hw7.R

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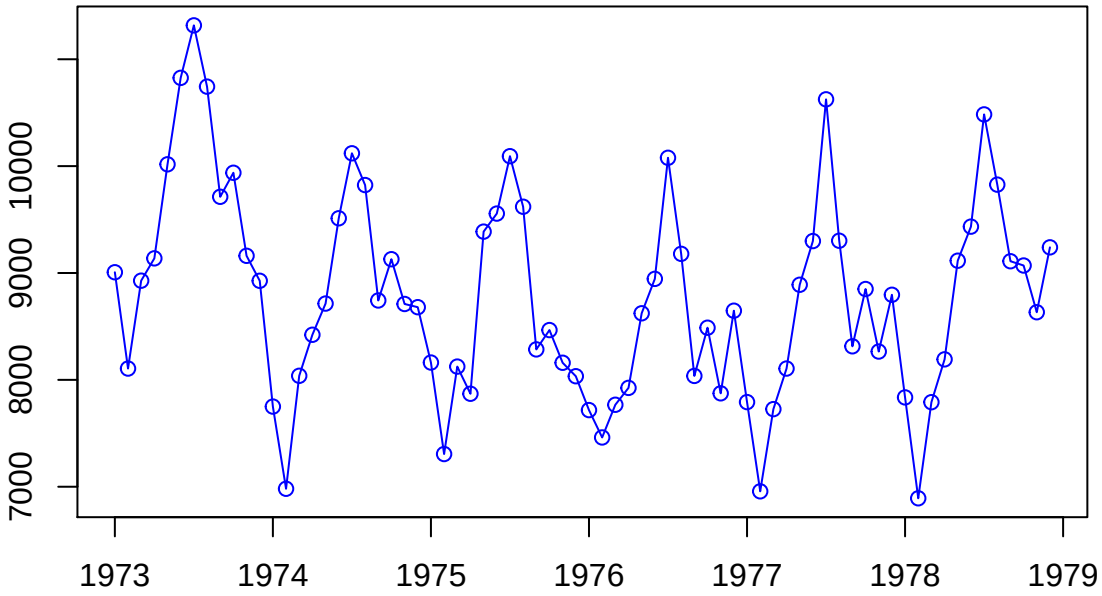
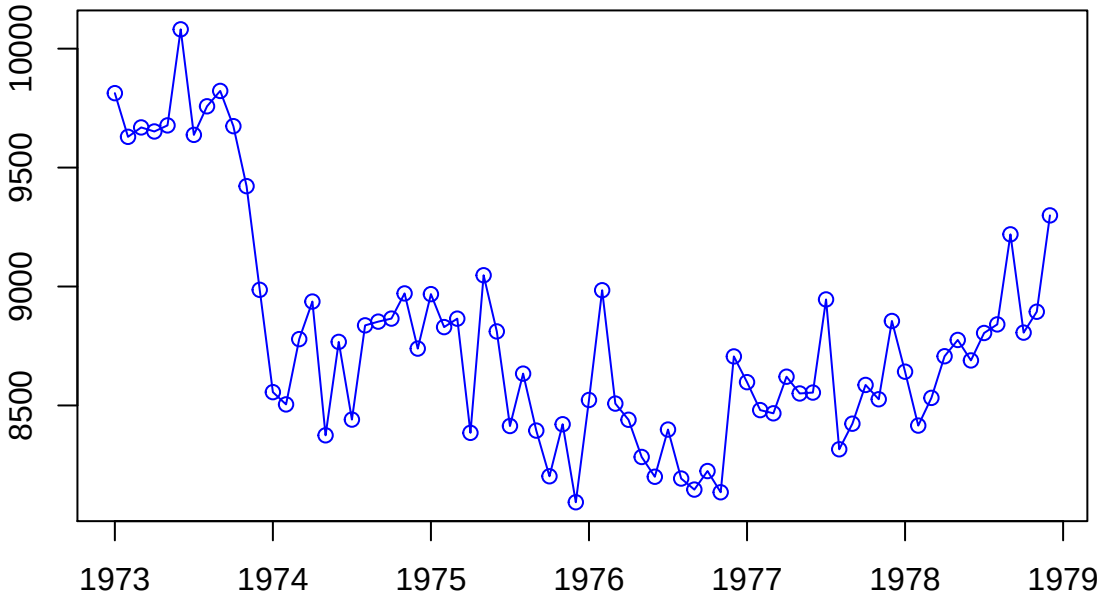
```
### Jiayuan Shi
### MA881 Assignment7: Time Series

## 1
library(itsmr)
library(MASS)
```

```
##
## Attaching package: 'MASS'
##
## The following object is masked from 'package:itsmr':
##
##     deaths
```

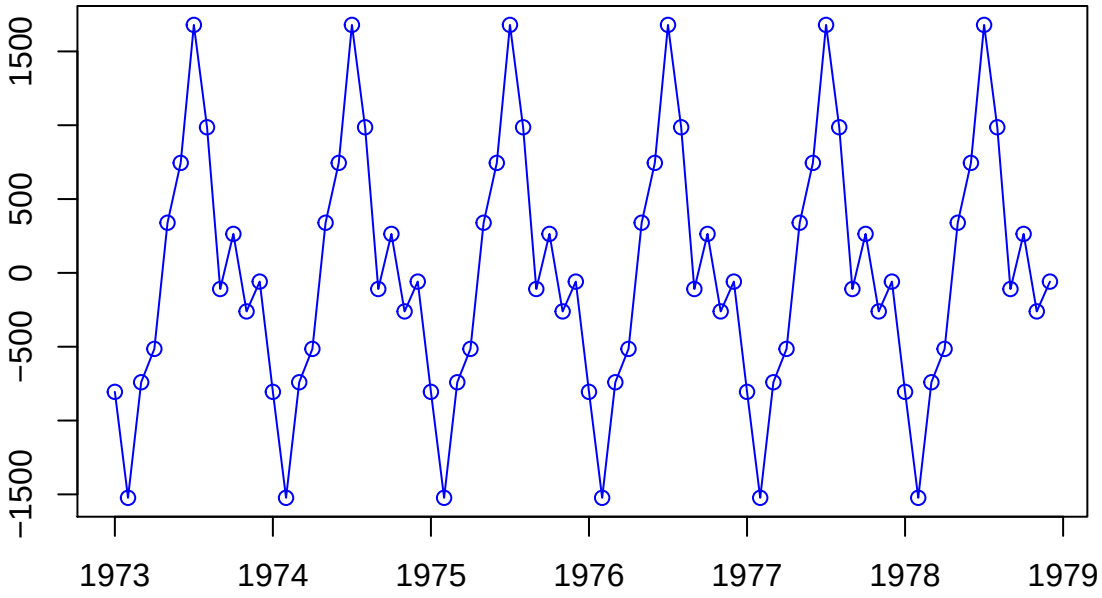
```
library(datasets)

# Estimation and Elimination of Both Trend and Seasonality
# Method S1: Estimation of Trend and Seasonal Components
plotc(accdeaths)
```



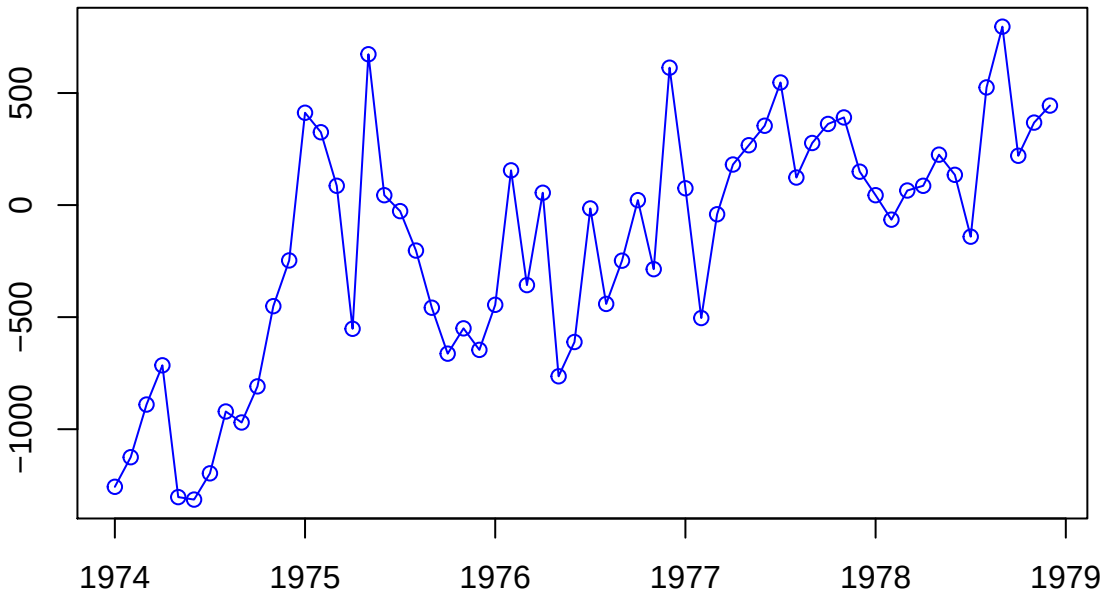

```
y1 <- season(accdeaths, 12)
deseasonalized.death <- accdeaths - y1
# Plot1: The deseasonalized monthly accidental deaths data
plotc(deseasonalized.death)
```



