# hw4

Haoyu(Michael)_Wang

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**package loading** We are still using UKgas data set from hw3.

```
library(fpp)
```

```
## Warning: package 'fpp' was built under R version 4.1.3

## Loading required package: forecast

## Registered S3 method overwritten by 'quantmod':
##   method            from
##   as.zoo.data.frame zoo

## Loading required package: fma

## Warning: package 'fma' was built under R version 4.1.3

## Loading required package: expsmooth

## Warning: package 'expsmooth' was built under R version 4.1.3

## Loading required package: lmtest

## Loading required package: zoo

##
## Attaching package: 'zoo'

## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric

## Loading required package: tseries
```

```
library(fpp2)
```

```
## Warning: package 'fpp2' was built under R version 4.1.3

## -- Attaching packages ---------------------------------------------- fpp2 2.4 --

## v ggplot2 3.3.5

##

##
## Attaching package: 'fpp2'

## The following objects are masked from 'package:fpp':
##
##     ausair, ausbeer, austa, austourists, debitcards, departures,
##     elecequip, euretail, guinearice, oil, sunspotarea, usmelec
```

```
library(TTR)
```

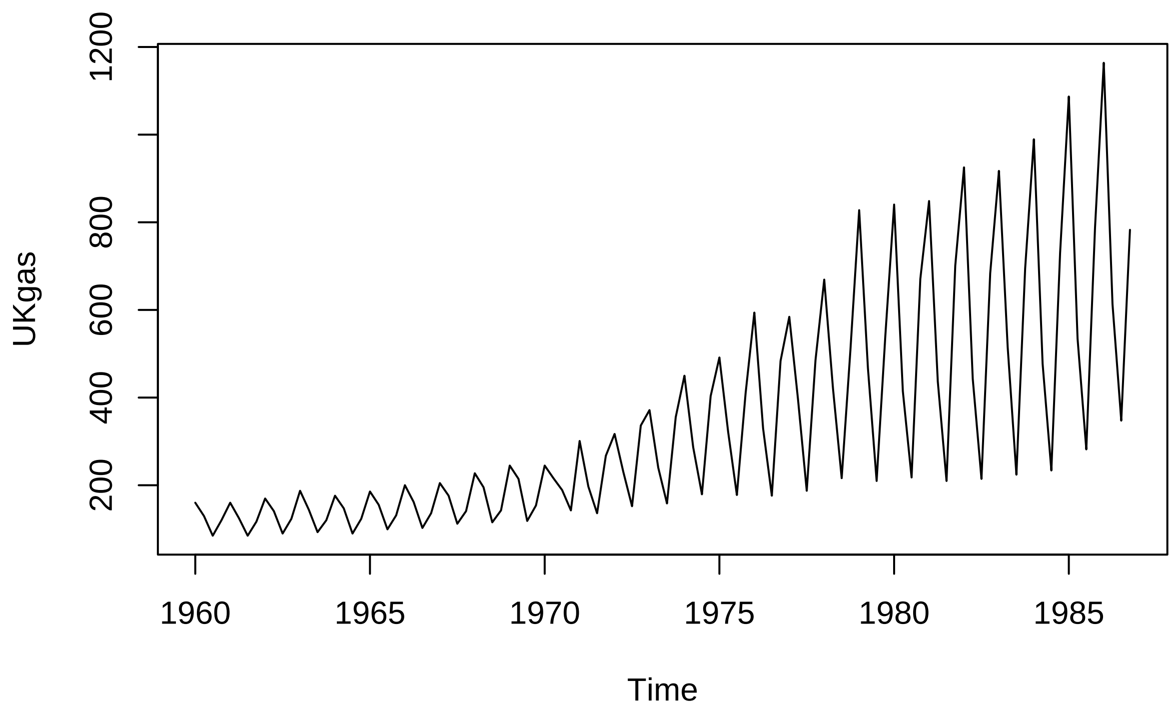
```
## Warning: package 'TTR' was built under R version 4.1.3
```

Attribute shows that it is a TS data from 1960 - 1986, the plot of UKgas showing a growing trend and increase over time means that we can use the whole data set instead shorten its periodicity. The acf shows a huge seasonality possiblity. So how should we properly predict the values in the future?

