hw3

2022-09-21

We are gonna explore xxx dataset from fpp #### package loading

```
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
```

####showing exesisting dataset.

```
data()
```

####Explore the dataset of UKgas.

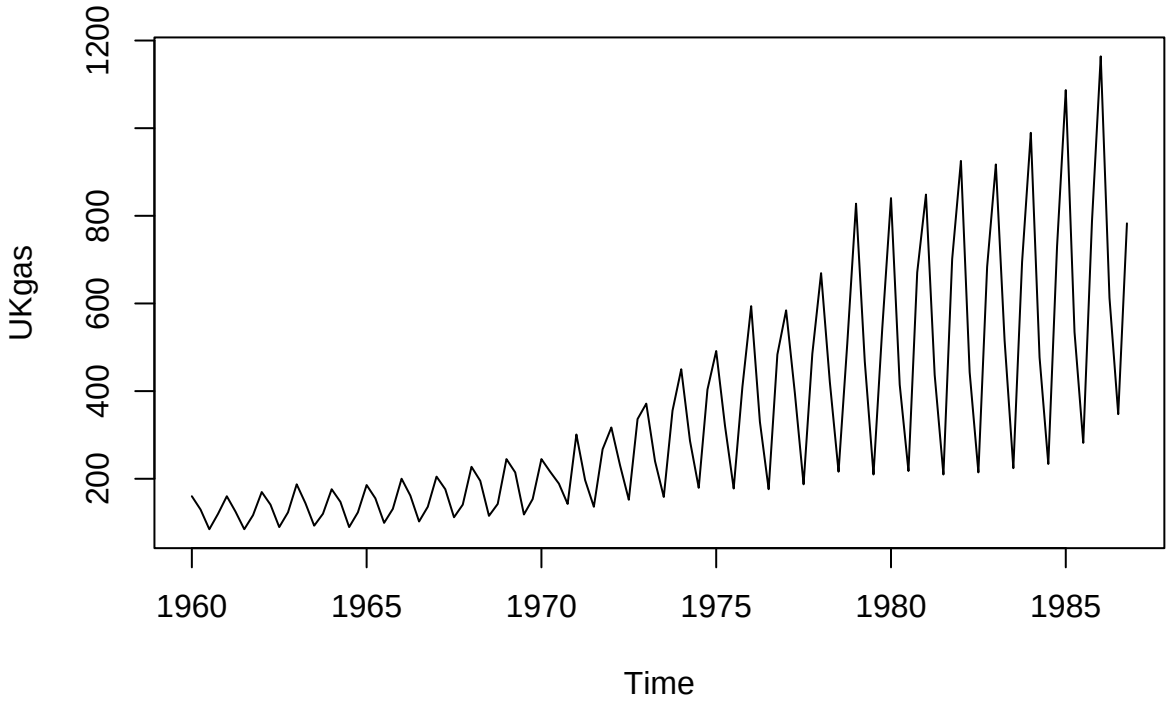
```
window(UKgas)
```

```
##        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
```