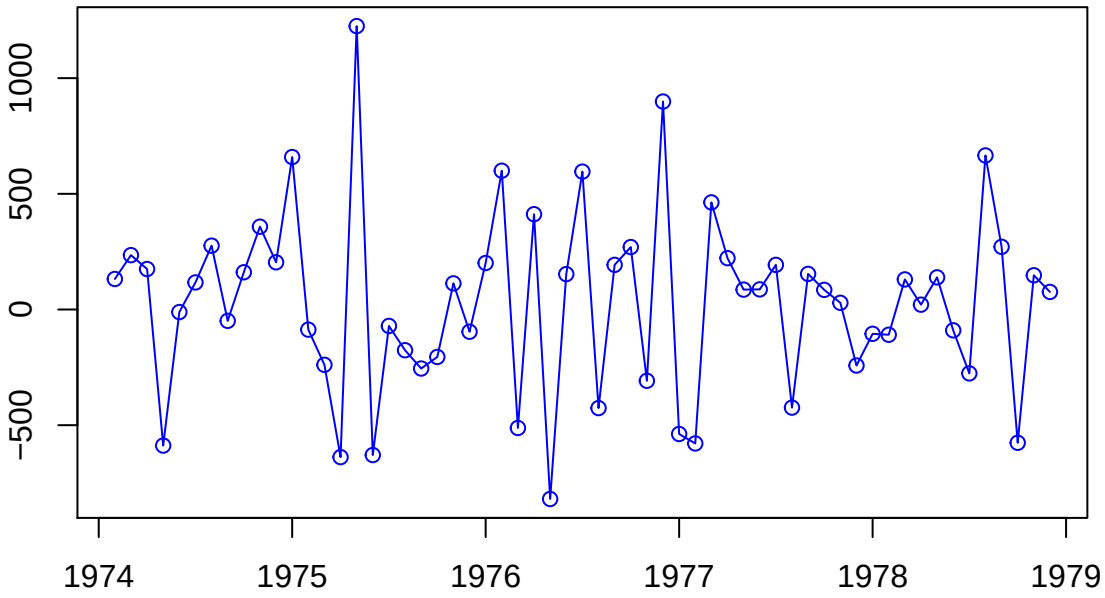

```
# Plot2: The estimated seasonal component of the monthly accidental deaths data
y1 <- ts(y1, start=c(1973,1), frequency = 12)
plotc(y1)
```




```
# Method S2: Elimination of Trend and Seasonal Components by Differencing
# Plot3 & 4: The differenced series derived from the monthly accidental deaths
d <- diff(accdeaths, lag=12)
plotc(d)
```

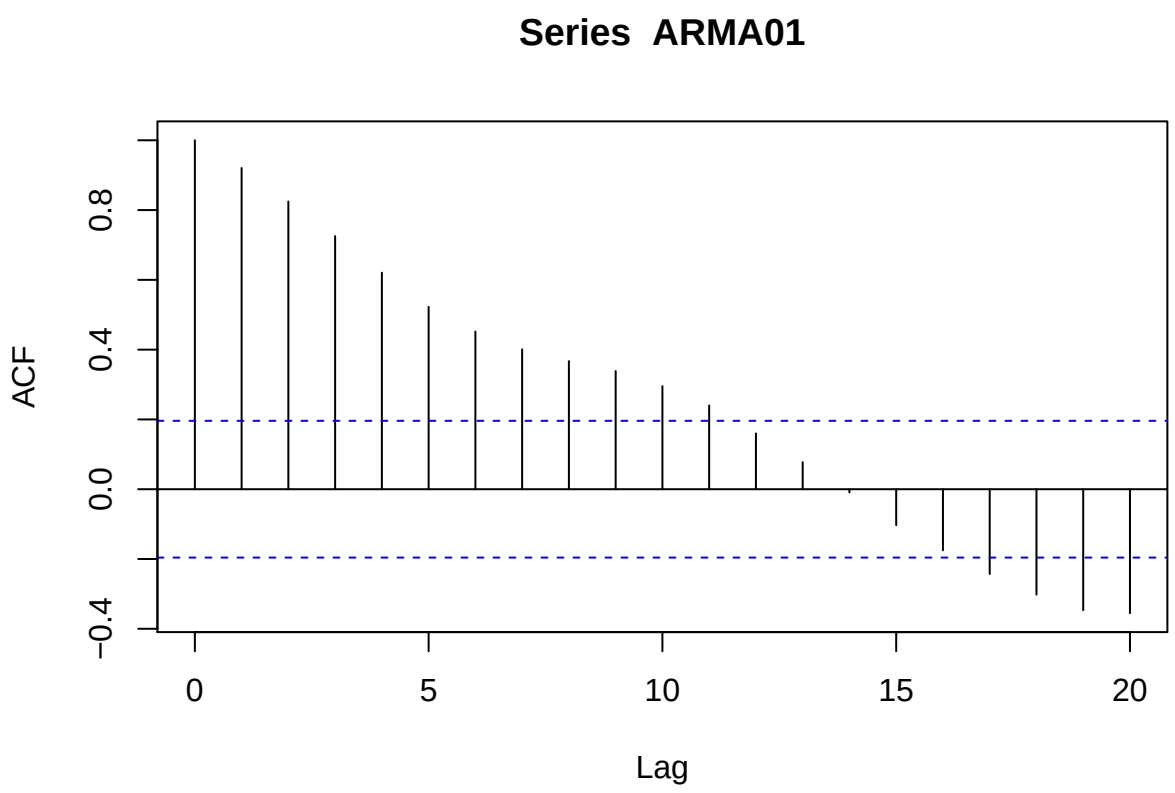



```
d1 <- diff(d, lag=1)
plotc(d1)
```

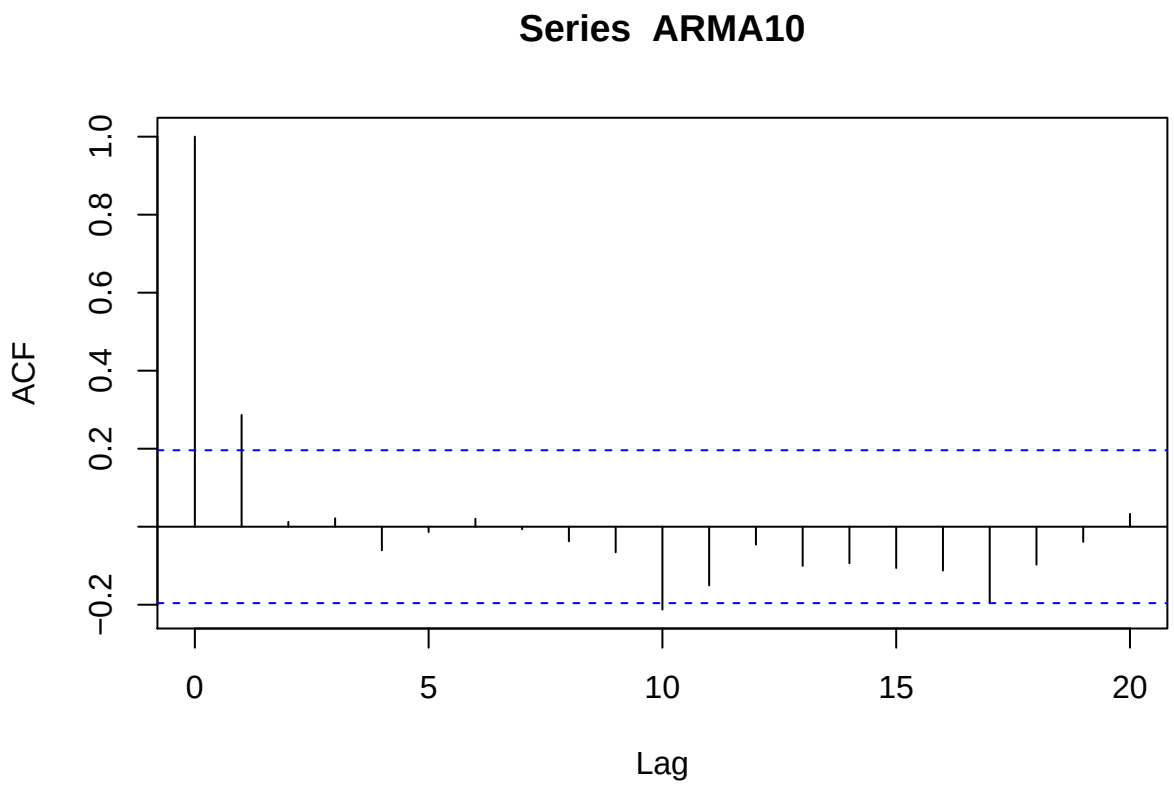



```
## 2
# AR(1), ARMA(1,0)
ARMA01 <- arima.sim(model=list(ar=c(0.9)), n=100)
# MA(1), ARMA(0,1)
ARMA10 <- arima.sim(model=list(ma=c(0.2)), n=100)
# ARMA(1,1)
ARMA11 <- arima.sim(model=list(ar=c(0.9),ma=c(0.2)), n=100)
# ARMA(1,2)
ARMA12 <- arima.sim(model=list(ar=c(0.9),ma=c(0.2,-0.9)), n=100)
# ARMA(2,1)
ARMA21 <- arima.sim(model=list(ar=c(0.9,-0.2),ma=c(0.2)), n=100)
# ARMA(2,2)
```