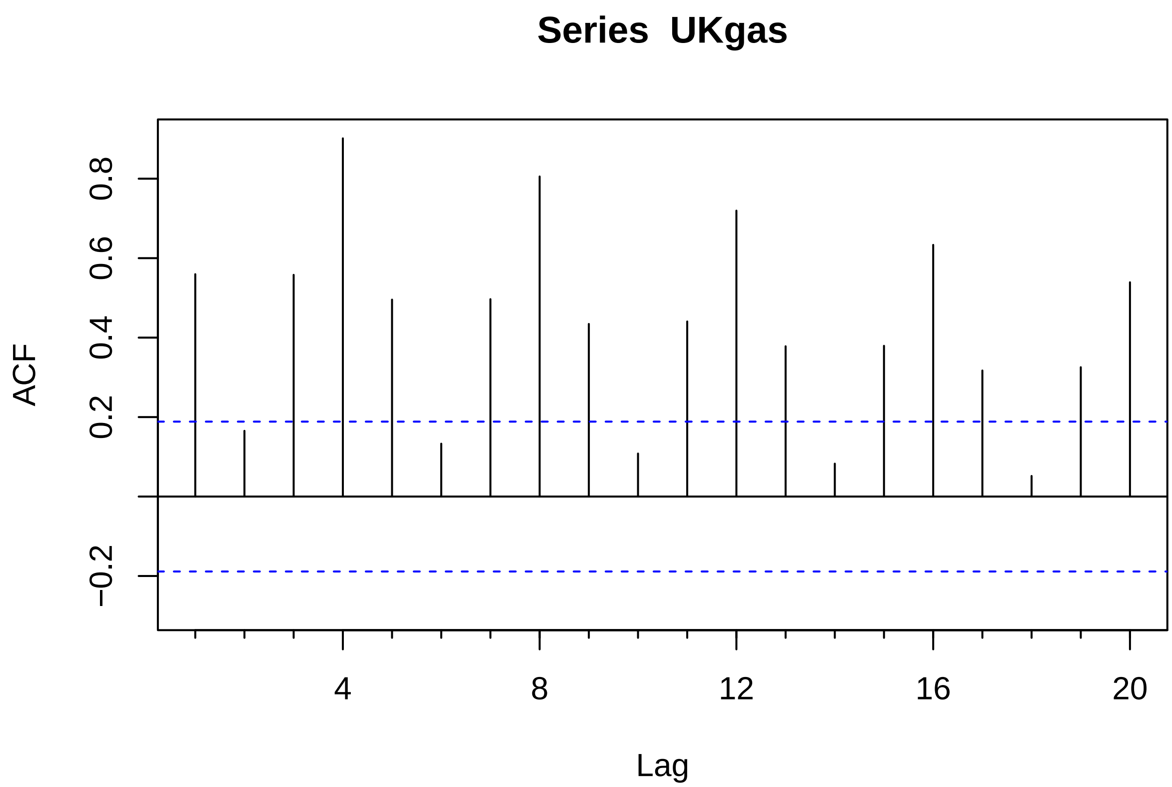
```
attributes(UKgas)
```

```
## $tsp
## [1] 1960.00 1986.75    4.00
##
## $class
## [1] "ts"
```

```
plot(UKgas)
```




```
Acf(UKgas)
```




**Basic mean.** In here, since the data is quarterly recorded and the atf shows a huge coefficient at 4, I think we should use h=4 to meanf() it.

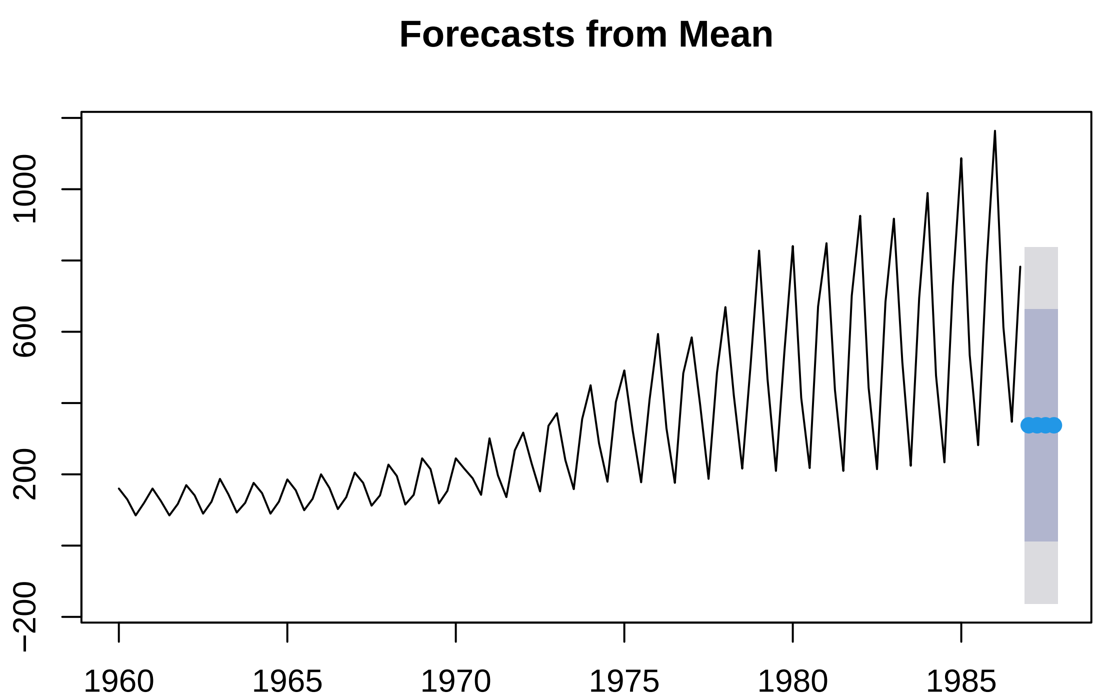
```
UKgas
```

```
##        Qtr1  Qtr2  Qtr3  Qtr4
## 1960  160.1 129.7  84.8 120.1
## 1961  160.1 124.9  84.8 116.9
## 1962  169.7 140.9  89.7 123.3
## 1963  187.3 144.1  92.9 120.1
## 1964  176.1 147.3  89.7 123.3
## 1965  185.7 155.3  99.3 131.3
## 1966  200.1 161.7 102.5 136.1
## 1967  204.9 176.1 112.1 140.9
## 1968  227.3 195.3 115.3 142.5
## 1969  244.9 214.5 118.5 153.7
## 1970  244.9 216.1 188.9 142.5
## 1971  301.0 196.9 136.1 267.3
## 1972  317.0 230.5 152.1 336.2
## 1973  371.4 240.1 158.5 355.4
## 1974  449.9 286.6 179.3 403.4
## 1975  491.5 321.8 177.7 409.8
## 1976  593.9 329.8 176.1 483.5
## 1977  584.3 395.4 187.3 485.1
## 1978  669.2 421.0 216.1 509.1
## 1979  827.7 467.5 209.7 542.7
```

```
## 1980  840.5  414.6  217.7  670.8
## 1981  848.5  437.0  209.7  701.2
## 1982  925.3  443.4  214.5  683.6
## 1983  917.3  515.5  224.1  694.8
## 1984  989.4  477.1  233.7  730.0
## 1985 1087.0  534.7  281.8  787.6
## 1986 1163.9  613.1  347.4  782.8
```