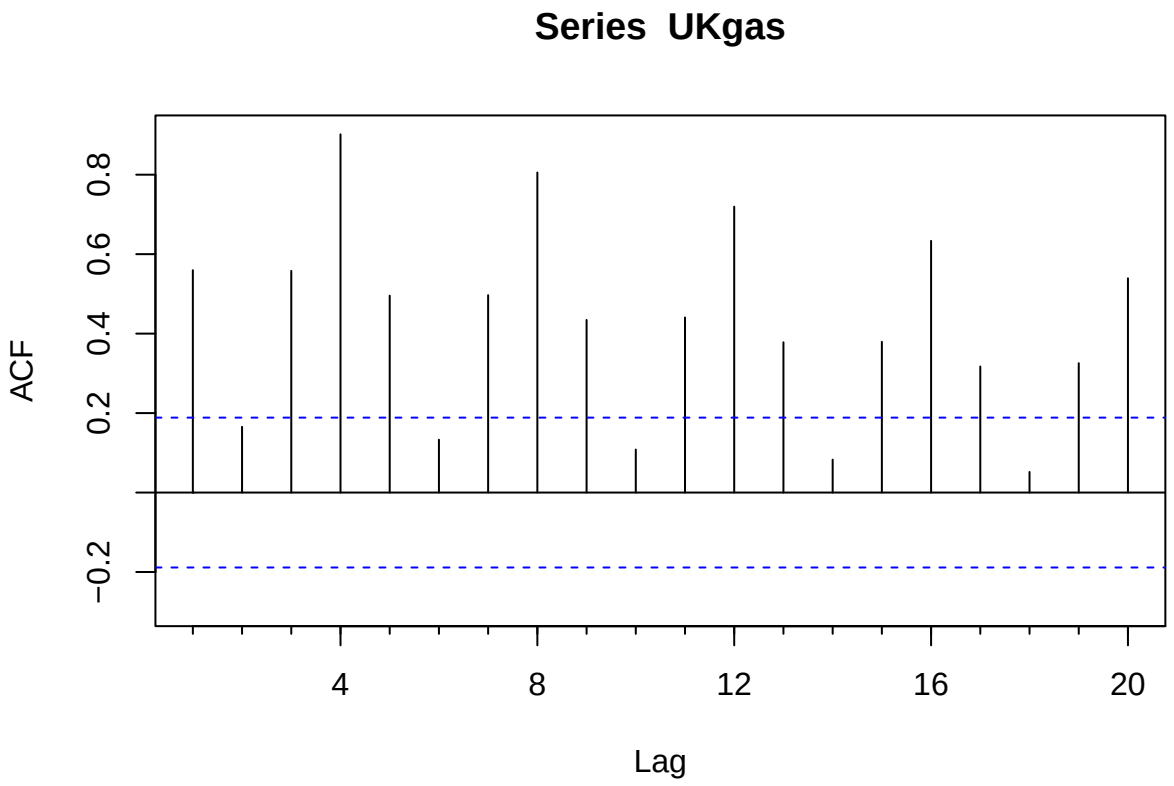
```
str(UKgas)
```

```
##  Time-Series [1:108] from 1960 to 1987: 160.1 129.7 84.8 120.1 160.1 ...
```

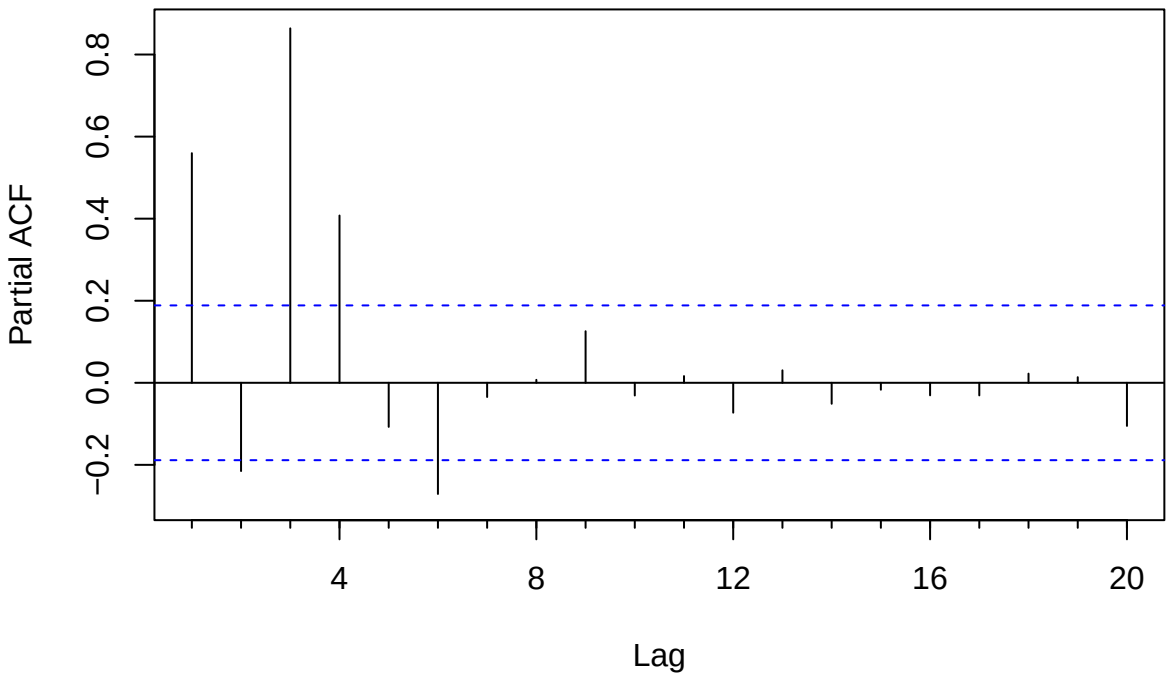
```
plot(UKgas)
```




```
Acf(UKgas)
```




```
Pacf(UKgas)
```