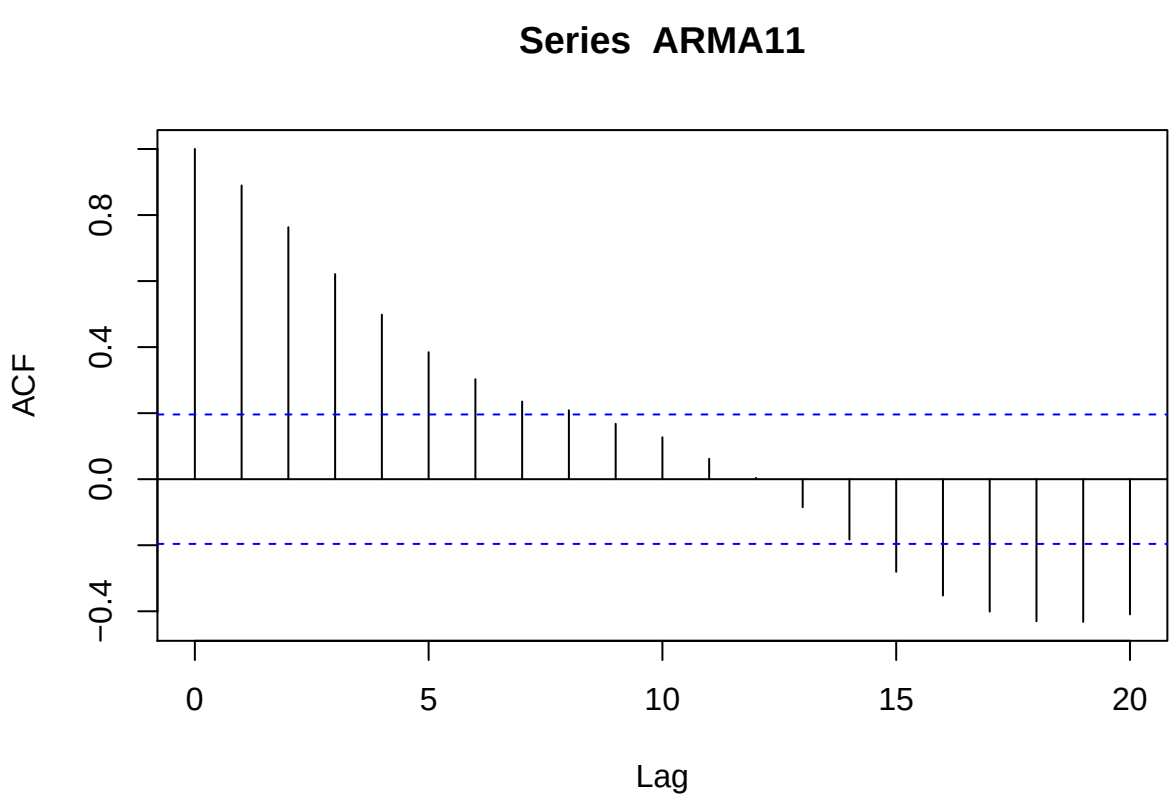
```r
ARMA22 <- arima.sim(model=list(ar=c(0.9,-0.2),ma=c(0.2,-0.9)), n=100)
# ARMA(2,3)
ARMA23 <- arima.sim(model=list(ar=c(0.9,-0.2),ma=c(0.2,-0.9,0.1)), n=100)

acf(ARMA01)
```



