Lab4 Practice

Problem 2

1.load libraries

```
library(tseries)
library(fBasics)
```

```
## Loading required package: timeDate
## Loading required package: timeSeries
##
## Rmetrics Package fBasics
## Analysing Markets and calculating Basic Statistics
## Copyright (C) 2005-2014 Rmetrics Association Zurich
## Educational Software for Financial Engineering and Computational Science
## Rmetrics is free software and comes with ABSOLUTELY NO WARRANTY.
## https://www.rmetrics.org --- Mail to: info@rmetrics.org
```

```
library(forecast)
library(lmtest)
```

```
## Loading required package: zoo
##
## Attaching package: 'zoo'
## The following object is masked from 'package:timeSeries':
##
##     time<-
## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric
```

2.Import Data

```
setwd("~/Desktop/CSC425/week4/")
myd = read.table("UNRATE48_2014.csv", header = T, sep = ',')
head(myd)
```

```
##       DATE change
## 1 2/1/1948    0.4
## 2 3/1/1948    0.2
## 3 4/1/1948   -0.1
## 4 5/1/1948   -0.4
## 5 6/1/1948    0.1
## 6 7/1/1948    0.0
```

```
tail(myd)
```

```
##          DATE change
## 798  7/1/2014    0.1
## 799  8/1/2014   -0.1
## 800  9/1/2014   -0.2
## 801 10/1/2014   -0.2
## 802 11/1/2014    0.1
## 803 12/1/2014   -0.2
```

```
date = myd[,1]
head(date)
```

```
## [1] 2/1/1948 3/1/1948 4/1/1948 5/1/1948 6/1/1948 7/1/1948
## 803 Levels: 1/1/1949 1/1/1950 1/1/1951 1/1/1952 1/1/1953 ... 9/1/2014
```

```
rate = myd[,2]
head(rate)
```

```
## [1]  0.4  0.2 -0.1 -0.4  0.1  0.0
```

```
#Creates time series object
ratets = ts(rate, start = c(1948,2), freq = 12)
ratets
```

```
##       Jan  Feb  Mar  Apr  May  Jun  Jul  Aug  Sep  Oct  Nov  Dec
## 1948       0.4  0.2 -0.1 -0.4  0.1  0.0  0.3 -0.1 -0.1  0.1  0.2
## 1949  0.3  0.4  0.3  0.3  0.8  0.1  0.5  0.1 -0.2  1.3 -1.5  0.2
## 1950 -0.1 -0.1 -0.1 -0.5 -0.3 -0.1 -0.4 -0.5 -0.1 -0.2  0.0  0.1
## 1951 -0.6 -0.3  0.0 -0.3 -0.1  0.2 -0.1  0.0  0.2  0.2  0.0 -0.4
## 1952  0.1 -0.1 -0.2  0.0  0.1  0.0  0.2  0.2 -0.3 -0.1 -0.2 -0.1
## 1953  0.2 -0.3  0.0  0.1 -0.2  0.0  0.1  0.1  0.2  0.2  0.4  1.0
