

1

A)

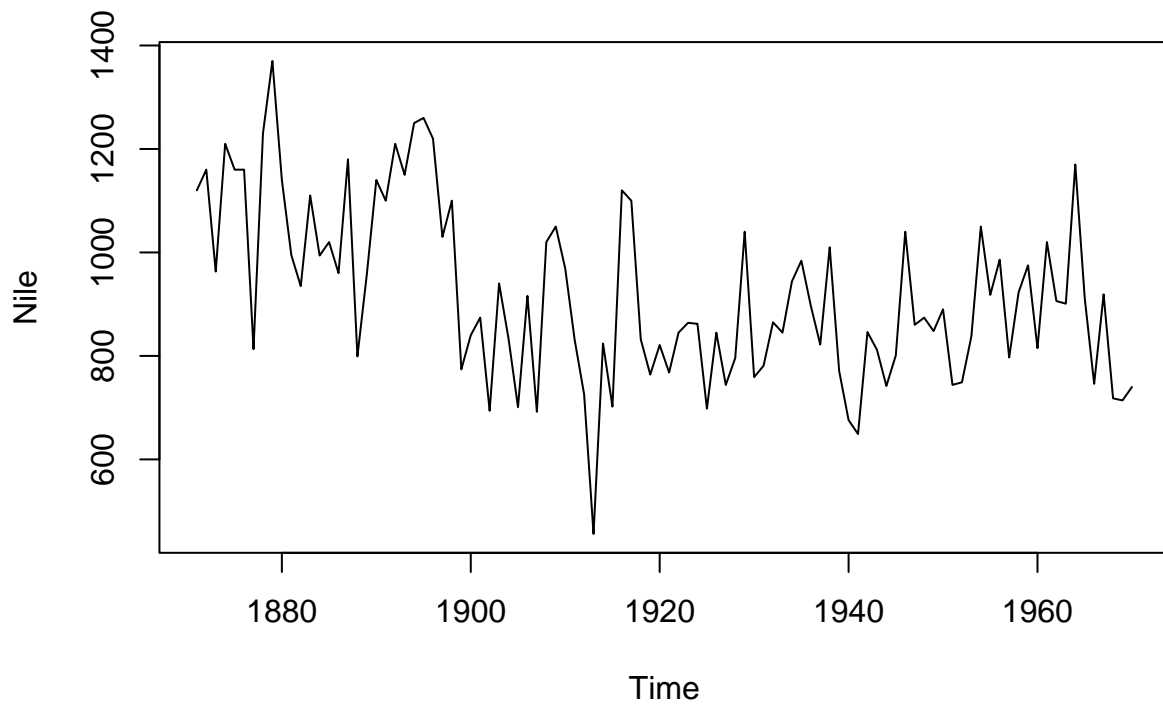
O parâmetro α chamado de constante de alisamento ou parâmetro da suavização, está contido num intervalo $(0,1)$, serve para refletir a influência dos valores passados:

- Mais próximo de 0 indica previsões que dependem mais dos valores mais antigos.
- Mais próximo de 1 indica previsões que dependem mais das observações mais recentes.