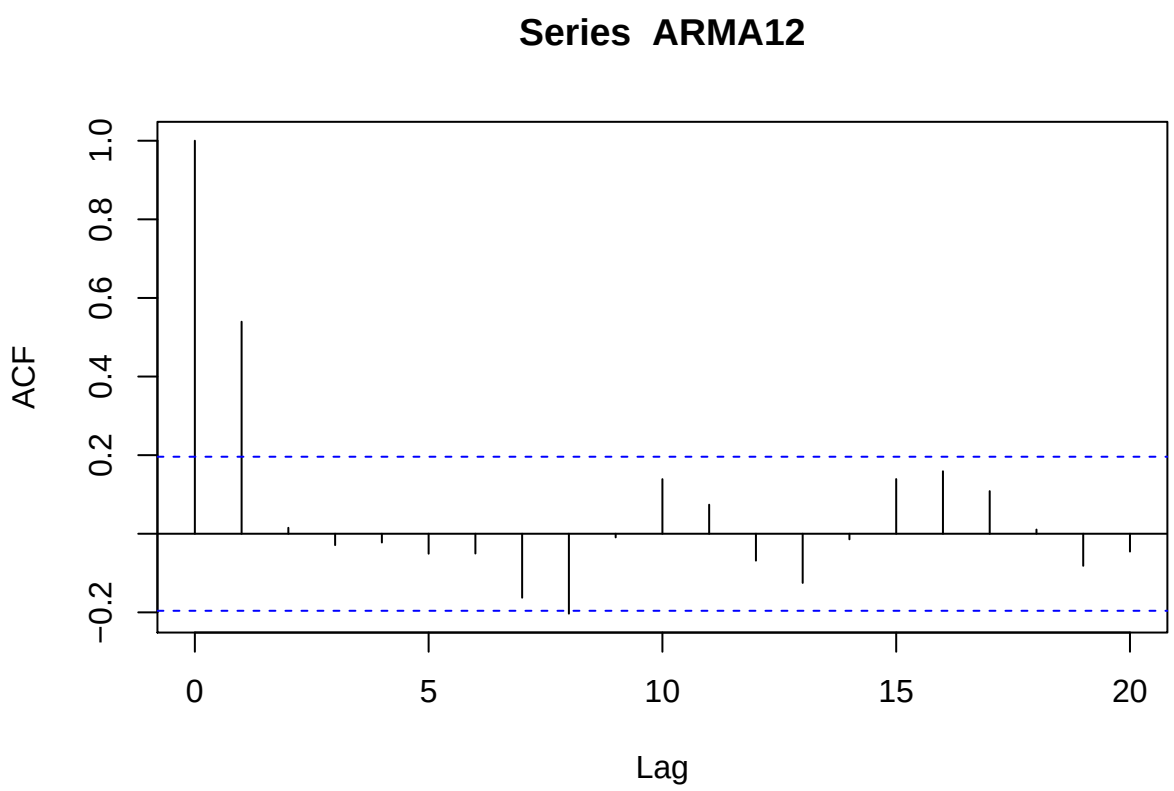

```r
acf(ARMA10)
```


Series ARMA10
ACF
1.0
0.8
0.6
0.4
0.2
−0.2
0
5
10
15
20
Lag

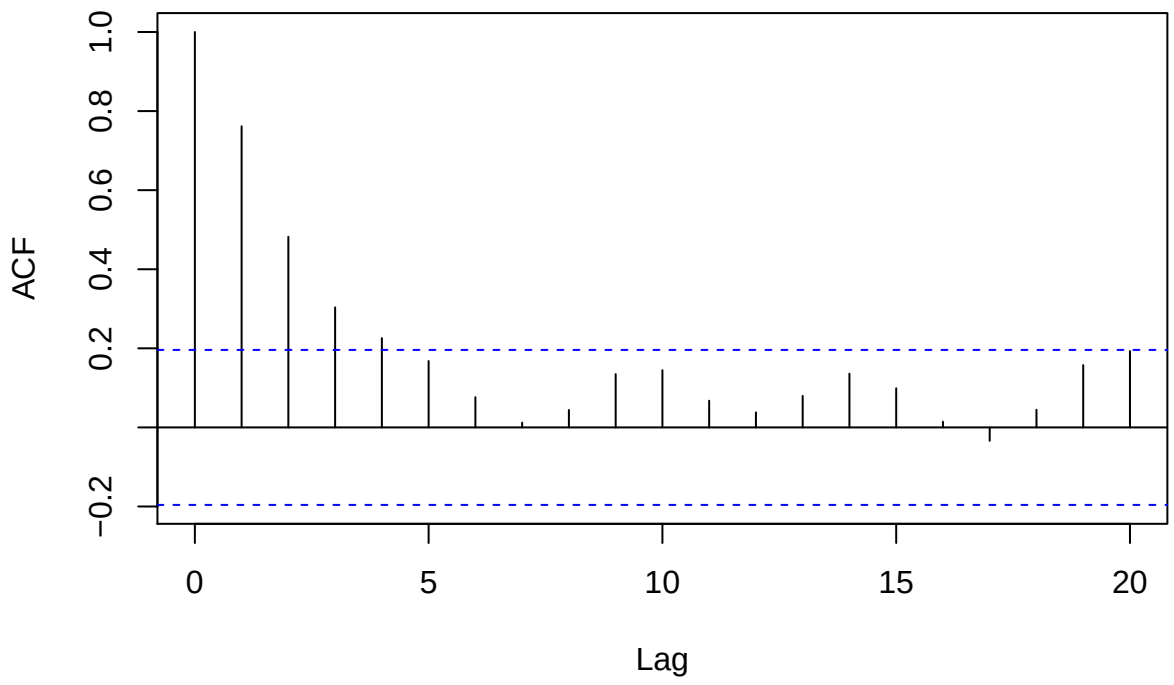
```
acf(ARMA11)
```


Series ARMA11
ACF
0.8
0.4
0.0
−0.4
0
5
10
15
20
Lag

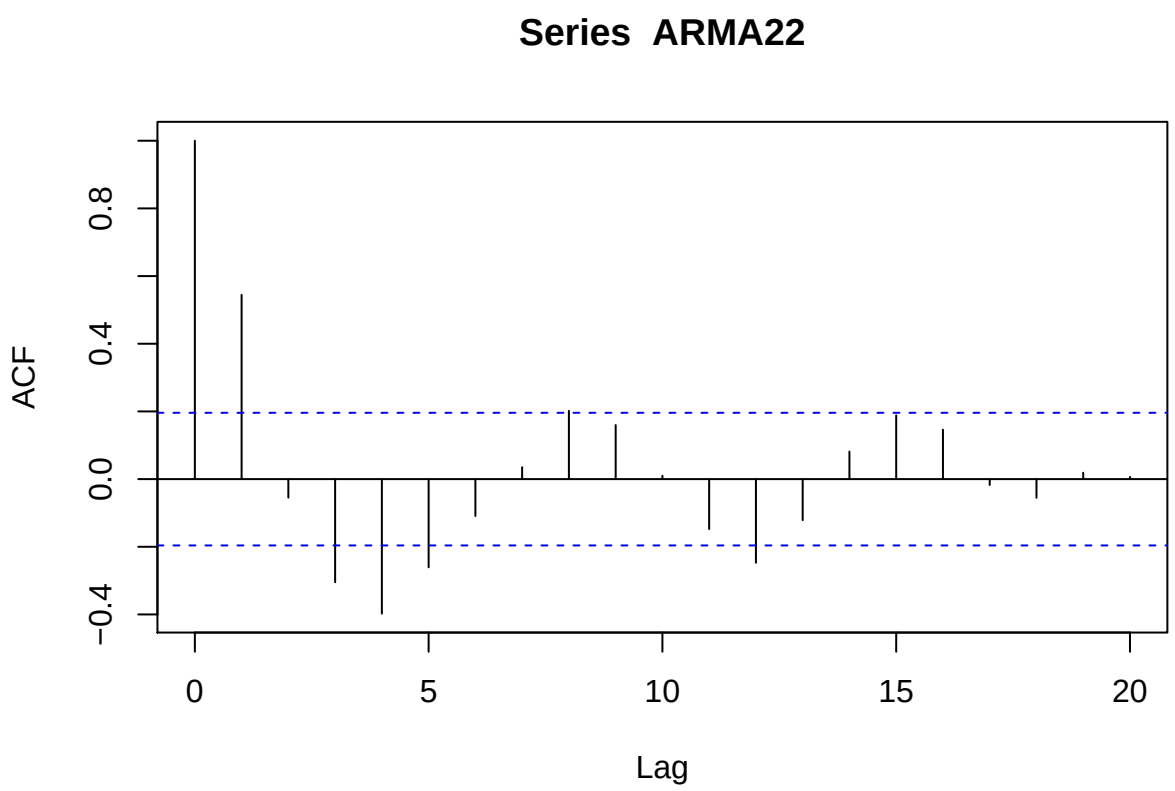
```r
acf(ARMA12)
```



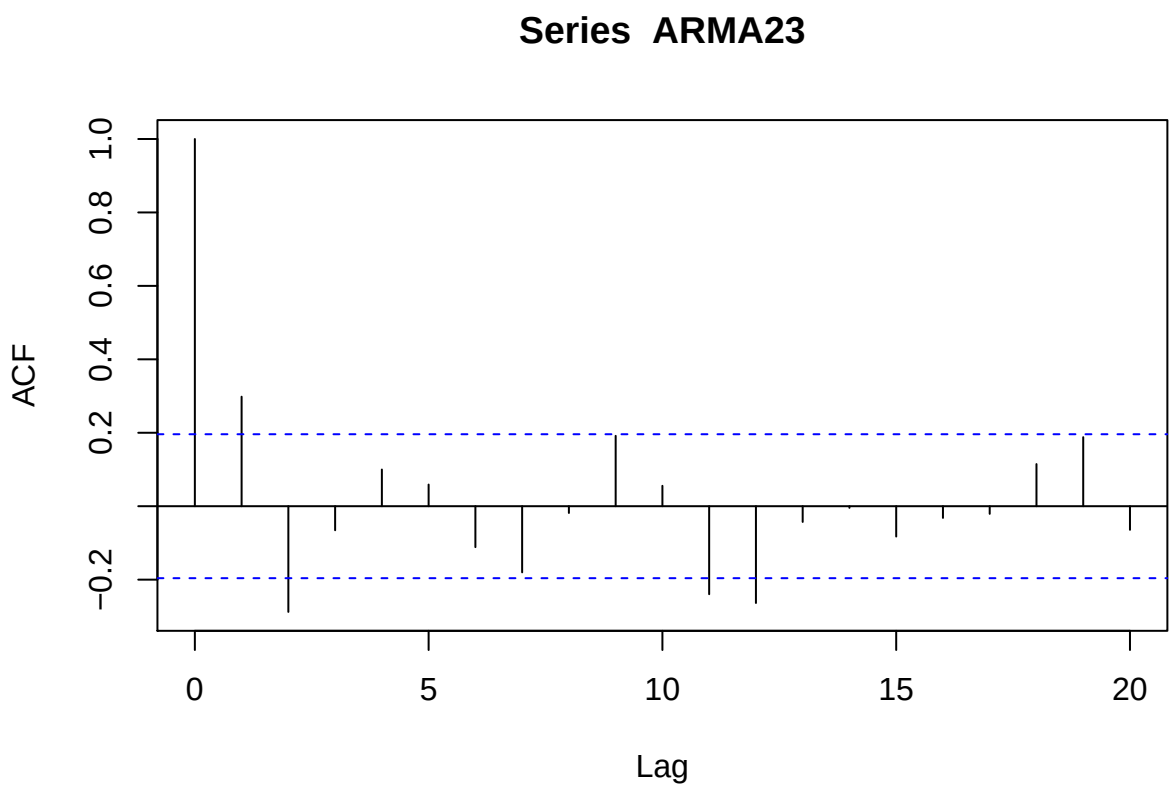

```r
acf(ARMA21)
```



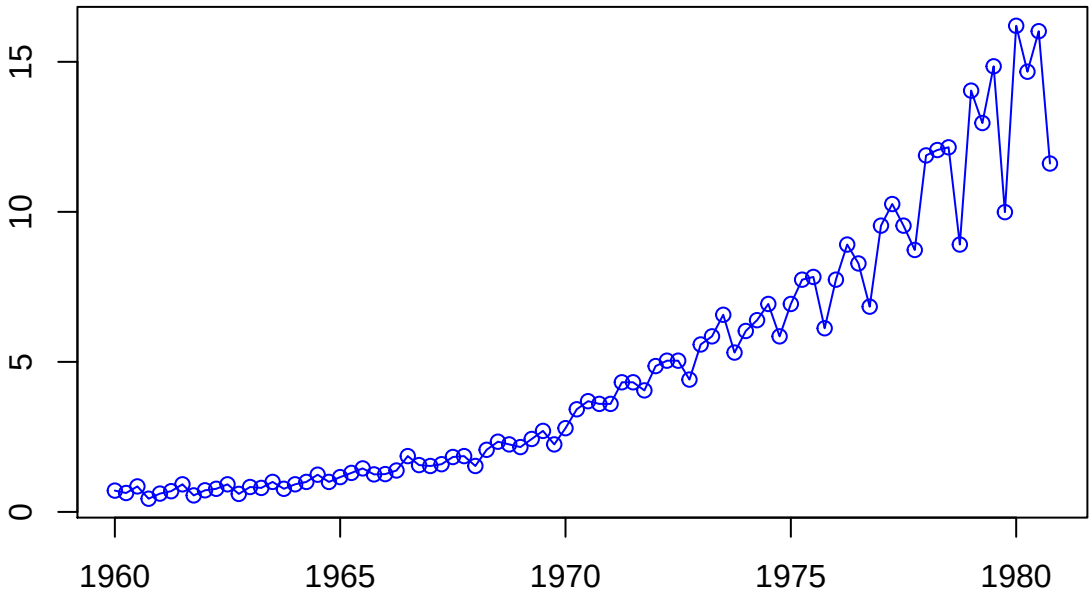
```
acf(ARMA22)
```



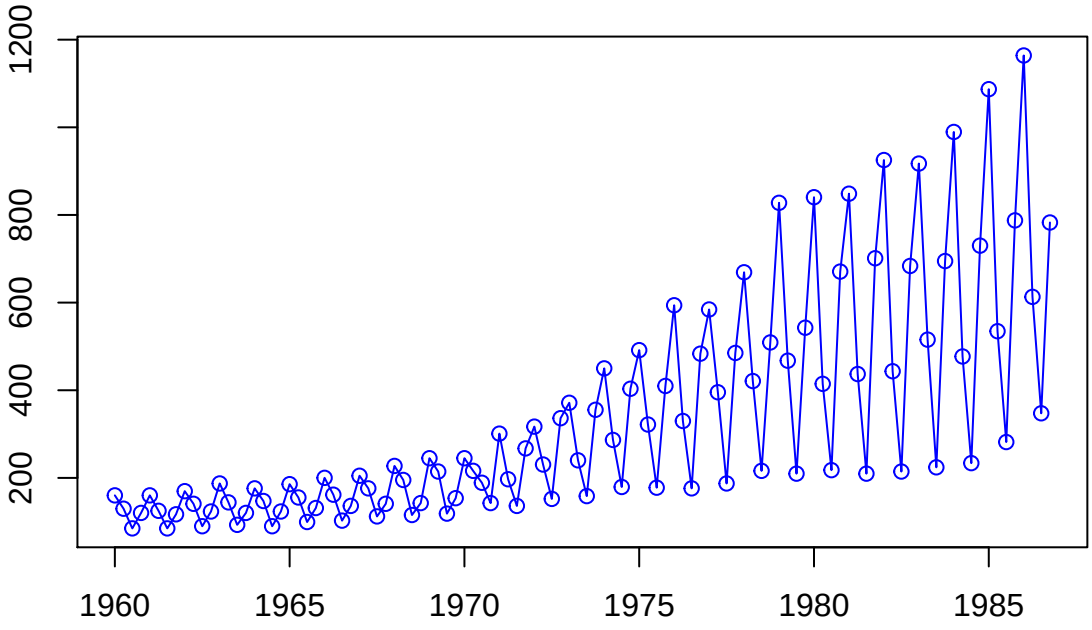

```
acf(ARMA23)
```



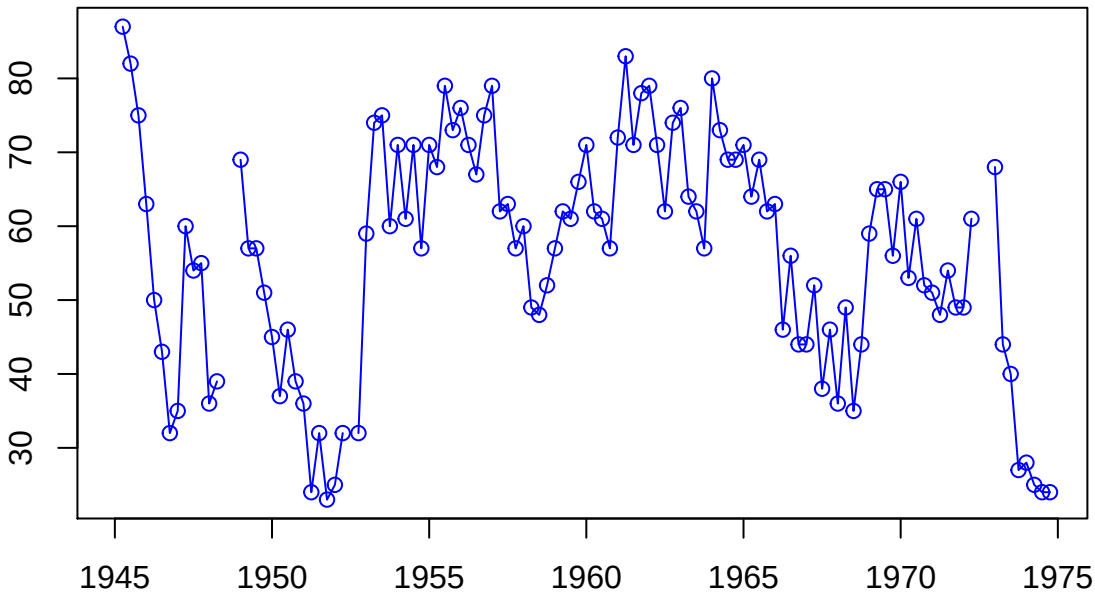
```
## 3
plotc(JohnsonJohnson) # No Seasonality
```




```
plotc(UKgas) # Seasonality
```