## 1954  0.4  0.3  0.5  0.2  0.0 -0.3  0.2  0.2  0.1 -0.4 -0.4 -0.3
## 1955 -0.1 -0.2 -0.1  0.1 -0.4 -0.1 -0.2  0.2 -0.1  0.2 -0.1  0.0
## 1956 -0.2 -0.1  0.3 -0.2  0.3  0.0  0.1 -0.3 -0.2  0.0  0.4 -0.1
## 1957  0.0 -0.3 -0.2  0.2  0.2  0.2 -0.1 -0.1  0.3  0.1  0.6  0.1
## 1958  0.6  0.6  0.3  0.7  0.0 -0.1  0.2 -0.1 -0.3 -0.4 -0.5  0.0
## 1959 -0.2 -0.1 -0.3 -0.4 -0.1 -0.1  0.1  0.1  0.3  0.2  0.1 -0.5
## 1960 -0.1 -0.4  0.6 -0.2 -0.1  0.3  0.1  0.1 -0.1  0.6  0.0  0.5
## 1961  0.0  0.3  0.0  0.1  0.1 -0.2  0.1 -0.4  0.1 -0.2 -0.4 -0.1
## 1962 -0.2 -0.3  0.1  0.0 -0.1  0.0 -0.1  0.3 -0.1 -0.2  0.3 -0.2
## 1963  0.2  0.2 -0.2  0.0  0.2 -0.3  0.0 -0.2  0.1  0.0  0.2 -0.2
## 1964  0.1 -0.2  0.0 -0.1 -0.2  0.1 -0.3  0.1  0.1  0.0 -0.3  0.2
## 1965 -0.1  0.2 -0.4  0.1 -0.2  0.0 -0.2  0.0 -0.1 -0.1 -0.1 -0.1
## 1966  0.0 -0.2  0.0  0.0  0.1 -0.1  0.0  0.0 -0.1  0.0 -0.1  0.2
## 1967  0.1 -0.1  0.0  0.0  0.0  0.1 -0.1  0.0  0.0  0.2 -0.1 -0.1
## 1968 -0.1  0.1 -0.1 -0.2  0.0  0.2  0.0 -0.2 -0.1  0.0  0.0  0.0
## 1969  0.0  0.0  0.0  0.0  0.0  0.1  0.0  0.0  0.2  0.0 -0.2  0.0
## 1970  0.4  0.3  0.2  0.2  0.2  0.1  0.1  0.1  0.3  0.1  0.4  0.2
## 1971 -0.2  0.0  0.1 -0.1  0.0  0.0  0.1  0.1 -0.1 -0.2  0.2  0.0
## 1972 -0.2 -0.1  0.1 -0.1  0.0  0.0 -0.1  0.0 -0.1  0.1 -0.3 -0.1
## 1973 -0.3  0.1 -0.1  0.1 -0.1  0.0 -0.1  0.0  0.0 -0.2  0.2  0.1
## 1974  0.2  0.1 -0.1  0.0  0.0  0.3  0.1  0.0  0.4  0.1  0.6  0.6
## 1975  0.9  0.0  0.5  0.2  0.2 -0.2 -0.2 -0.2  0.0  0.0 -0.1 -0.1
## 1976 -0.3 -0.2 -0.1  0.1 -0.3  0.2  0.2  0.0 -0.2  0.1  0.1  0.0
## 1977 -0.3  0.1 -0.2 -0.2 -0.2  0.2 -0.3  0.1 -0.2  0.0  0.0 -0.4
```

```
## 1978  0.0 -0.1  0.0 -0.2 -0.1 -0.1  0.3 -0.3  0.1 -0.2  0.1  0.1
## 1979 -0.1  0.0 -0.1  0.0 -0.2  0.1  0.0  0.3 -0.1  0.1 -0.1  0.1
## 1980  0.3  0.0  0.0  0.6  0.6  0.1  0.2 -0.1 -0.2  0.0  0.0 -0.3
## 1981  0.3 -0.1  0.0 -0.2  0.3  0.0 -0.3  0.2  0.2  0.3  0.4  0.2
## 1982  0.1  0.3  0.1  0.3  0.1  0.2  0.2  0.0  0.3  0.3  0.4  0.0
## 1983 -0.4  0.0 -0.1 -0.1 -0.1  0.0 -0.7  0.1 -0.3 -0.4 -0.3 -0.2
## 1984 -0.3 -0.2  0.0 -0.1 -0.3 -0.2  0.3  0.0 -0.2  0.1 -0.2  0.1
## 1985  0.0 -0.1  0.0  0.1 -0.1  0.2  0.0 -0.3  0.0  0.0 -0.1  0.0
## 1986 -0.3  0.5  0.0 -0.1  0.1  0.0 -0.2 -0.1  0.1  0.0 -0.1 -0.3
## 1987  0.0  0.0  0.0 -0.3  0.0 -0.1 -0.1 -0.1 -0.1  0.1 -0.2 -0.1
## 1988  0.0  0.0  0.0 -0.3  0.2 -0.2  0.0  0.2 -0.2  0.0 -0.1  0.0
## 1989  0.1 -0.2 -0.2  0.2  0.0  0.1 -0.1  0.0  0.1  0.0  0.1  0.0
## 1990  0.0 -0.1 -0.1  0.2  0.0 -0.2  0.3  0.2  0.2  0.0  0.3  0.1
## 1991  0.1  0.2  0.2 -0.1  0.2  0.0 -0.1  0.1  0.0  0.1  0.0  0.3
## 1992  0.0  0.1  0.0  0.0  0.2  0.2 -0.1 -0.1  0.0 -0.3  0.1  0.0
## 1993 -0.1 -0.2 -0.1  0.1  0.0 -0.1 -0.1 -0.1 -0.1  0.1 -0.2 -0.1
## 1994  0.1  0.0 -0.1 -0.1 -0.3  0.0  0.0 -0.1 -0.1 -0.1 -0.2 -0.1
## 1995  0.1 -0.2  0.0  0.4 -0.2  0.0  0.1  0.0 -0.1 -0.1  0.1  0.0
## 1996  0.0 -0.1  0.0  0.1  0.0 -0.3  0.2 -0.4  0.1  0.0  0.2  0.0
## 1997 -0.1 -0.1  0.0 -0.1 -0.2  0.1 -0.1 -0.1  0.1 -0.2 -0.1  0.1
## 1998 -0.1  0.0  0.1 -0.4  0.1  0.1  0.0  0.0  0.1 -0.1 -0.1  0.0
## 1999 -0.1  0.1 -0.2  0.1 -0.1  0.1  0.0 -0.1  0.0 -0.1  0.0 -0.1
## 2000  0.0  0.1 -0.1 -0.2  0.2  0.0  0.0  0.1 -0.2  0.0  0.0  0.0
## 2001  0.3  0.0  0.1  0.1 -0.1  0.2  0.1  0.3  0.1  0.3  0.2  0.2
## 2002  0.0  0.0  0.0  0.2 -0.1  0.0  0.0 -0.1  0.0  0.0  0.2  0.1
## 2003 -0.2  0.1  0.0  0.1  0.1  0.2 -0.1 -0.1  0.0 -0.1 -0.2 -0.1
## 2004  0.0 -0.1  0.2 -0.2  0.0  0.0 -0.1 -0.1  0.0  0.1 -0.1  0.0
## 2005 -0.1  0.1 -0.2  0.0 -0.1 -0.1  0.0 -0.1  0.1  0.0  0.0 -0.1
## 2006 -0.2  0.1 -0.1  0.0 -0.1  0.0  0.1  0.0 -0.2 -0.1  0.1 -0.1
## 2007  0.2 -0.1 -0.1  0.1 -0.1  0.2  0.1 -0.1  0.1  0.0  0.0  0.3
## 2008  0.0 -0.1  0.2 -0.1  0.4  0.2  0.2  0.3  0.0  0.4  0.3  0.5
## 2009  0.5  0.5  0.4  0.3  0.4  0.1  0.0  0.1  0.2  0.2 -0.1  0.0
## 2010 -0.1  0.0  0.1  0.0 -0.3 -0.2  0.0  0.1  0.0 -0.1  0.4 -0.5
## 2011 -0.1 -0.2  0.0  0.1 -0.1  0.1 -0.1  0.0  0.0 -0.2 -0.2 -0.1
## 2012 -0.2  0.0 -0.1  0.0  0.0  0.0  0.0 -0.2 -0.2  0.0 -0.1  0.2
## 2013  0.1 -0.3 -0.2  0.1 -0.1  0.0 -0.2 -0.1  0.0  0.0 -0.2 -0.3
## 2014 -0.1  0.1 -0.1 -0.4  0.1 -0.2  0.1 -0.1 -0.2 -0.2  0.1 -0.2
```