3

A) Nile

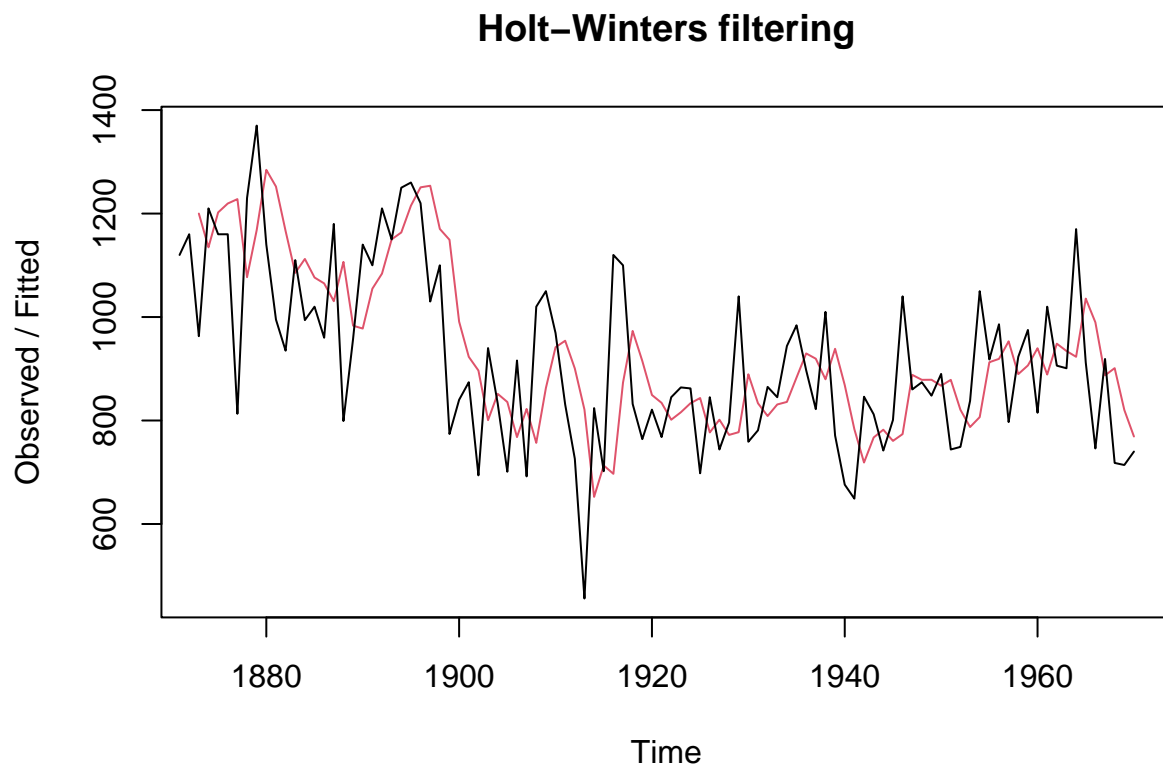
```
plot(Nile)
```



```
(fit.nile <- HoltWinters(x = Nile, gamma=FALSE))
```

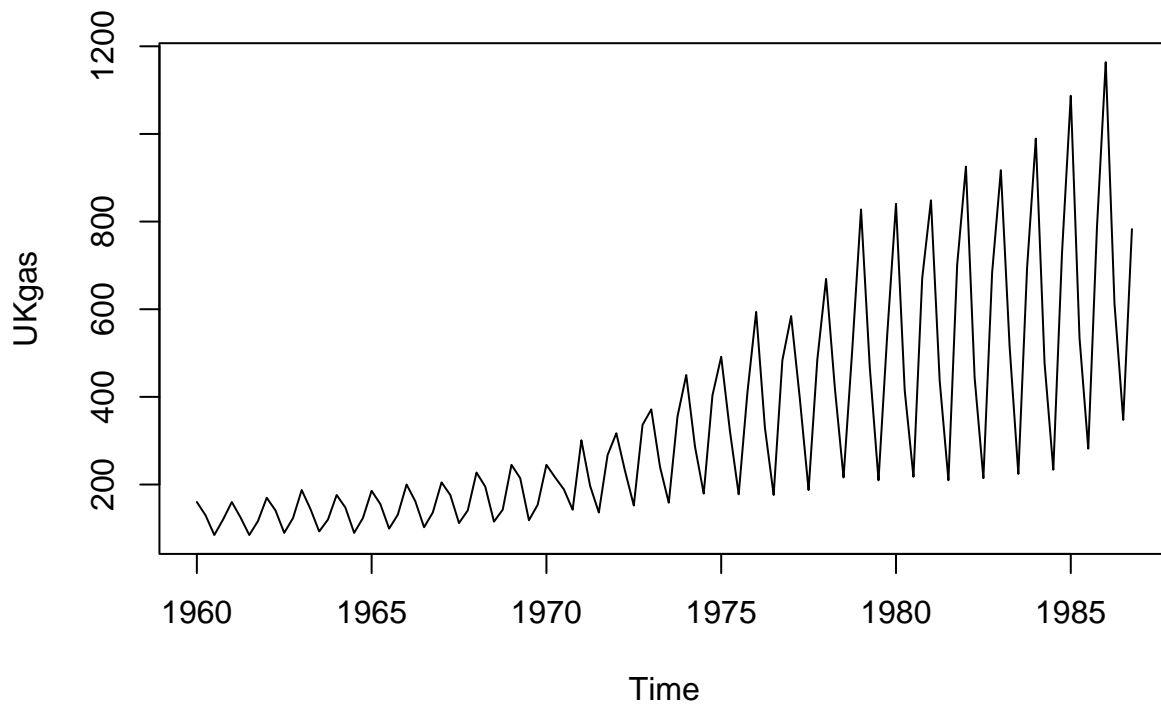
```
## Holt-Winters exponential smoothing with trend and without seasonal component.  
##  
## Call:  
## HoltWinters(x = Nile, gamma = FALSE)  
##  
## Smoothing parameters:  
##  alpha: 0.4190643  
##  beta : 0.05987705  
##  gamma: FALSE  
##  
## Coefficients:  
##      [,1]  
## a 756.913740  
## b  -7.424597
```

```
plot(fit.nile)
```