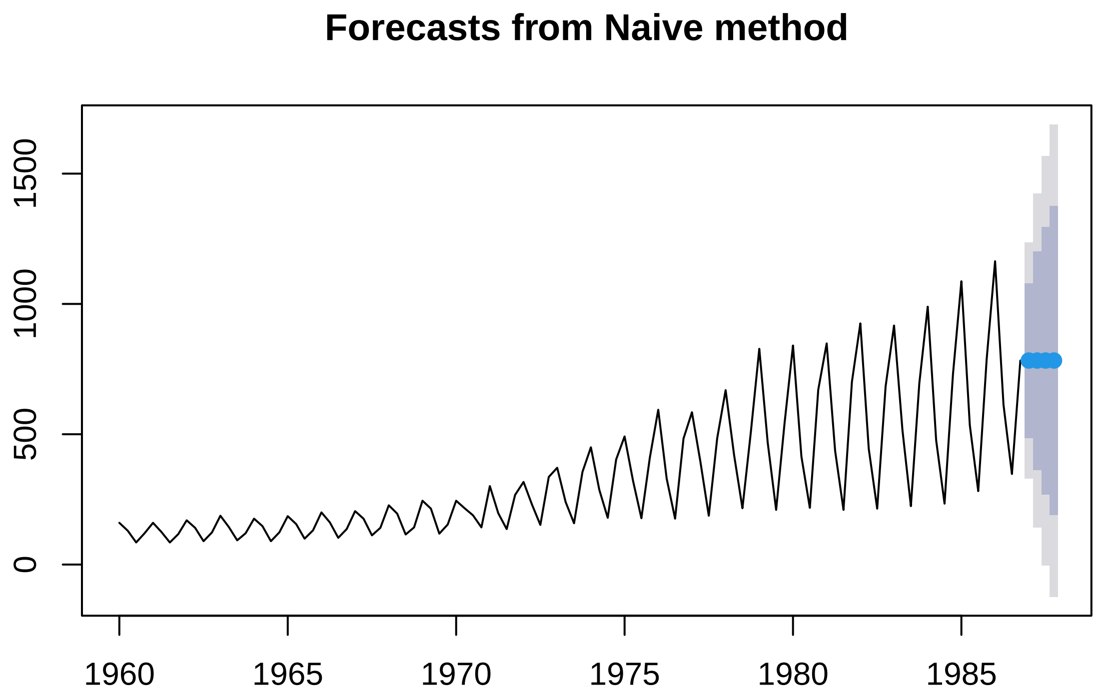
```r
meanUKgas <- meanf(UKgas,4)

plot(meanUKgas)
```



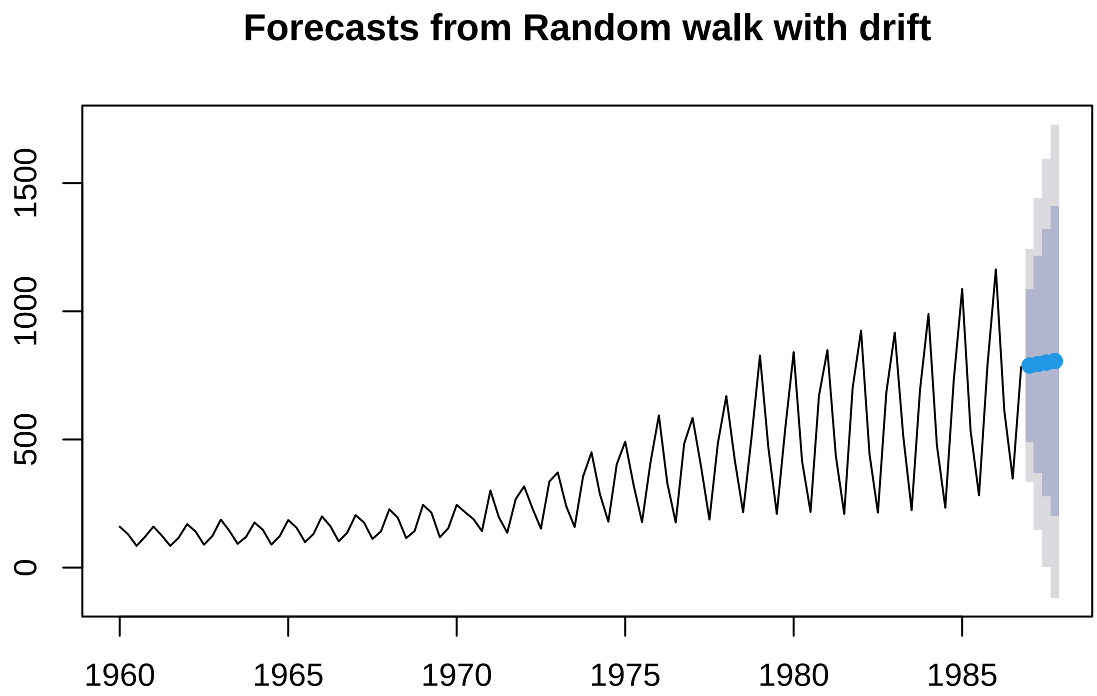

```r
naiveUKgas <- naive(UKgas,4)

plot(naiveUKgas)
```