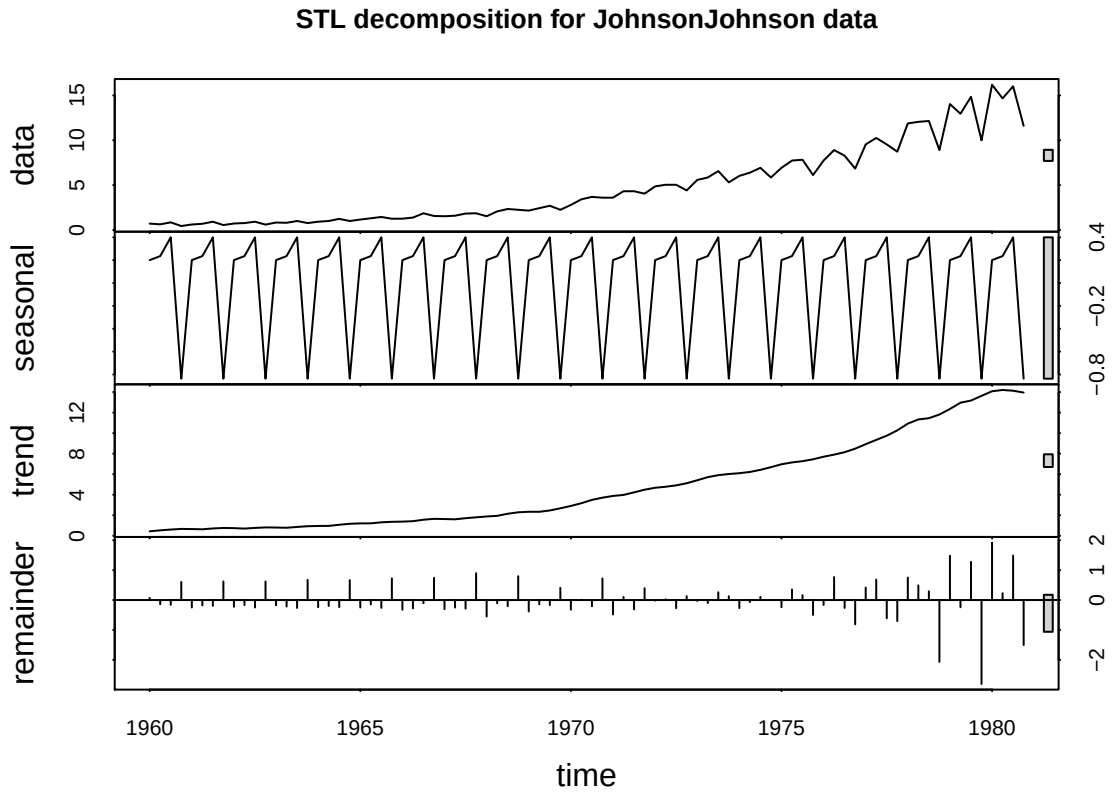



```
plotc(presidents) # No Seasonality
```



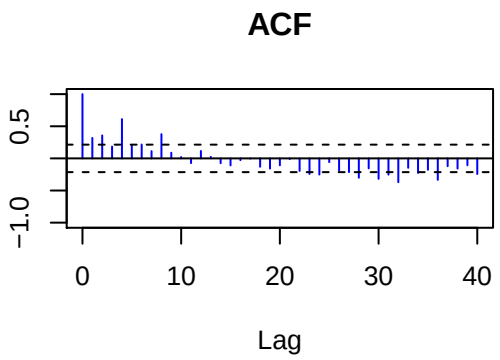

```
# JohnsonJohnson:
jstl = stl(JohnsonJohnson, s.window="periodic")
plot(jstl, main = "STL decomposition for JohnsonJohnson data")

library(forecast)
```

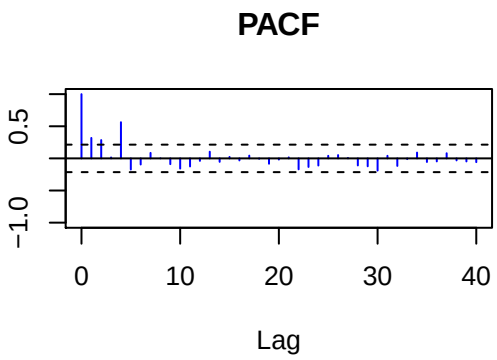
```
## Loading required package: zoo
##
## Attaching package: 'zoo'
##
## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric
##
## Loading required package: timeDate
## This is forecast 6.2
##
##
## Attaching package: 'forecast'
##
## The following object is masked from 'package:itsmr':
##
##     forecast
```

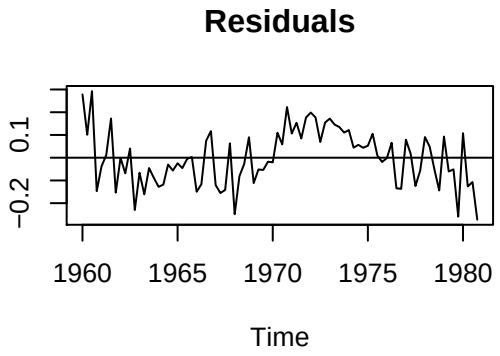


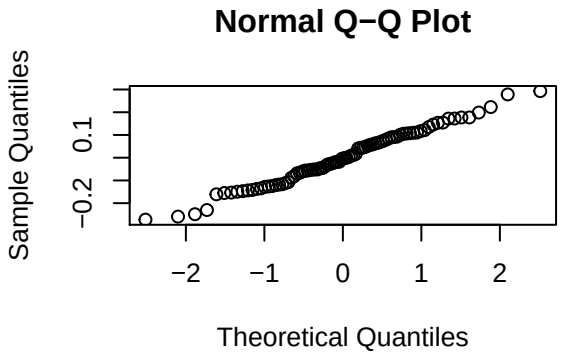

```
# noise
M=c("log","season",12,"trend",1)
e <- Resid(JohnsonJohnson,M)
test(e)
```

```
## Null hypothesis: Residuals are iid noise.
## Test                        Distribution Statistic   p-value
## Ljung-Box Q                Q ~ chisq(20)     90.11         0 *
## McLeod-Li Q                Q ~ chisq(20)     20.74    0.4128
## Turning points T   (T-54.7)/3.8 ~ N(0,1)        58    0.3832
## Diff signs S       (S-41.5)/2.7 ~ N(0,1)        43     0.573
## Rank P           (P-1743)/129.4 ~ N(0,1)      1801    0.6541
```



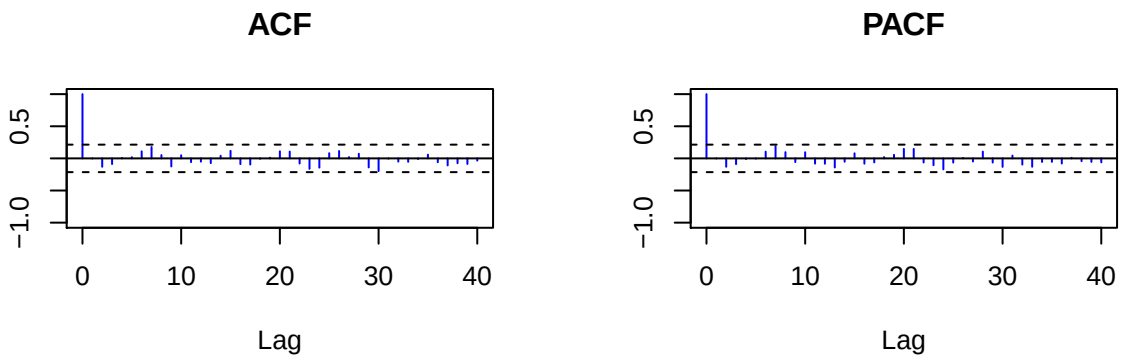


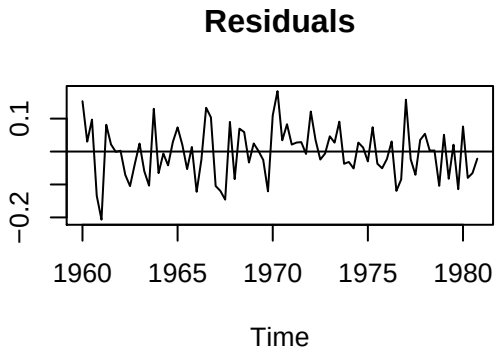


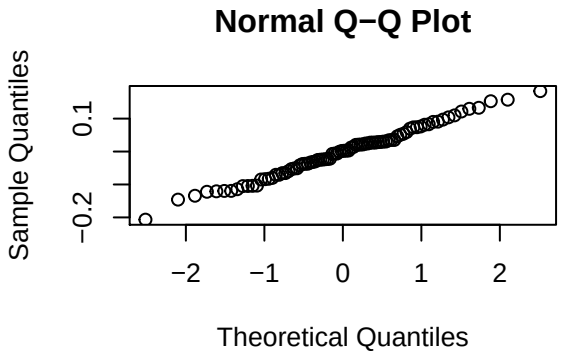



```
# ARIMA model for Noise
a = arma(e,p=4,q=3)
ee <- Resid(JohnsonJohnson,M,a)
test(ee)
```