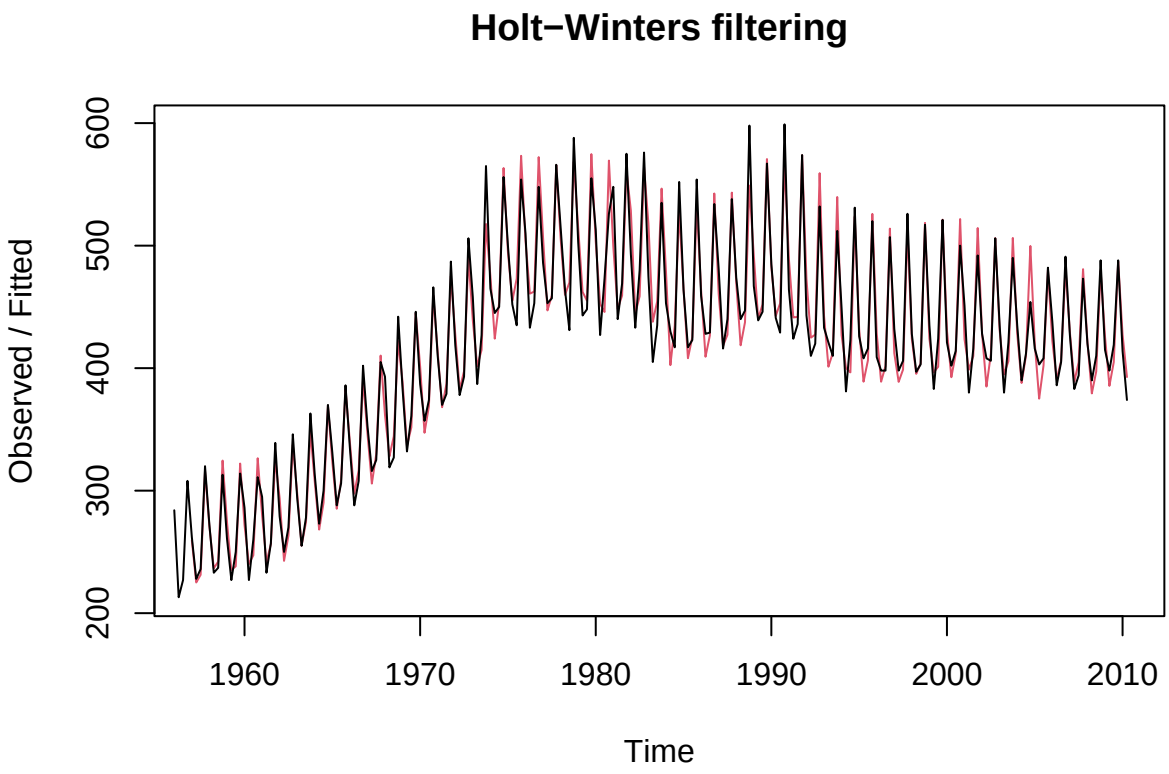
In figure1 we can see that all the lines showing a nice trending with no sudden drop and increase over time means that we can use the whole data set instead shorten its periodicity. We can see that in the UK gas usage between 1960 and 1987 auto correlation in figure2, there is a strong coefficient in the gap of 4 quarters(a year). And since it is all positive and dropping, we can say that it has a likely growing seasonal trend. However, this still need further exploration.