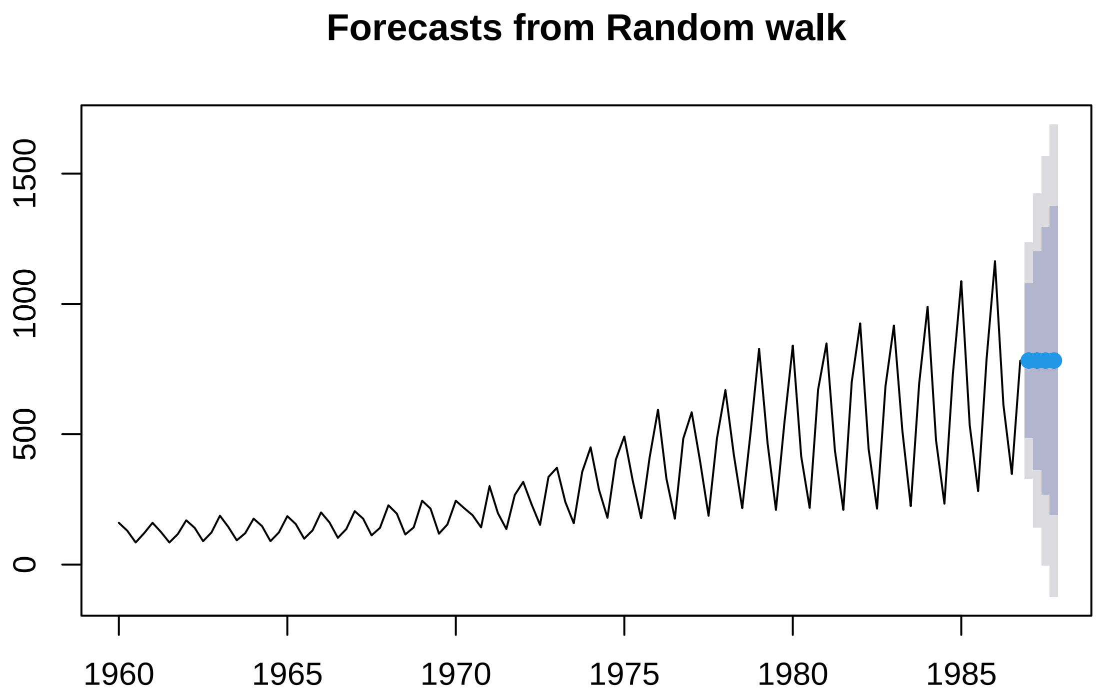

**Naive**

```
rwfUKgas <- rwf(UKgas,4)
rwfUKgas <- rwf(UKgas,4, drift=TRUE)
#A variation on the naive method is to allow the forecasts to increase or decrease over time, where the
rwfUKgasDriftOff <- rwf(UKgas,4, drift=FALSE)
plot(rwfUKgas)
```




**random walk**

```
plot(rwfUKgasDriftOff)
```




```
#Here we can see that the prediction when drift off is completely flat.
```