B) UKgas

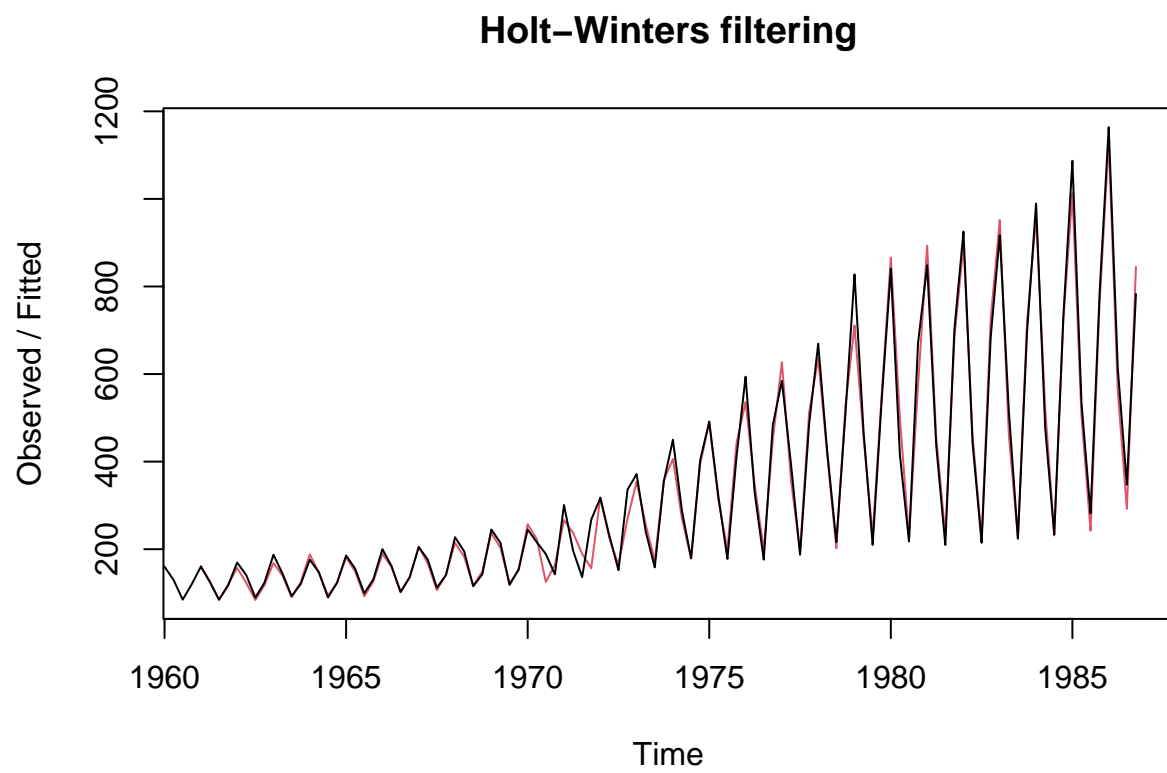
```
plot(UKgas)
```



```
(fit.UKgas <- HoltWinters(x = UKgas, seasonal = "multiplicative"))
```