3. Compute Summary Statistics

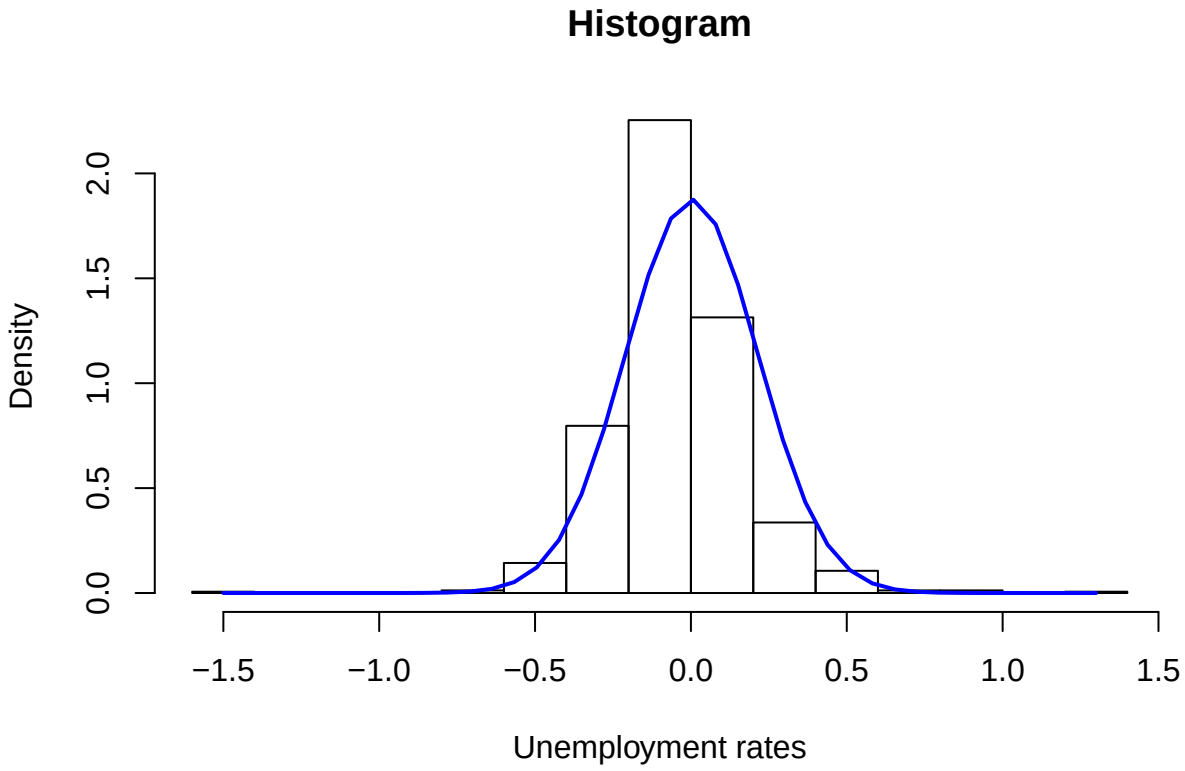
```
basicStats(rate)
```

```
##                  rate
## nobs        803.000000
## NAs           0.000000
## Minimum      -1.500000
## Maximum       1.300000
## 1. Quartile  -0.100000
## 3. Quartile   0.100000
## Mean          0.002740
## Median        0.000000
## Sum           2.200000
## SE Mean       0.007507
```

```
## LCL Mean     -0.011996
## UCL Mean      0.017476
## Variance      0.045254
## Stdev         0.212731
## Skewness      0.336031
## Kurtosis      5.717320
```

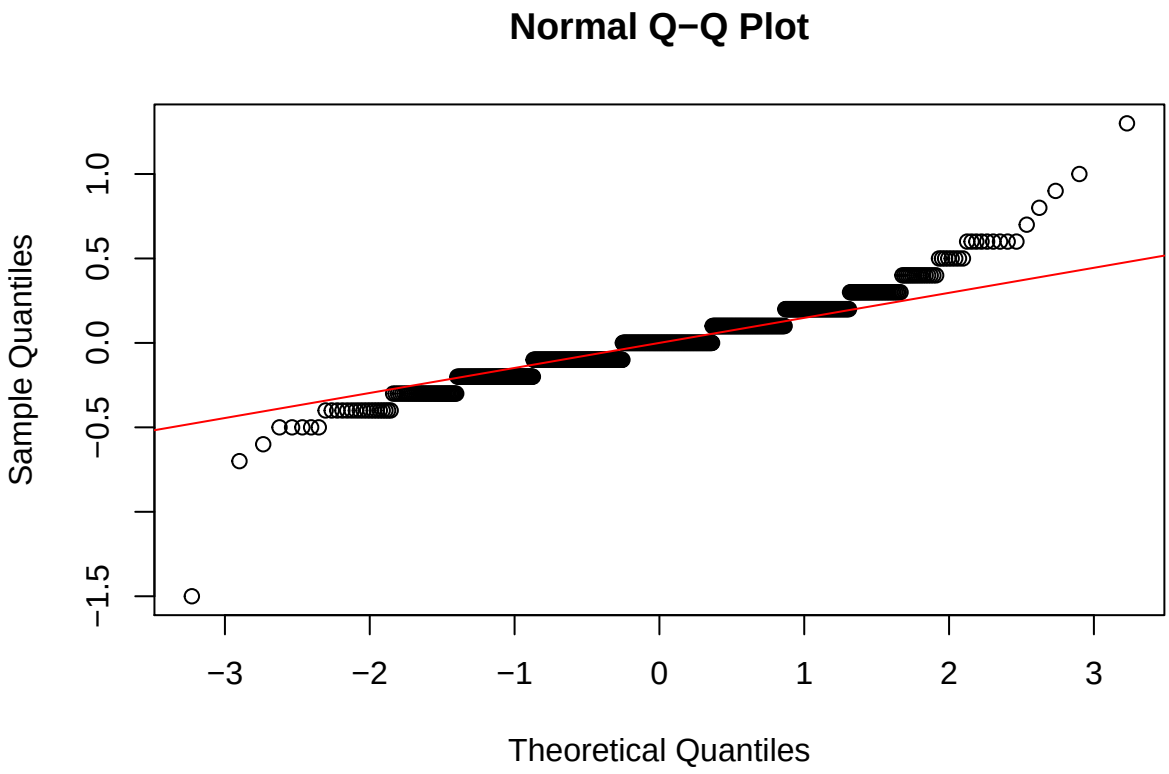
4. Crate Histogram

```
# Creates 2 by 2 display for 4 plots
par(mfcol = c(1,1))
hist(rate, xlab="Unemployment rates", prob=TRUE, main="Histogram")
xfit<-seq(min(rate),max(rate),length=40)
yfit<-dnorm(xfit,mean=mean(rate),sd=sd(rate))
lines(xfit, yfit, col="blue", lwd=2)
```