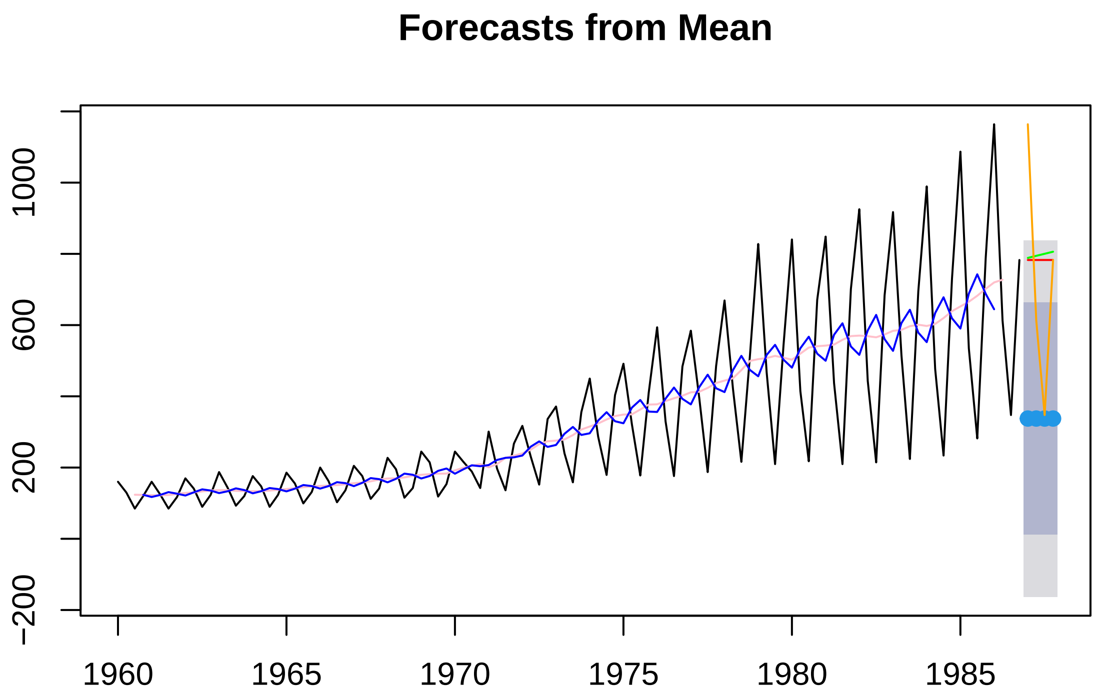
```
snaiveUKgas <- snaive(UKgas,4)
```

**Seasonal Naive**

```
fourMAUKgas <- ma(UKgas,order=4)
sevenMAUKgas <- ma(UKgas,order=7)
```

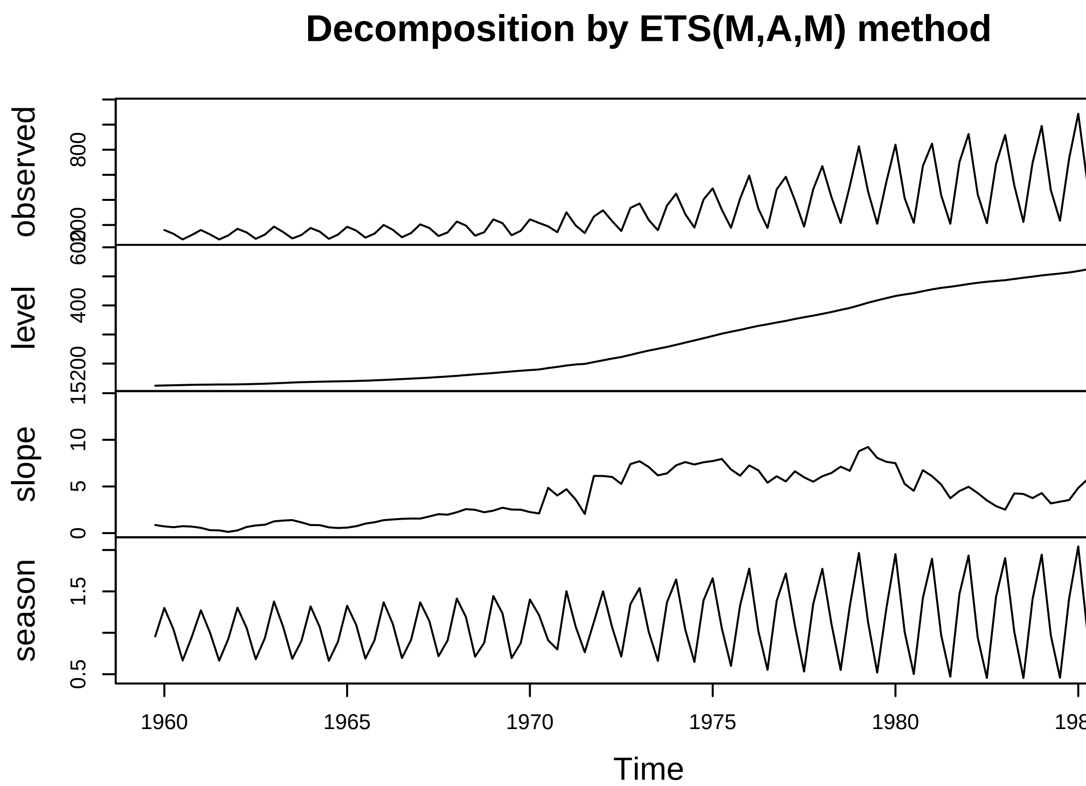
**Moving Average**

```
plot(meanUKgas)
lines(naiveUKgas$mean,col="red")
lines(rwfUKgas$mean,col="green")
lines(snaiveUKgas$mean,col="orange")
lines(fourMAUKgas,col="Pink")
lines(sevenMAUKgas,col="Blue")
```