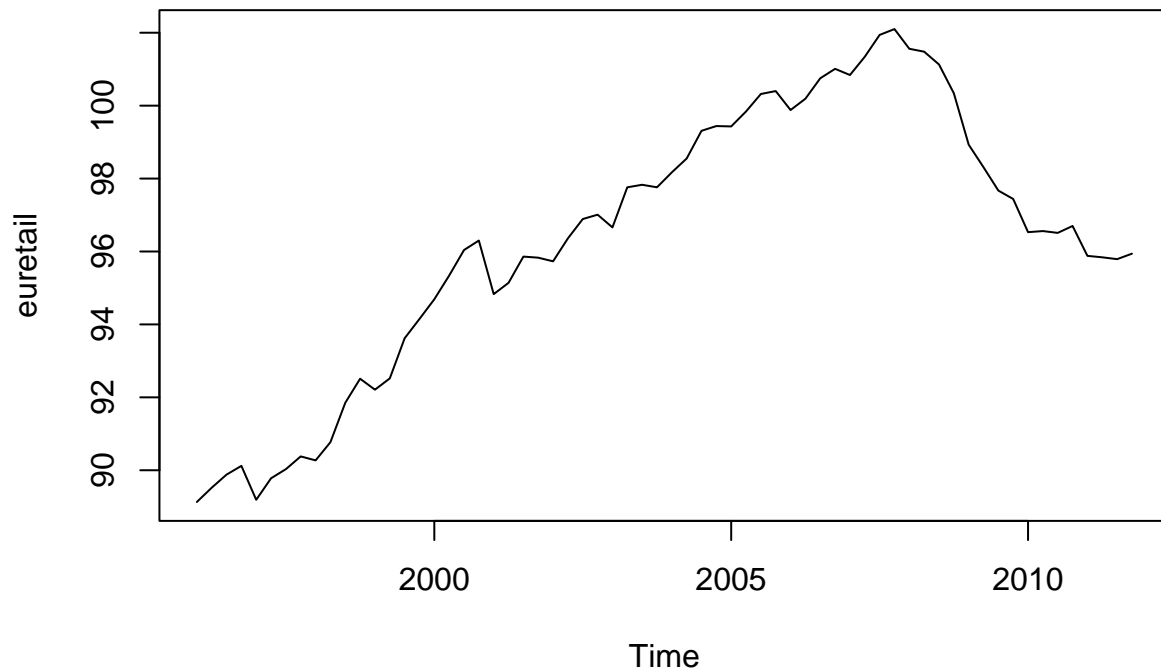
```
## Holt-Winters exponential smoothing with trend and multiplicative seasonal component.
##
## Call:
## HoltWinters(x = UKgas, seasonal = "multiplicative")
##
## Smoothing parameters:
##   alpha: 0.02412858
##   beta : 1
##   gamma: 0.7828624
##
## Coefficients:
##           [,1]
## a  515.0263067
## b    9.9725235
## s1   2.3829116
## s2   1.2182884
## s3   0.6645498
## s4   1.5453760
```

```
plot(fit.UKgas)
```



C) euretail

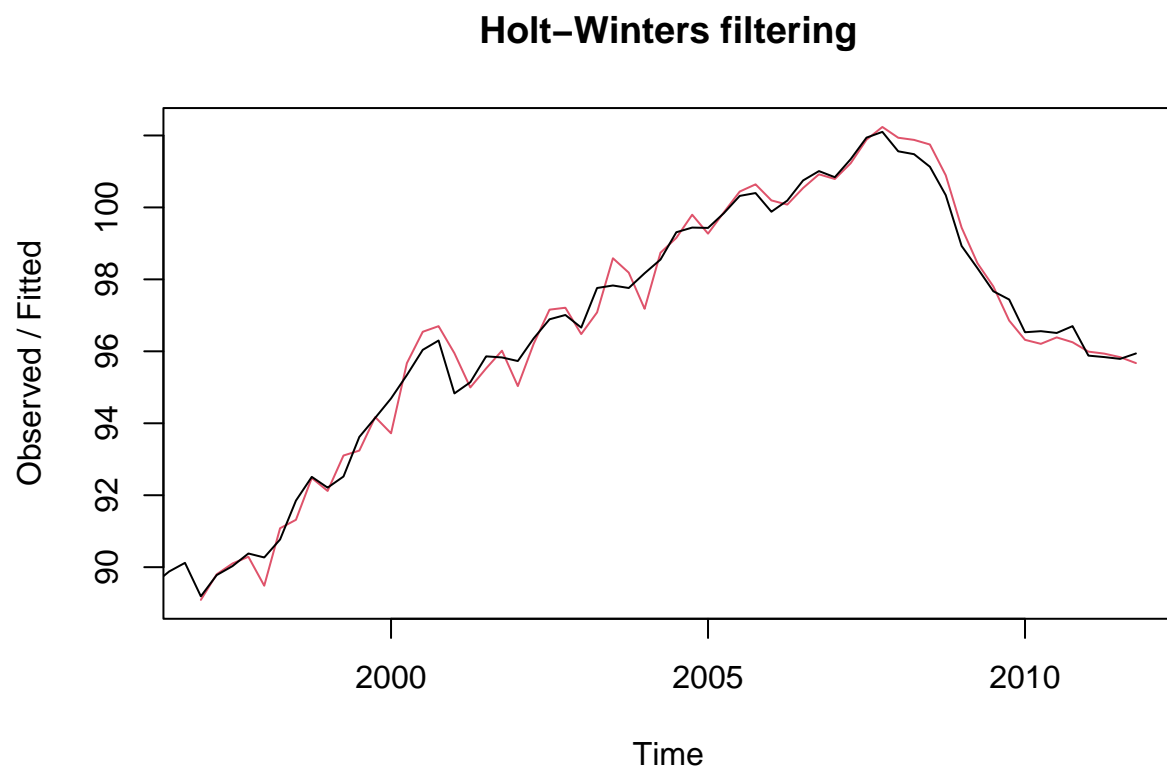
```
plot(euretail)
```



```
(fit.euretail <- HoltWinters(x = euretail, seasonal = "additive"))
```