####Models As the figure 2 and figure 3 showed above, the coefficient are significant at lag of 4 in ACF and tail off in PACF, we should use MA models.

```
UKgasHotltWinters<- HoltWinters(ausbeer)
attributes(UKgasHotltWinters)
```

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

```
plot(UKgasHotltWinters)
```




```
##we can see that the predictions have generally small errors.
```

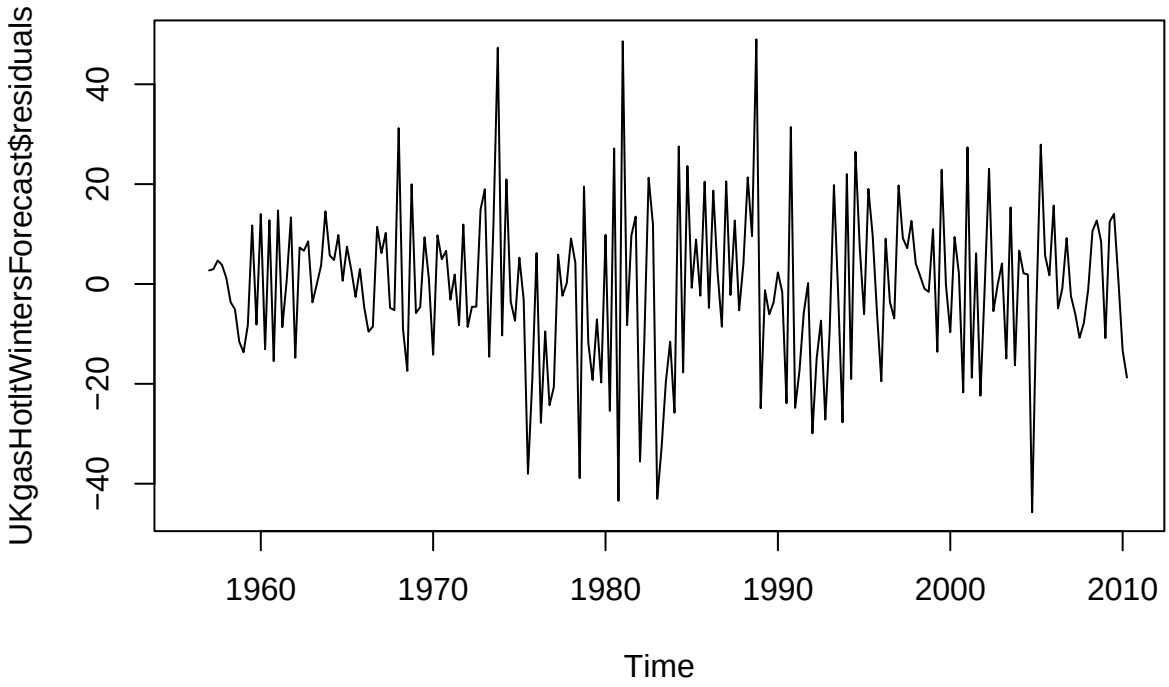
```
UKgasHotltWintersForecast <- forecast(UKgasHotltWinters)
attributes(UKgasHotltWintersForecast)
```

```
## $names
##  [1] "method"    "model"     "level"     "mean"      "lower"     "upper"
##  [7] "x"         "series"    "fitted"    "residuals"
##
## $class
## [1] "forecast"
```

```
head(UKgasHotltWintersForecast$residuals,20)
```

```
##            Qtr1       Qtr2       Qtr3       Qtr4
## 1956         NA         NA         NA         NA
## 1957   2.712500   2.957591   4.695659   3.809655
## 1958   1.202940  -3.629963  -5.079526 -11.545379
## 1959 -13.688612  -8.196576  11.733310  -8.128276
## 1960  14.026249 -13.066206  12.763914 -15.464205
```