**Ploting everying**

```
etsUKgas <- ets(UKgas)
plot(etsUKgas)
```




**Tearing apart the graph.**

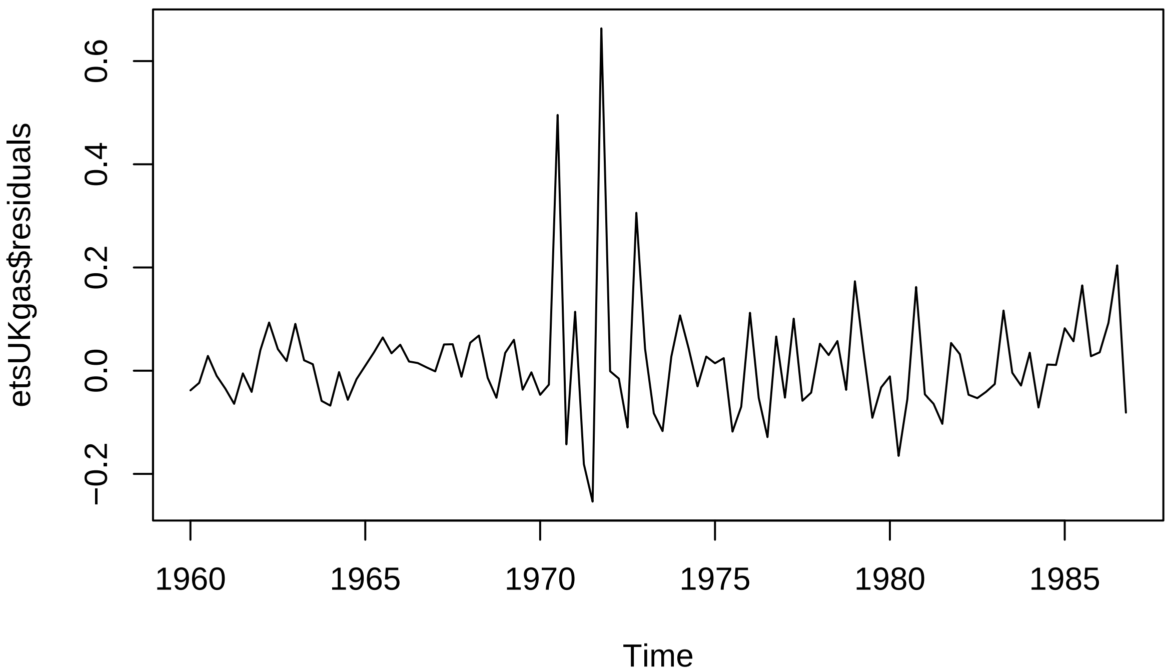
```
attributes(etsUKgas)
```

```
## $names
##  [1] "loglik"     "aic"        "bic"        "aicc"       "mse"
##  [6] "amse"       "fit"        "residuals"  "fitted"     "states"
## [11] "par"        "m"          "method"     "series"     "components"
## [16] "call"       "initstate"  "sigma2"     "x"
##
## $class
## [1] "ets"
```

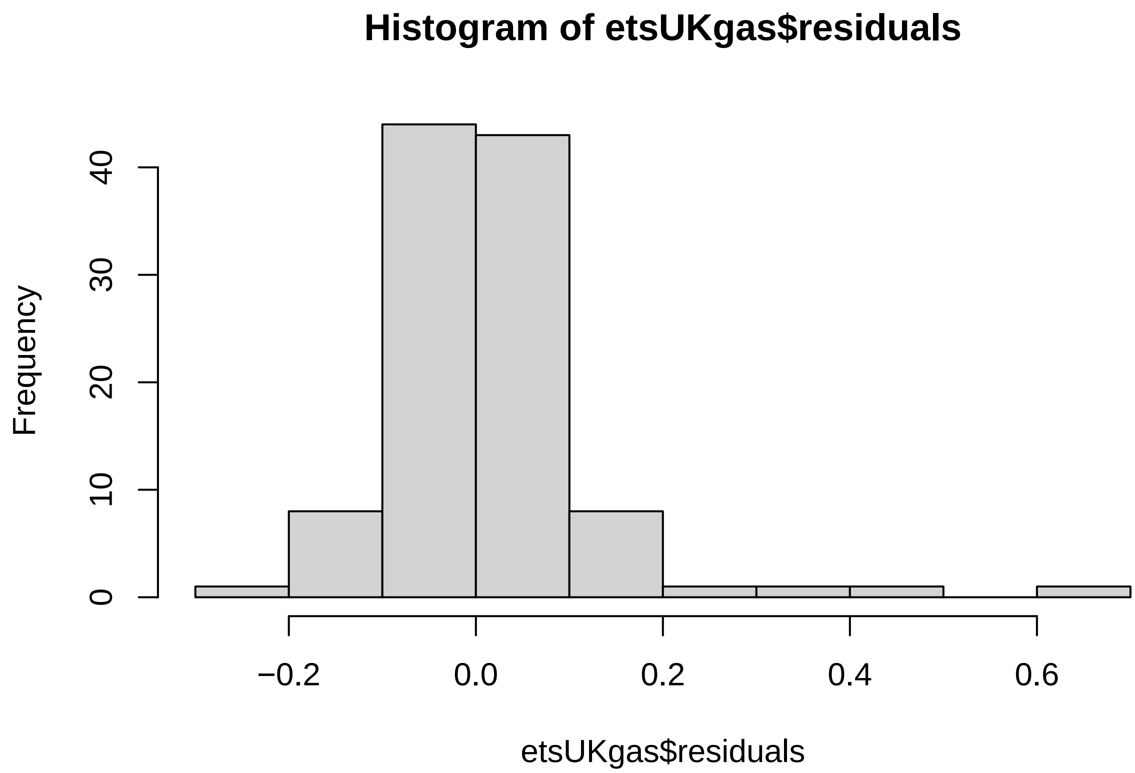
```
#showing mse
etsUKgas$mse
```

```
## [1] 1034.411
```