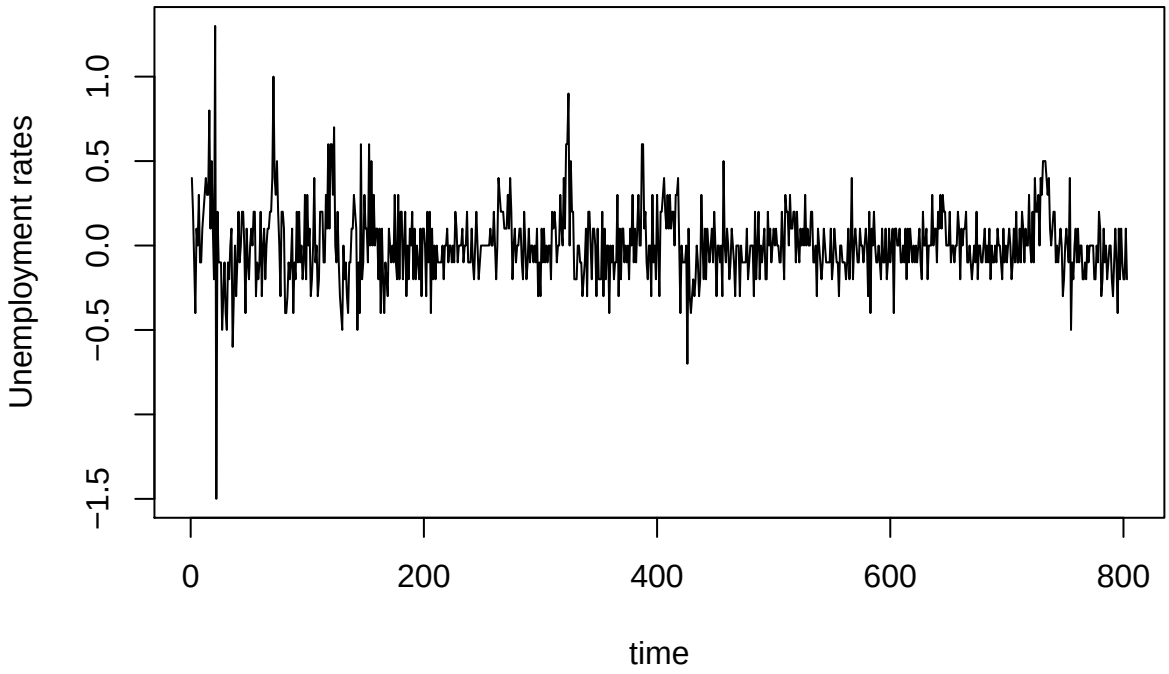
5. Create normal Probability Plot

```
qqnorm(rate)
qqline(rate, col = 2)
```



6. Create Time Plot

```
# use time series object lnatts to draw time plot indexed with time
plot(rate, type = 'l', xlab = 'time', ylab = 'Unemployment rates')
```