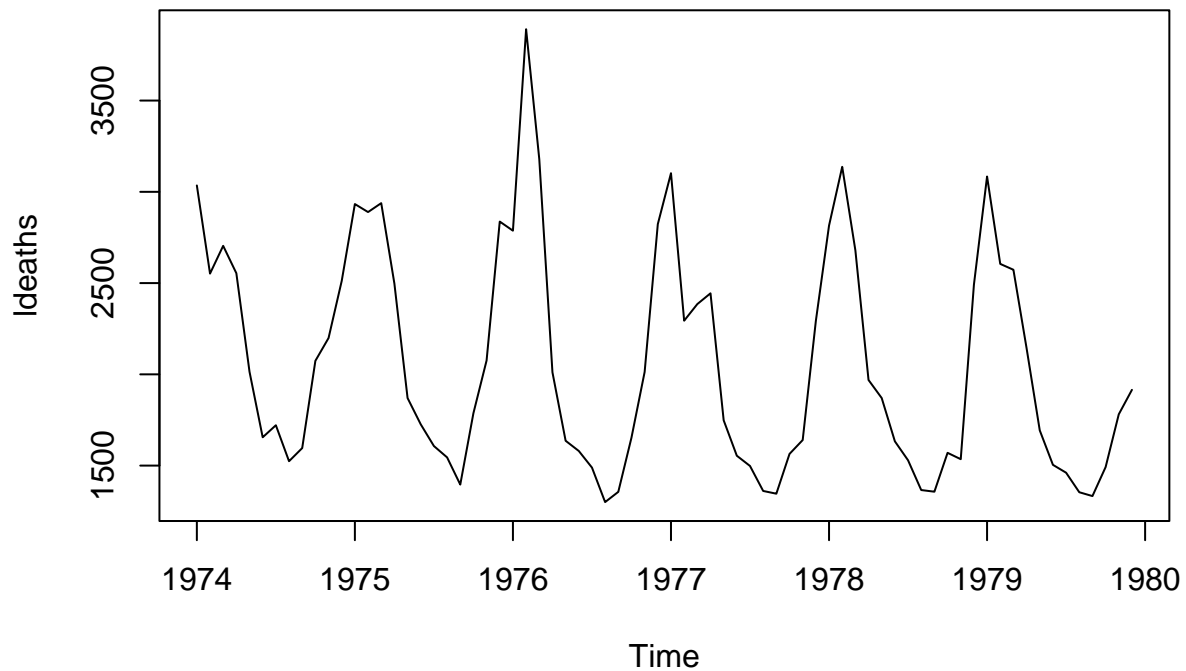
```
## Holt-Winters exponential smoothing with trend and additive seasonal component.
##
## Call:
## HoltWinters(x = euretail, seasonal = "additive")
##
## Smoothing parameters:
##  alpha: 0.8691965
##  beta : 0.449748
##  gamma: 1
##
## Coefficients:
##           [,1]
## a  95.6666446
## b  -0.1406139
## s1 -0.3394992
## s2 -0.1075213
## s3  0.1105958
## s4  0.2733554
```

```
plot(fit.euretail)
```