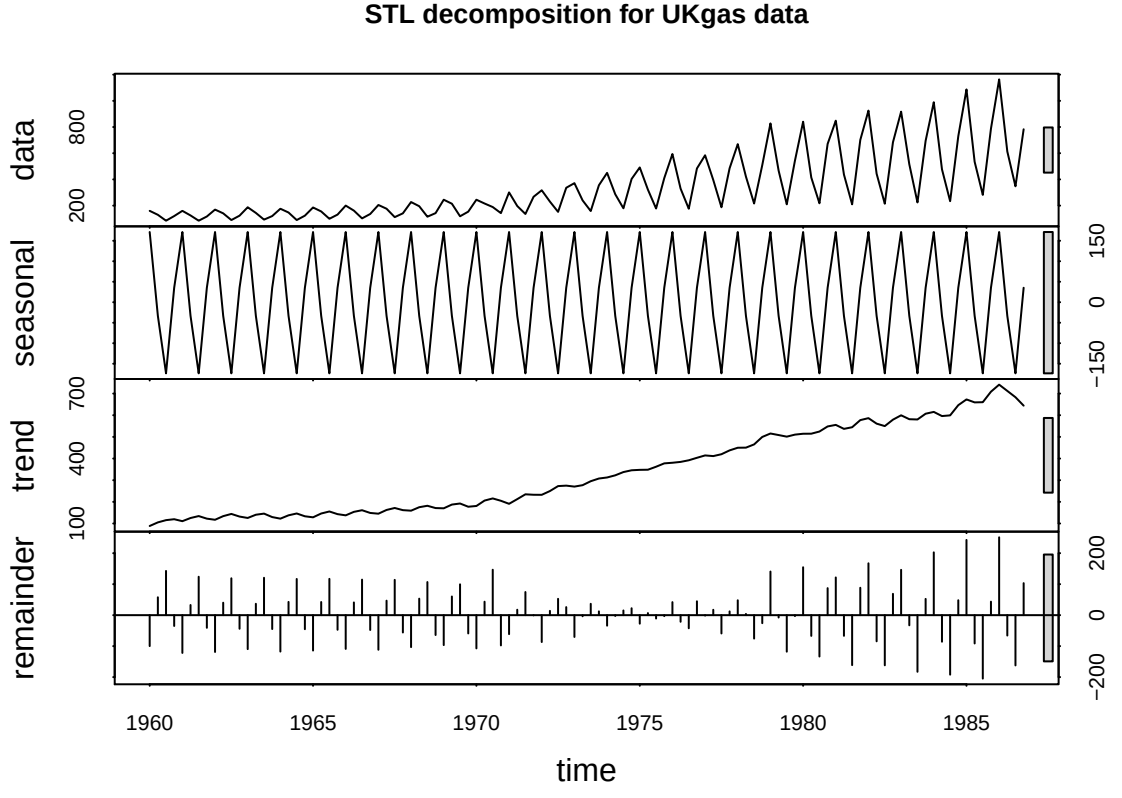
```
## Null hypothesis: Residuals are iid noise.
## Test                        Distribution Statistic   p-value
## Ljung-Box Q                Q ~ chisq(20)     14.29    0.8155
## McLeod-Li Q                Q ~ chisq(20)      20.3    0.4393
## Turning points T   (T-54.7)/3.8 ~ N(0,1)        57    0.5416
## Diff signs S       (S-41.5)/2.7 ~ N(0,1)        39    0.3476
## Rank P           (P-1743)/129.4 ~ N(0,1)      1705    0.7691
```





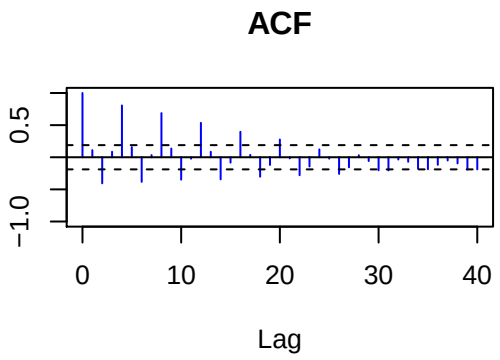


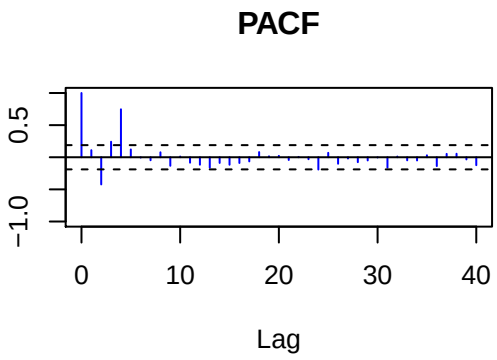

```
# UKgas:
ustl = stl(UKgas, s.window="periodic")
plot(ustl, main = "STL decomposition for UKgas data")
```

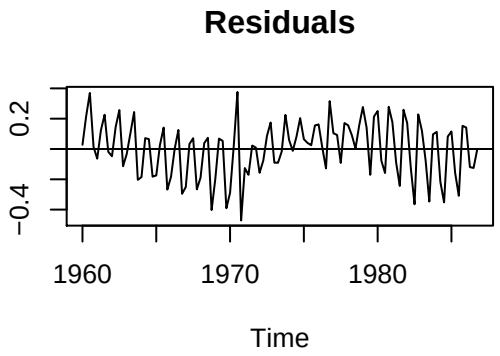


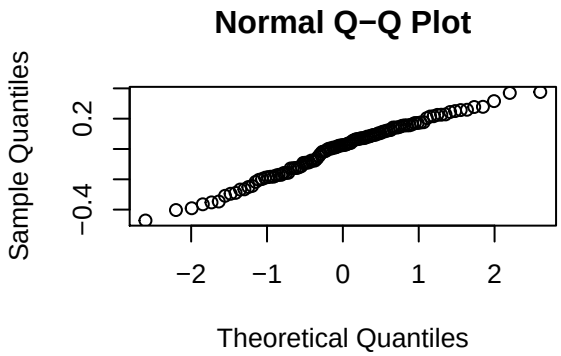
```r
# noise
M=c("log","season",12,"trend",1)
e <- Resid(UKgas,M)
test(e)
```

```
## Null hypothesis: Residuals are iid noise.
## Test                        Distribution Statistic   p-value
## Ljung-Box Q                Q ~ chisq(20)    285.06         0 *
## McLeod-Li Q                Q ~ chisq(20)     89.32         0 *
## Turning points T   (T-70.7)/4.3 ~ N(0,1)        54     1e-04 *
## Diff signs S         (S-53.5)/3 ~ N(0,1)        54    0.8682
## Rank P           (P-2889)/188.3 ~ N(0,1)      2977    0.6403
```



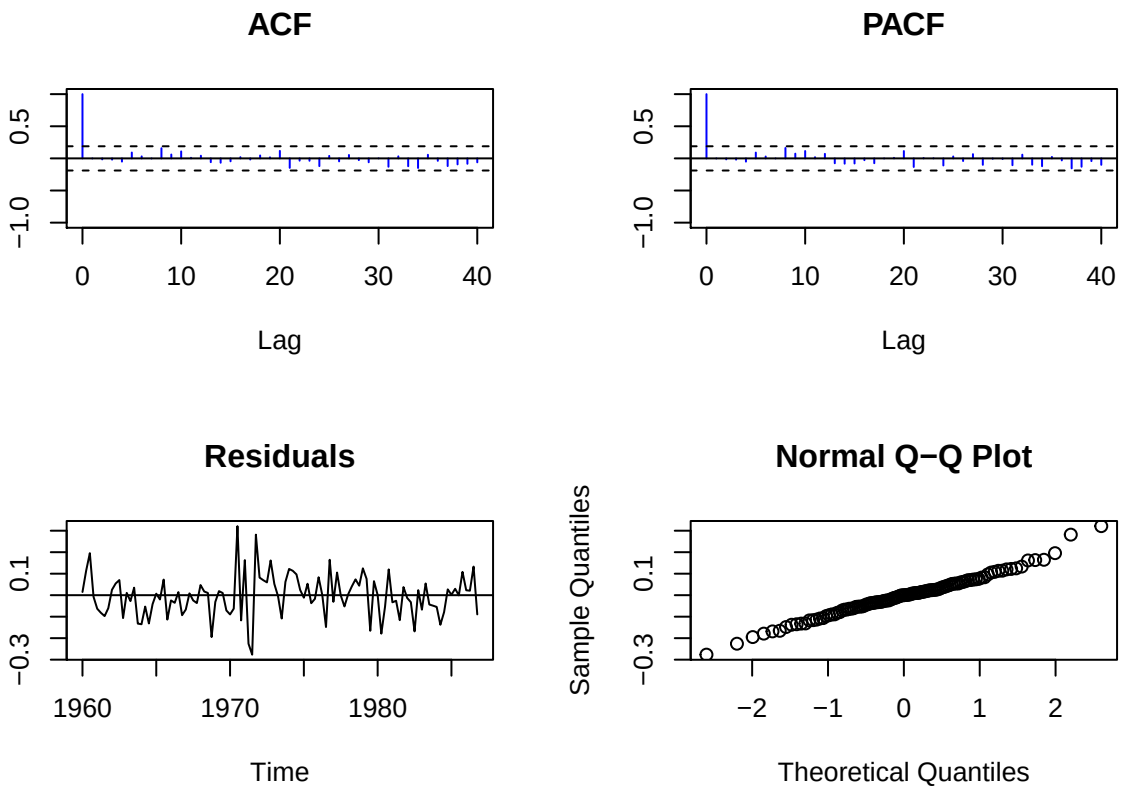




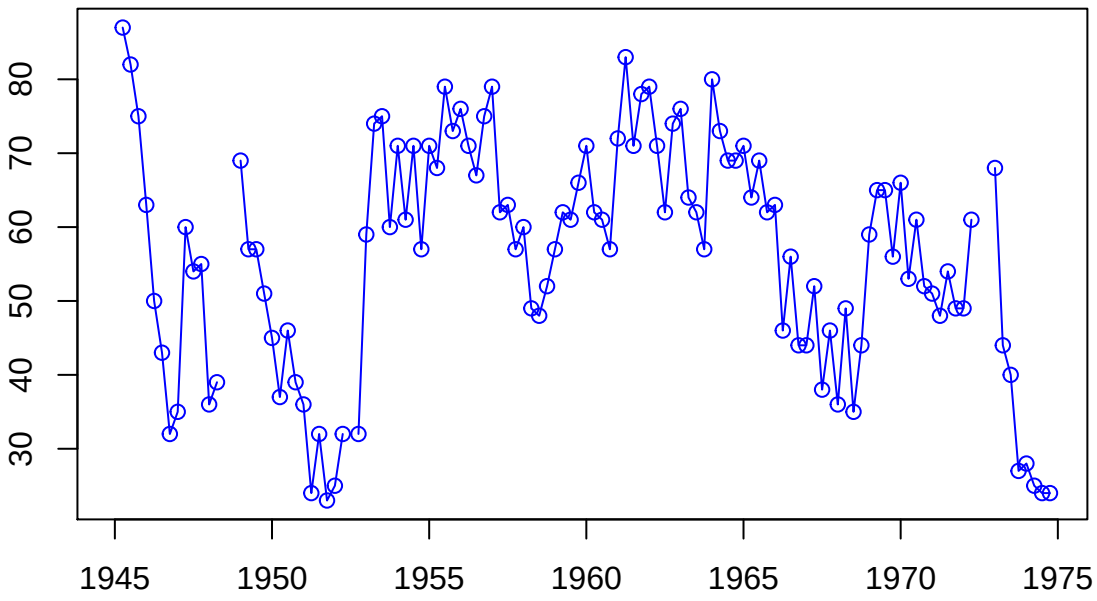



```r
# ARIMA model for Noise
a = arma(e,p=4,q=3)
ee <- Resid(UKgas,M,a)
test(ee)
```