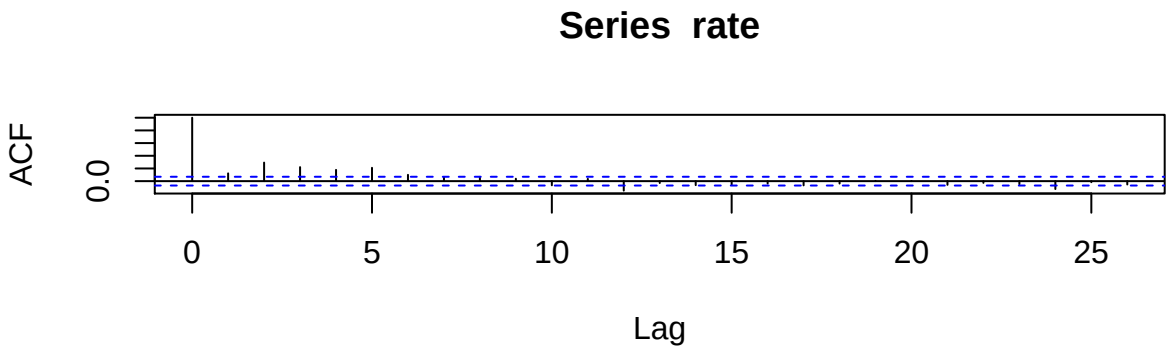


7. Compute ACF and PACF and Plot Correlogram

```
# prints acf to console
acf(rate, plot = F, lag = 20)
```

```
##
## Autocorrelations of series 'rate', by lag
##
##      0      1      2      3      4      5      6      7      8      9
##  1.000  0.123  0.293  0.221  0.178  0.210  0.100  0.063  0.068  0.038
##     10     11     12     13     14     15     16     17     18     19
## -0.066  0.036 -0.150 -0.030 -0.063 -0.054 -0.038 -0.067 -0.038  0.004
##     20
##  0.003
```

```
# creats 2 by 1 display for 2 plots
par(mfcol=c(2,1))
# plots acf(correlogram)
acf(rate, plot=T, lag=26)
```



8. Nomality Test

```
#perform Jarque-Bera normality Test
normalTest(rate, method = c('jb'))
```

```
##
## Title:
##  Jarque - Bera Normalality Test
##
## Test Results:
##   STATISTIC:
##     X-squared: 1117.1844
##   P VALUE:
##     Asymptotic p Value: < 2.2e-16
##
## Description:
##  Thu Oct  5 16:50:12 2017 by user:
```

9. Compute Ljung-Box test for White Noise (No autocorrelation)

```
Box.test(rate, lag = 4, type = 'Ljung')
```

```
##
##  Box-Ljung test
##
## data:  rate
## X-squared = 146.53, df = 4, p-value < 2.2e-16
```

```
Box.test(rate, lag = 8, type = 'Ljung')
```

```
##
##  Box-Ljung test
##
## data:  rate
## X-squared = 197.42, df = 8, p-value < 2.2e-16
```

```
Box.test(rate, lag = 12, type = 'Ljung')
```

```
##
##  Box-Ljung test
##
## data:  rate
## X-squared = 221.51, df = 12, p-value < 2.2e-16
```

```
library(forecast)
# apply a automated order selection procedure
auto.arima(ratets, stationary = T, seasonal = F)
```

```
## Series: ratets
## ARIMA(2,0,2) with zero mean
##
## Coefficients:
##          ar1      ar2      ma1     ma2
##       1.6564  -0.7776  -1.6309  0.8470
## s.e.  0.0419   0.0464   0.0418  0.0485
##
## sigma^2 estimated as 0.03892:  log likelihood=165.6
## AIC=-321.2   AICc=-321.13   BIC=-297.76
```

```
# Fit a MA(5) model
m1 = Arima(ratets, order = c(0,0,5), method = 'ML', include.mean = T)
m1
```

```
## Series: ratets
## ARIMA(0,0,5) with non-zero mean
##
## Coefficients:
##          ma1     ma2     ma3     ma4    ma5    mean
##       0.0217  0.2240  0.1378  0.1132  0.175  0.0028
## s.e.  0.0353  0.0353  0.0350  0.0329  0.035  0.0117
##
## sigma^2 estimated as 0.03962:  log likelihood=159.65
## AIC=-305.31   AICc=-305.16   BIC=-272.49
```

```r
# T-tests on coeeficients
coeftest(m1)
```

```
##
## z test of coefficients:
##
##            Estimate Std. Error z value  Pr(>|z|)
## ma1       0.0217401  0.0352832  0.6162 0.5377887
## ma2       0.2239667  0.0353066  6.3435 2.246e-10 ***
## ma3       0.1377526  0.0350329  3.9321 8.421e-05 ***
## ma4       0.1132062  0.0328793  3.4431 0.0005751 ***
## ma5       0.1750180  0.0350419  4.9945 5.898e-07 ***
## intercept 0.0028054  0.0116794  0.2402 0.8101743
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
#Residual Analysis
Box.test(m1$residuals,lag=6,type='Ljung', fitdf=5)
```

```
##
##  Box-Ljung test
##
## data:  m1$residuals
## X-squared = 5.3081, df = 1, p-value = 0.02123
```