D) ldeaths

```
plot(ldeaths)
```

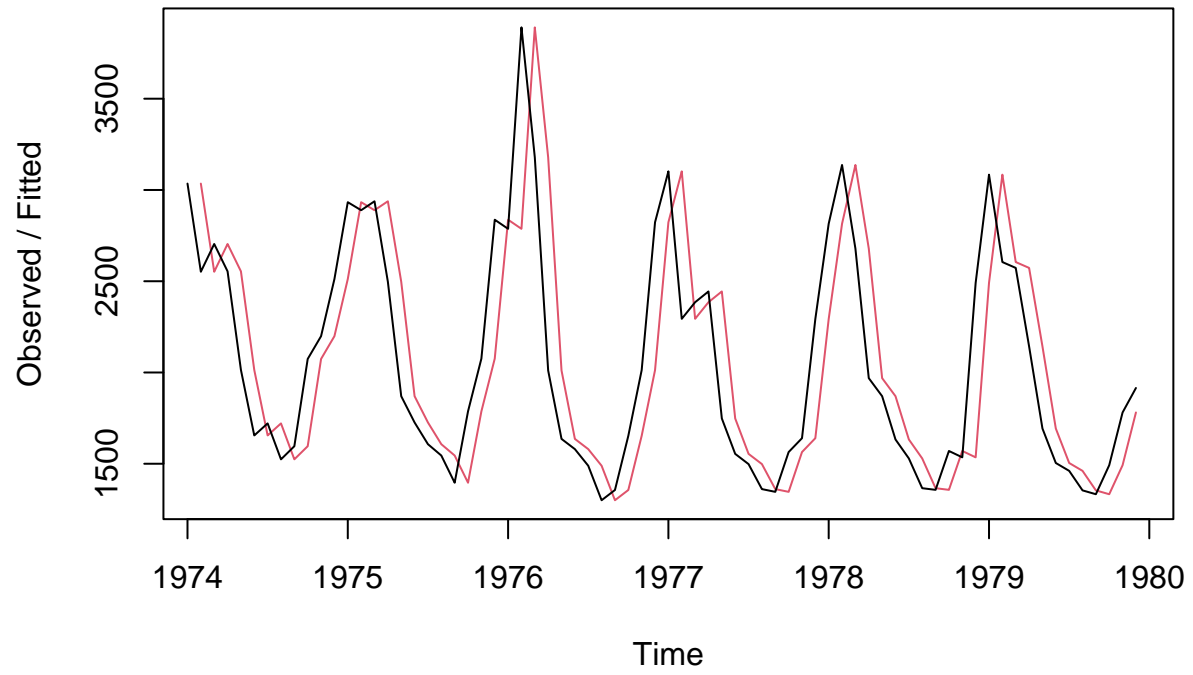


```
(fit.ldeaths <- HoltWinters(x = ldeaths, beta=FALSE, gamma=FALSE))
```

```
## Holt-Winters exponential smoothing without trend and without seasonal component.
##
## Call:
## HoltWinters(x = ldeaths, beta = FALSE, gamma = FALSE)
##
## Smoothing parameters:
##   alpha: 0.9999339
##   beta  : FALSE
##   gamma : FALSE
##
## Coefficients:
##      [,1]
## a 1914.991
```

```
plot(fit.ldeaths)
```

Holt-Winters filtering

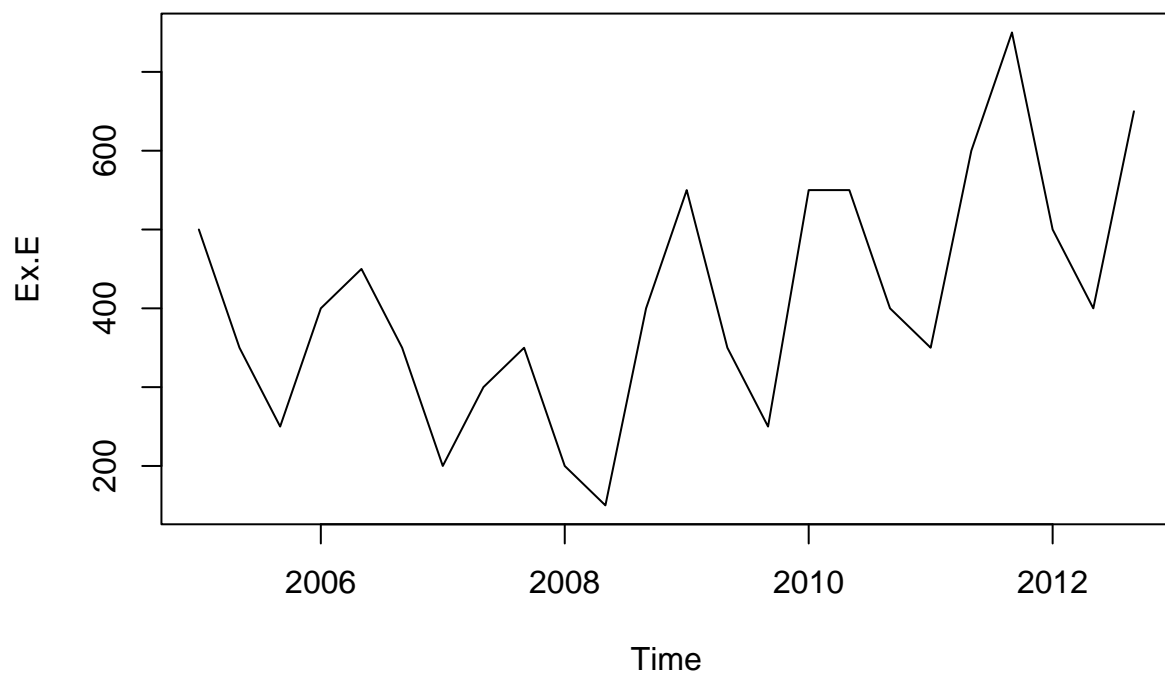


E) Sales

```
vendas <- c(500, 350, 250, 400, 450, 350, 200, 300, 350, 200, 150, 400, 550, 350, 250,
550, 550, 400, 350, 600, 750, 500, 400, 650)

Ex.E <- ts(vendas, start = 2005, frequency = 3)

plot(Ex.E)
```