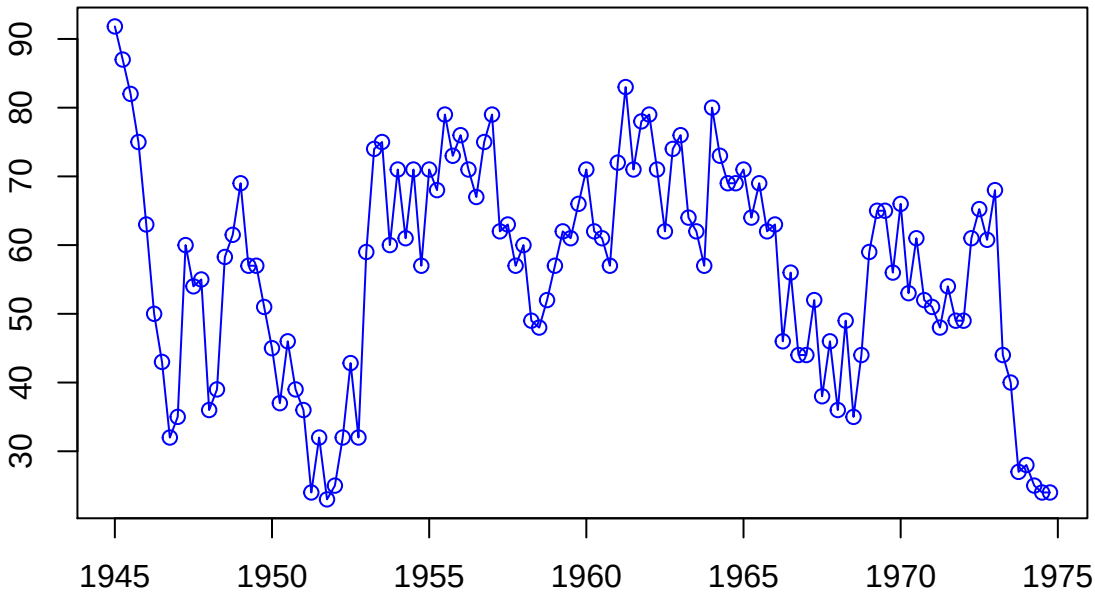
```
## Null hypothesis: Residuals are iid noise.
## Test                        Distribution Statistic   p-value
## Ljung-Box Q                Q ~ chisq(20)     10.05    0.9673
## McLeod-Li Q                Q ~ chisq(20)     44.53    0.0013 *
## Turning points T   (T-70.7)/4.3 ~ N(0,1)        65    0.1922
## Diff signs S         (S-53.5)/3 ~ N(0,1)        47     0.031 *
## Rank P           (P-2889)/188.3 ~ N(0,1)      3008    0.5275
```



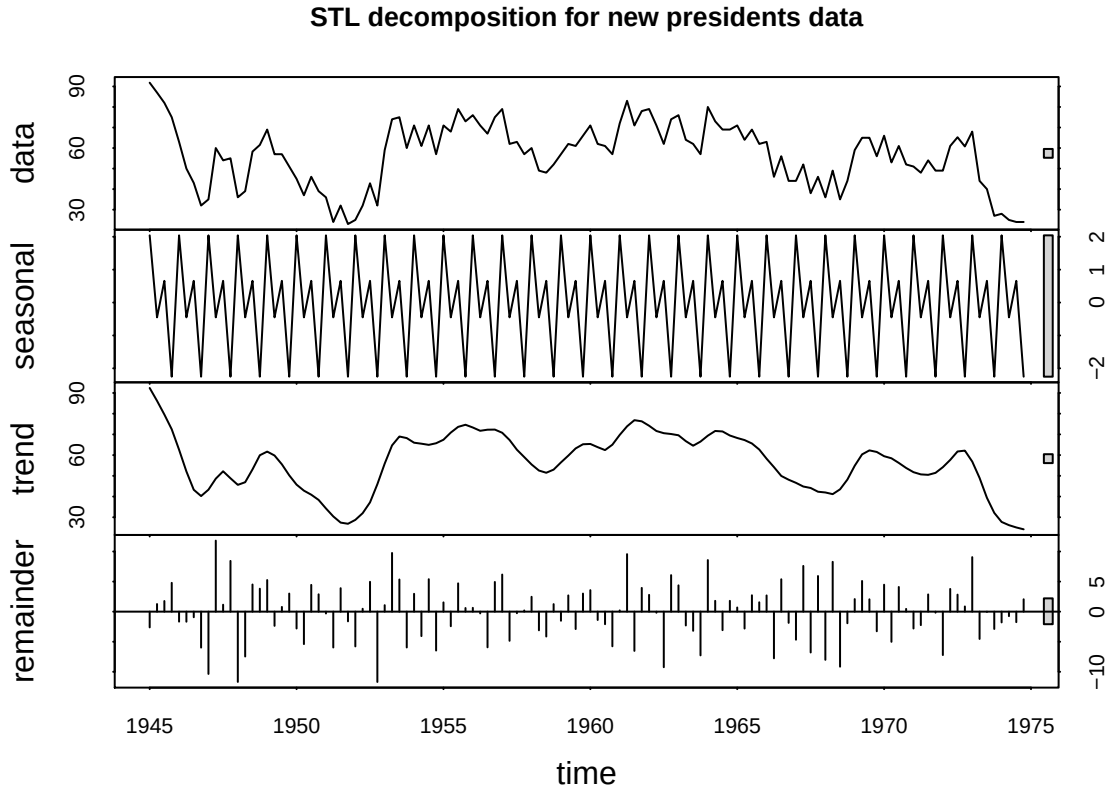

```
# presidents:
newp <- na.interp(presidents)
plotc(presidents)
```



```
plotc(newp) # continuous new presidents data
```



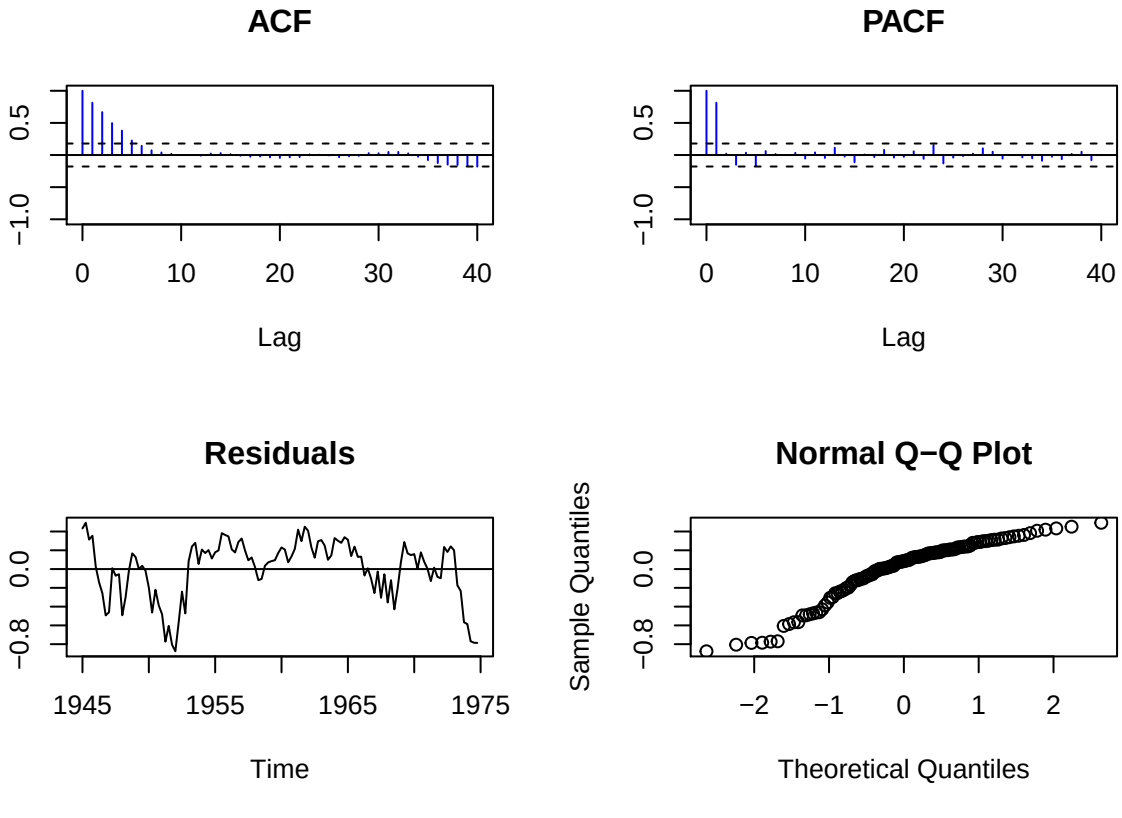

```
pstl = stl(newp, s.window="periodic")
plot(pstl, main = "STL decomposition for new presidents data")
```




```
# noise
M=c("log","season",12,"trend",1)
```

