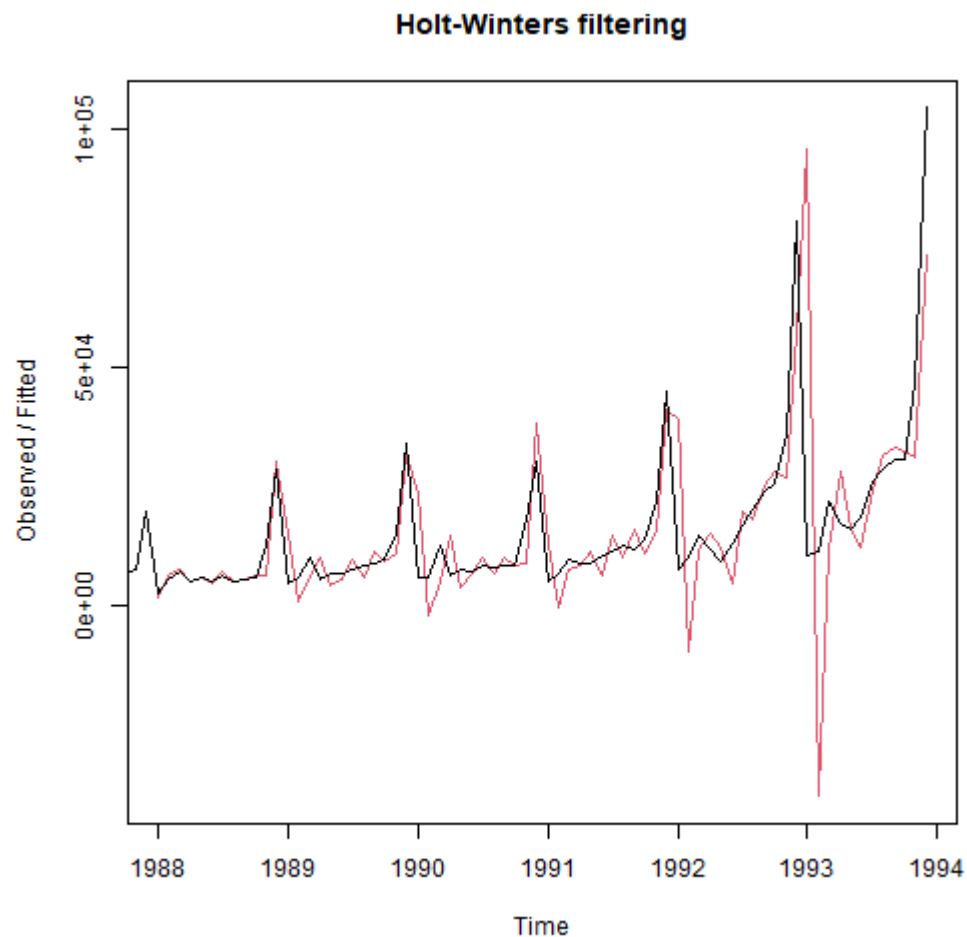

Holt-Winters filtering

```
ts3_forecasts2 <- forecast(ts3_forecasts, h=48)
plot(ts3_forecasts2)
```


Forecasts from HoltWinters

```r
souvenir <- read.csv('souvenir.csv')
ts3 <- ts(souvenir, frequency=12, start=c(1987,1))
logts3 <- log(ts3)
ts3_forecasts <- HoltWinters(logts3)
plot(ts3_forecasts)
ts3_forecasts2 <- forecast(ts3_forecasts, h=48)
plot(ts3_forecasts2)
```

- The parameters alpha, beta and gamma all have values between 0 and 1.

- Values that are close to 0 mean that relatively little weight is placed on the most recent observations (the weights are spread out for the past observations) when making forecasts of future values.

- Alpha estimates the level

- Beta estimate the slopes of the trend component

- Gamma estimate the slope of the seasonal component