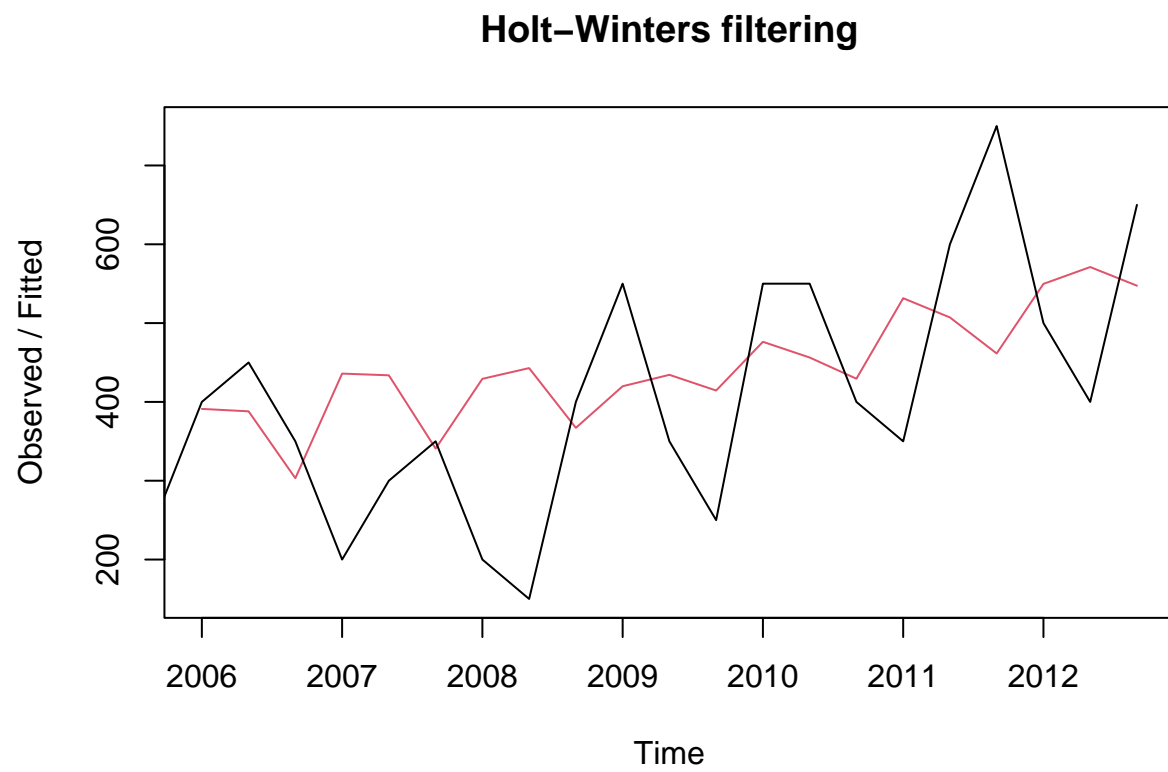


```
(fit.Ex.E <- HoltWinters(x = Ex.E, seasonal = "additive"))

## Holt-Winters exponential smoothing with trend and additive seasonal component.
##
## Call:
## HoltWinters(x = Ex.E, seasonal = "additive")
##
## Smoothing parameters:
##  alpha: 0.02946233
##  beta : 0
##  gamma: 0.157255
##
## Coefficients:
##           [,1]
## a  594.72784
```

```
## b 13.33333
## s1 -29.39493
## s2 -38.41639
## s3 -28.56955
```

```
plot(fit.Ex.E)
```



4

A) AirPassengers

```
fit.hw.mult <- hw(AirPassengers, h=24, seasonal = "m", initial = "o")
summary(fit.hw.mult)
```