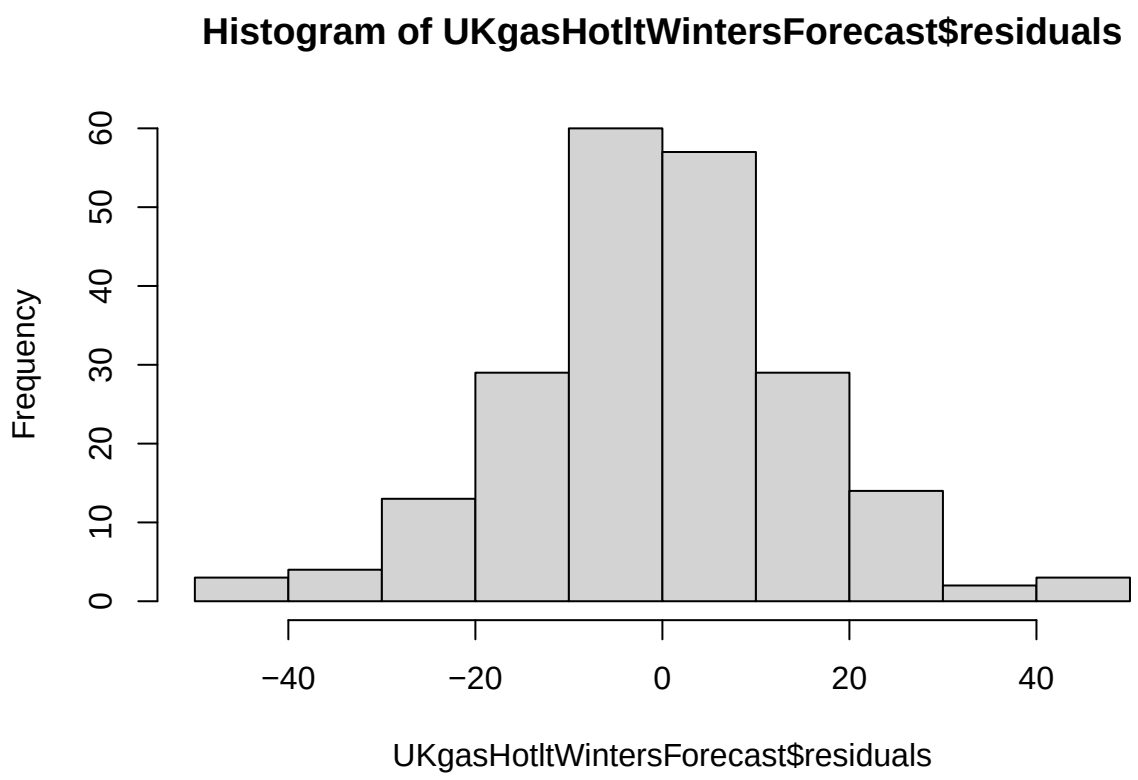
```
## "guess": the first row of residuals empty because the forecast use the 1956 data as a start point to
plot(UKgasHotltWintersForecast$residuals)
```



####Display the Histogram of prediction's residuals

we can see that the distribution of the residuals has a mean close to 0, completely random,and since the graph doesn't have severe skewed so that it have a constant std deviation.

```
hist(UKgasHotltWintersForecast$residuals)
```