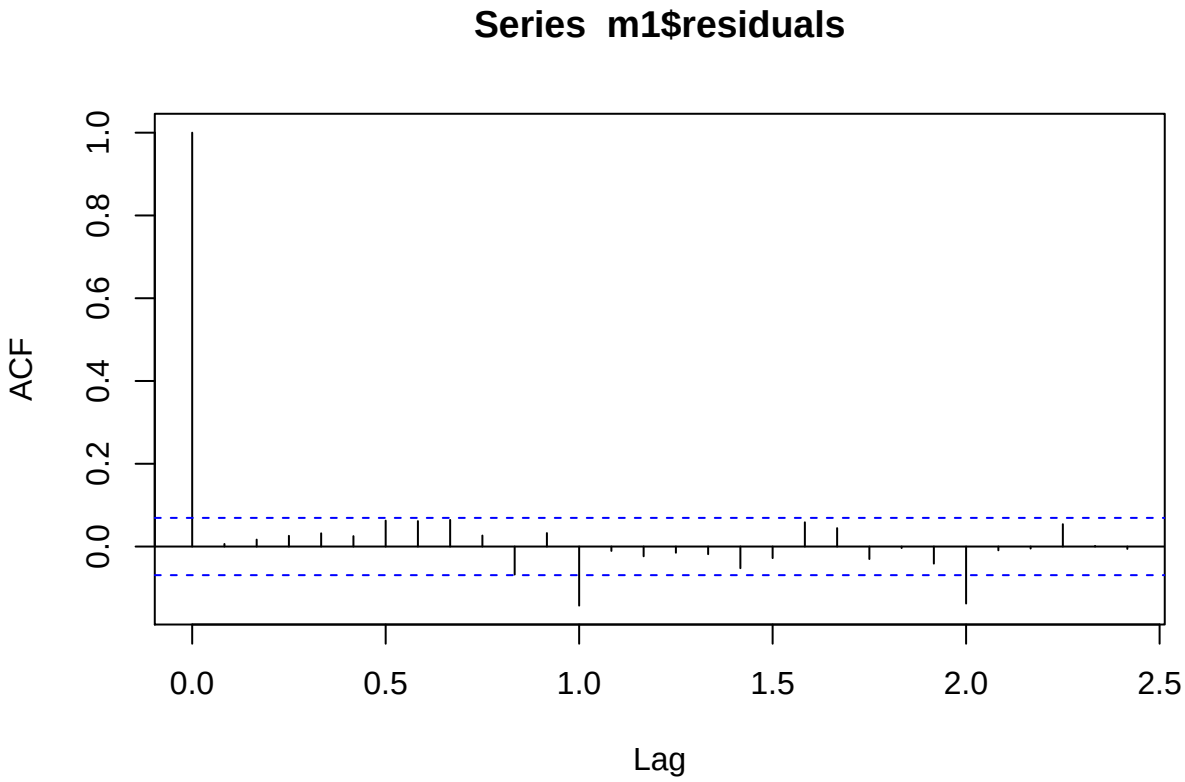
```r
Box.test(m1$residuals,lag=10,type='Ljung', fitdf=5)
```

```
##
##  Box-Ljung test
##
## data:  m1$residuals
## X-squared = 16.039, df = 5, p-value = 0.006735
```

```r
Box.test(m1$residuals,lag=12,type='Ljung', fitdf=5)
```

```
##
##  Box-Ljung test
##
## data:  m1$residuals
## X-squared = 33.552, df = 7, p-value = 2.089e-05
```

```r
acf(m1$residuals)
```


Series m1$residuals
ACF
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.5
1.0
1.5
2.0
2.5
Lag