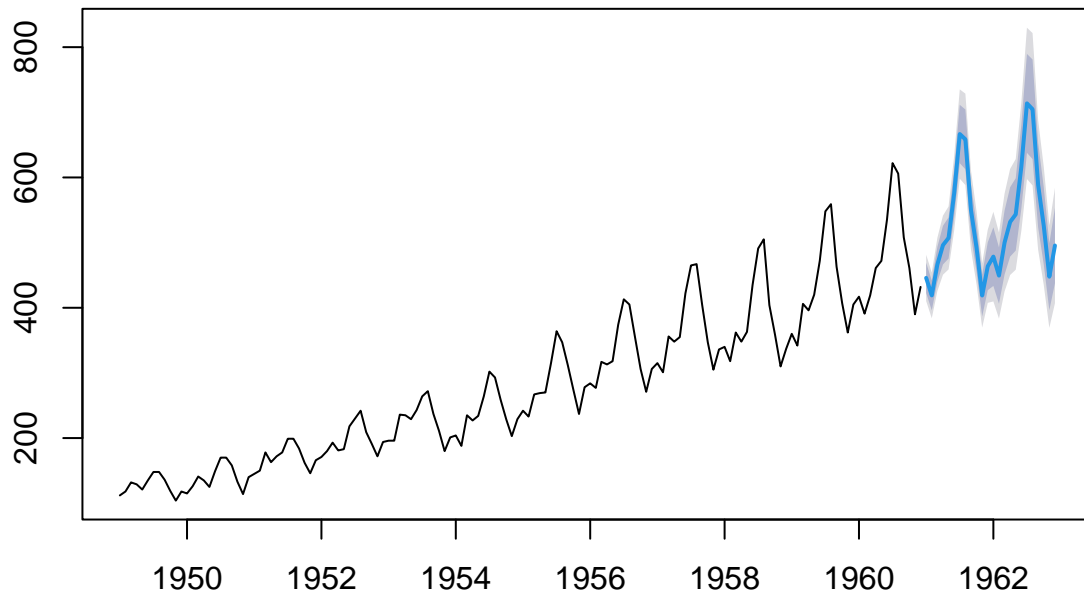
```
##
## Forecast method: Holt-Winters' multiplicative method
##
## Model Information:
## Holt-Winters' multiplicative method
##
## Call:
## hw(y = AirPassengers, h = 24, seasonal = "m", initial = "o")
##
## Smoothing parameters:
##   alpha = 0.3146
##   beta  = 0.0071
##   gamma = 0.5977
##
## Initial states:
##   l = 120.3796
##   b = 1.7757
##   s = 0.9298 0.7946 0.9024 1.0451 1.1338 1.1388
##       1.0529 0.9638 1.0349 1.0807 0.9854 0.9378
##
## sigma: 0.0407
##
##      AIC      AICc      BIC
## 1405.654 1410.511 1456.141
##
## Error measures:
##              ME      RMSE      MAE      MPE      MAPE      MASE      ACF1
## Training set 1.256973 10.63256 7.790649 0.2182707 2.914411 0.2432275 0.2135914
##
## Forecasts:
##      Point Forecast      Lo 80      Hi 80      Lo 95      Hi 95
## Jan 1961      445.8901 422.6577 469.1225 410.3592 481.4210
## Feb 1961      418.9478 396.0288 441.8667 383.8963 453.9993
## Mar 1961      466.4298 439.7182 493.1414 425.5780 507.2816
## Apr 1961      496.1291 466.4627 525.7955 450.7583 541.4999
## May 1961      507.1463 475.5546 538.7381 458.8309 555.4617
## Jun 1961      575.6281 538.3478 612.9083 518.6129 632.6432
## Jul 1961      666.6573 621.8494 711.4652 598.1295 735.1850
## Aug 1961      658.4970 612.6386 704.3554 588.3627 728.6313
## Sep 1961      550.0907 510.4559 589.7255 489.4745 610.7069
## Oct 1961      491.7130 455.1069 528.3190 435.7289 547.6971
## Nov 1961      418.8086 386.6330 450.9842 369.6003 468.0169
## Dec 1961      463.7188 426.9948 500.4428 407.5543 519.8833
## Jan 1962      478.5040 433.5276 523.4805 409.7185 547.2896
## Feb 1962      449.4074 406.2454 492.5694 383.3969 515.4179
```

## Mar 1962	500.1396	451.0781	549.2010	425.1065	575.1726
## Apr 1962	531.7730	478.5135	585.0325	450.3196	613.2263
## May 1962	543.3672	487.8249	598.9096	458.4226	628.3119
## Jun 1962	616.4994	552.2059	680.7929	518.1710	714.8279
## Jul 1962	713.7167	637.8042	789.6291	597.6185	829.8148
## Aug 1962	704.7115	628.2918	781.1313	587.8376	821.5855
## Sep 1962	588.4751	523.4340	653.5163	489.0033	687.9469
## Oct 1962	525.8278	466.6127	585.0428	435.2661	616.3894
## Nov 1962	447.7002	396.3464	499.0539	369.1614	526.2389
## Dec 1962	495.5277	437.6488	553.4067	407.0096	584.0459

```
a <- summary(fit.hw.mult)
```

```
plot(fit.hw.mult)
```

Forecasts from Holt-Winters' multiplicative method



B) Nile

B) UKgas

B) euretail

B) ldeaths

B) Sales