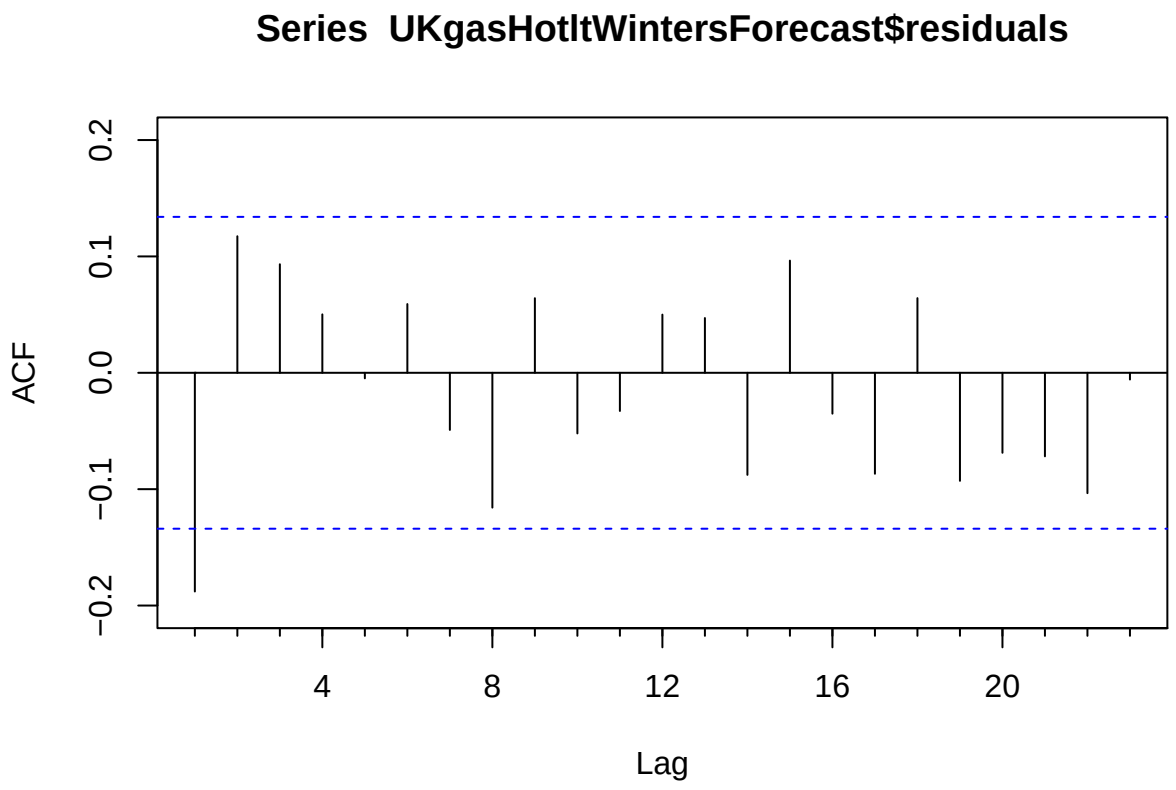



```
summary(UKgasHotltWintersForecast$residuals)
```

```
##      Min.   1st Qu.    Median      Mean   3rd Qu.      Max.      NA's
## -45.7208  -8.8918  -0.1887  -0.3702   9.5377  48.9959         4
```

####Residuals' pattern Now we should find that our prediction's residuals have a pattern or not.

```
Acf(UKgasHotltWintersForecast$residuals)
```



We can see that our residual don't have seasonality.

####Showing the Accuracies. Personaly, I think MAPE and RMSE are in resonable range.

```
accuracy(UKgasHotltWintersForecast)
```

```
##                       ME     RMSE      MAE        MPE     MAPE      MASE
## Training set -0.3702353 15.86279 12.15598 -0.1241059 2.874404 0.7837843
##                     ACF1
## Training set -0.1879524
```