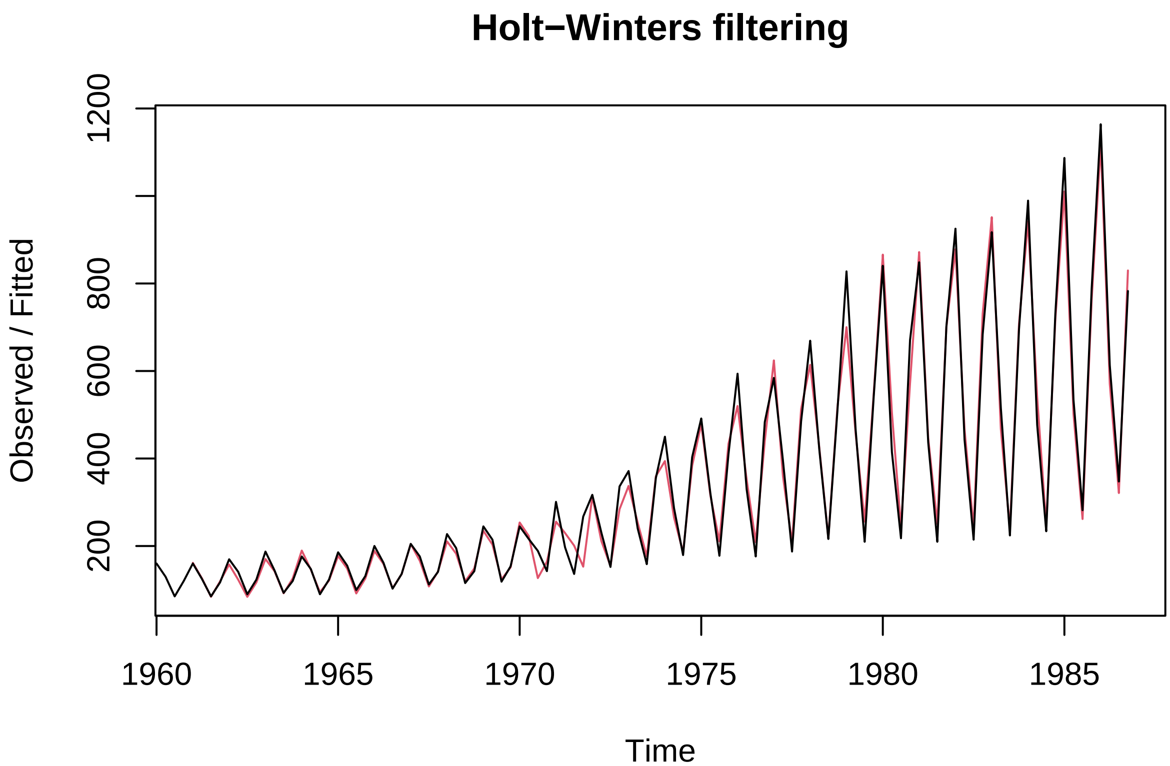
```
#We can see that the mean is not around 0 and right skewed. Errors are high around 1970s, probably caus
plot(etsUKgas$residuals)
```




```
hist(etsUKgas$residuals)
```




```
hwUKgas <- HoltWinters(UKgas)
plot(hwUKgas)
```

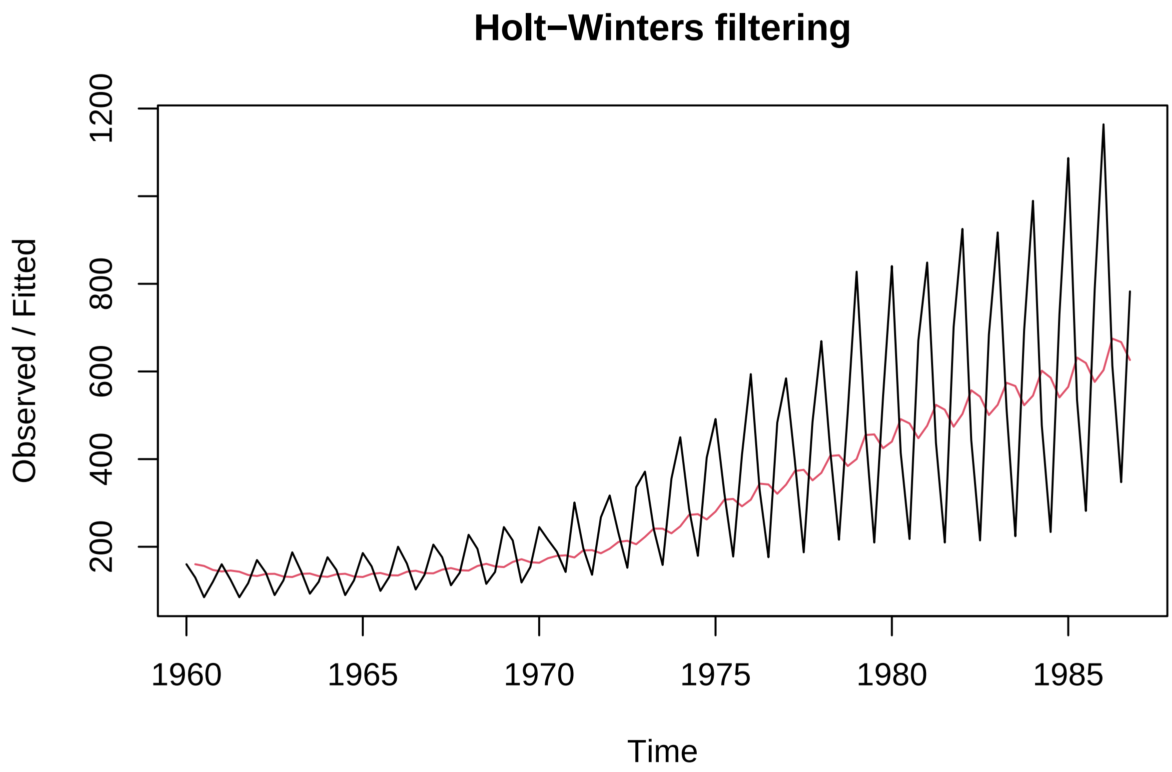



**HoltWinters**

```
SSE_Simple <- HoltWinters(UKgas,beta=FALSE,gamma=FALSE)
attributes(SSE_Simple)
```

```
## $names
## [1] "fitted"       "x"            "alpha"        "beta"         "gamma"
## [6] "coefficients" "seasonal"     "SSE"          "call"
##
## $class
## [1] "HoltWinters"
```

```
plot(SSE_Simple)
```



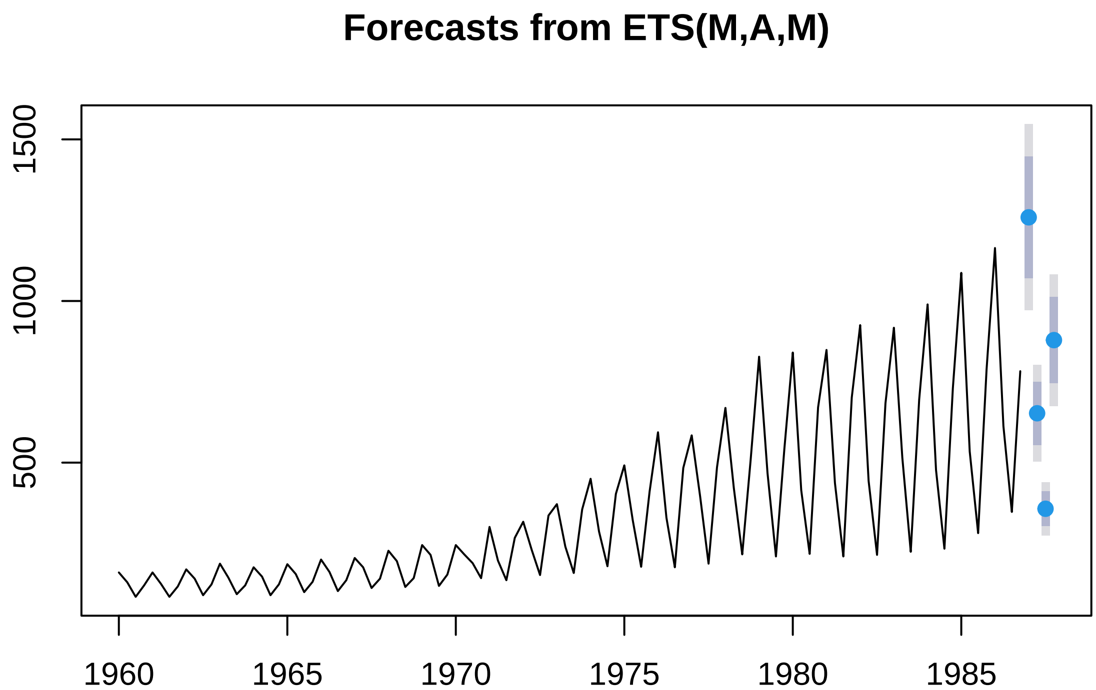

```
SSE_Simple$SSE
```

```
## [1] 3450731
```

```
head(SSE_Simple$fitted)
```

```
##             xhat    level
## 1960 Q2 160.1000 160.1000
## 1960 Q3 156.2124 156.2124
## 1960 Q4 147.0800 147.0800
## 1961 Q1 143.6298 143.6298
## 1961 Q2 145.7360 145.7360
## 1961 Q3 143.0715 143.0715
```

```
#Forecast
forecast_ets_1 <- forecast.ets(etsUKgas, h=4)
plot(forecast_ets_1)
forecast_ets_2 <- forecast(etsUKgas, h=4)
plot(forecast_ets_2)
```


Forecasts from ETS(M,A,M)
1500
1000
500
1960
1965
1970
1975
1980
1985