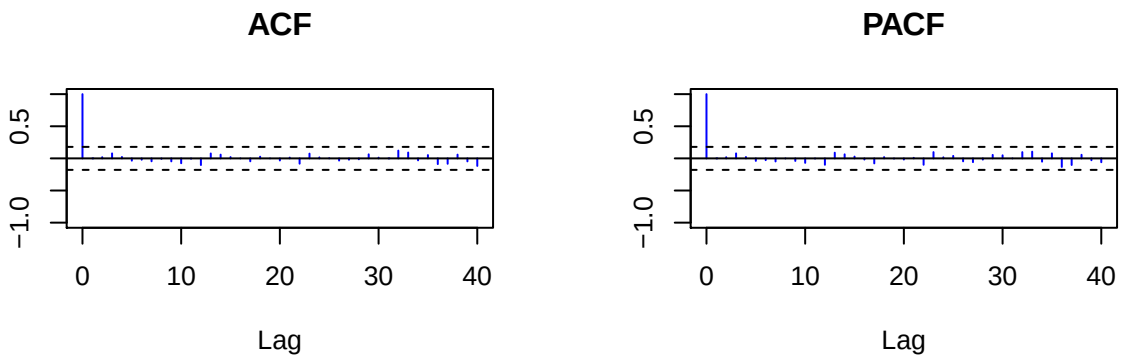
```
e <- Resid(newp,M)
test(e)
```

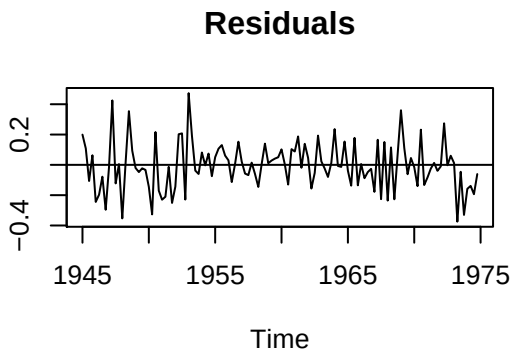
```
## Null hypothesis: Residuals are iid noise.
## Test                        Distribution Statistic   p-value
## Ljung-Box Q                Q ~ chisq(20)    196.63         0 *
## McLeod-Li Q                Q ~ chisq(20)    125.87         0 *
## Turning points T   (T-78.7)/4.6 ~ N(0,1)        65    0.0029 *
## Diff signs S       (S-59.5)/3.2 ~ N(0,1)        54    0.0833
## Rank P           (P-3570)/220.4 ~ N(0,1)      3538    0.8846
```

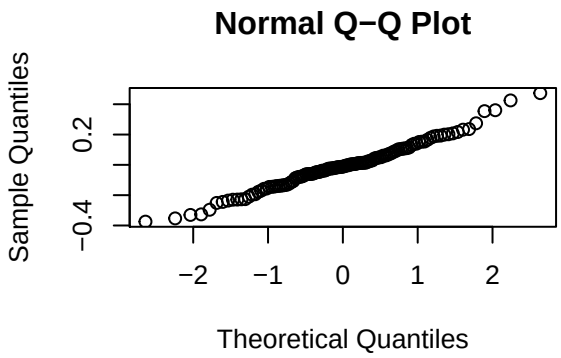



```
# ARIMA model for Noise
a = arma(e,p=4,q=3)
ee <- Resid(newp,M,a)
test(ee)
```

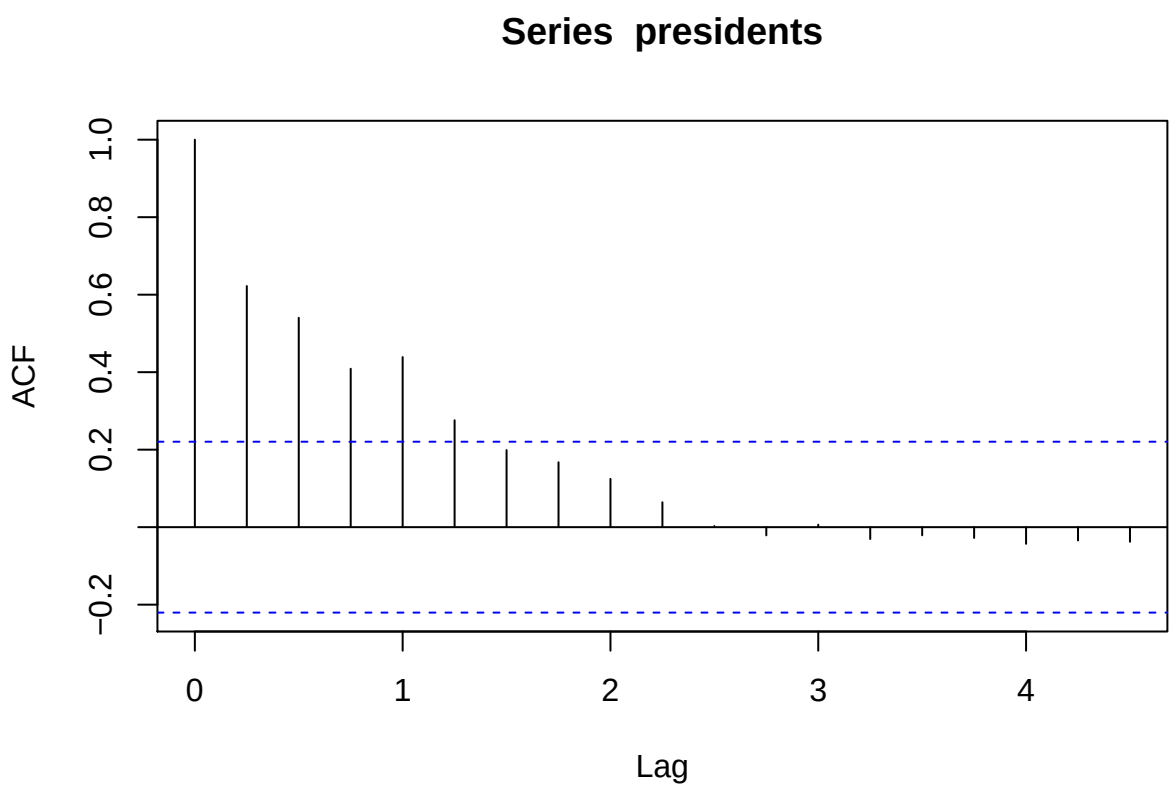
```
## Null hypothesis: Residuals are iid noise.
## Test                        Distribution Statistic   p-value
## Ljung-Box Q                Q ~ chisq(20)      5.75    0.9992
## McLeod-Li Q                Q ~ chisq(20)     20.17    0.4475
## Turning points T   (T-78.7)/4.6 ~ N(0,1)        75    0.4238
## Diff signs S       (S-59.5)/3.2 ~ N(0,1)        59    0.8749
## Rank P           (P-3570)/220.4 ~ N(0,1)      3460    0.6178
```



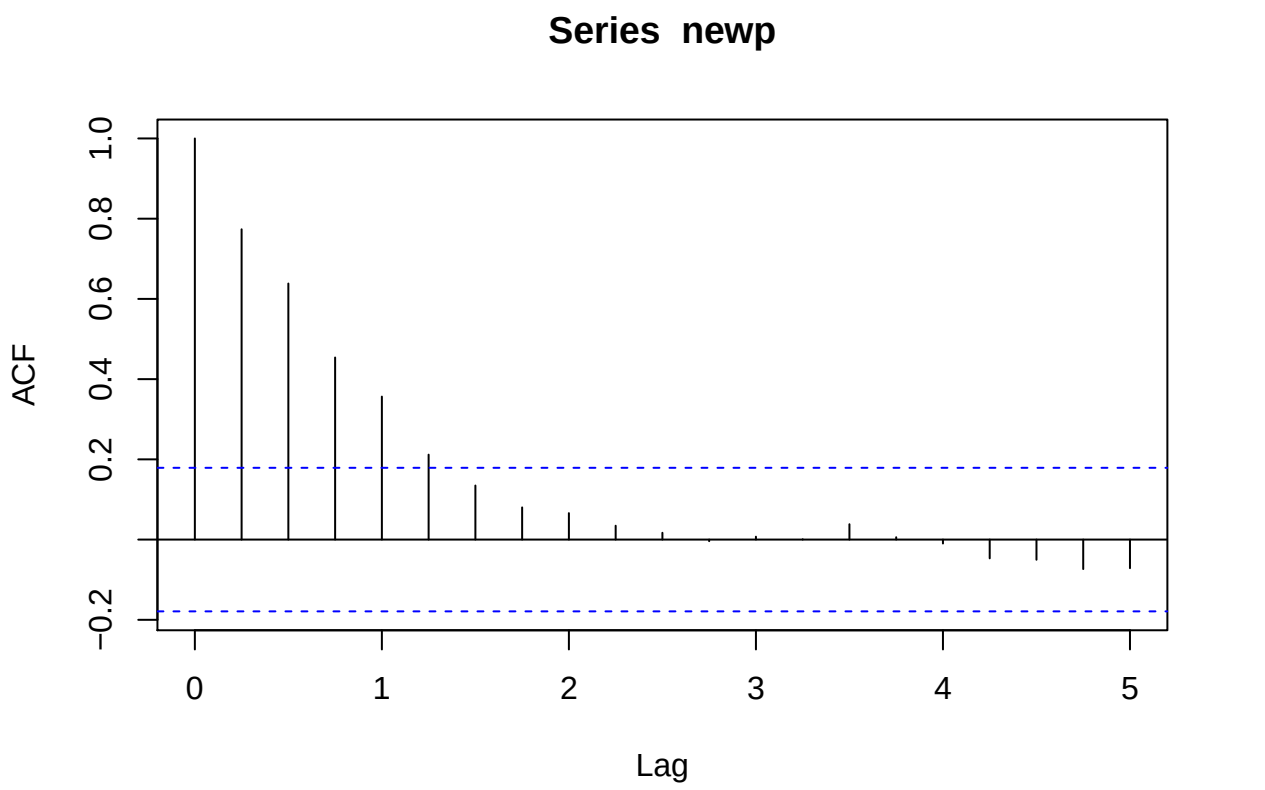




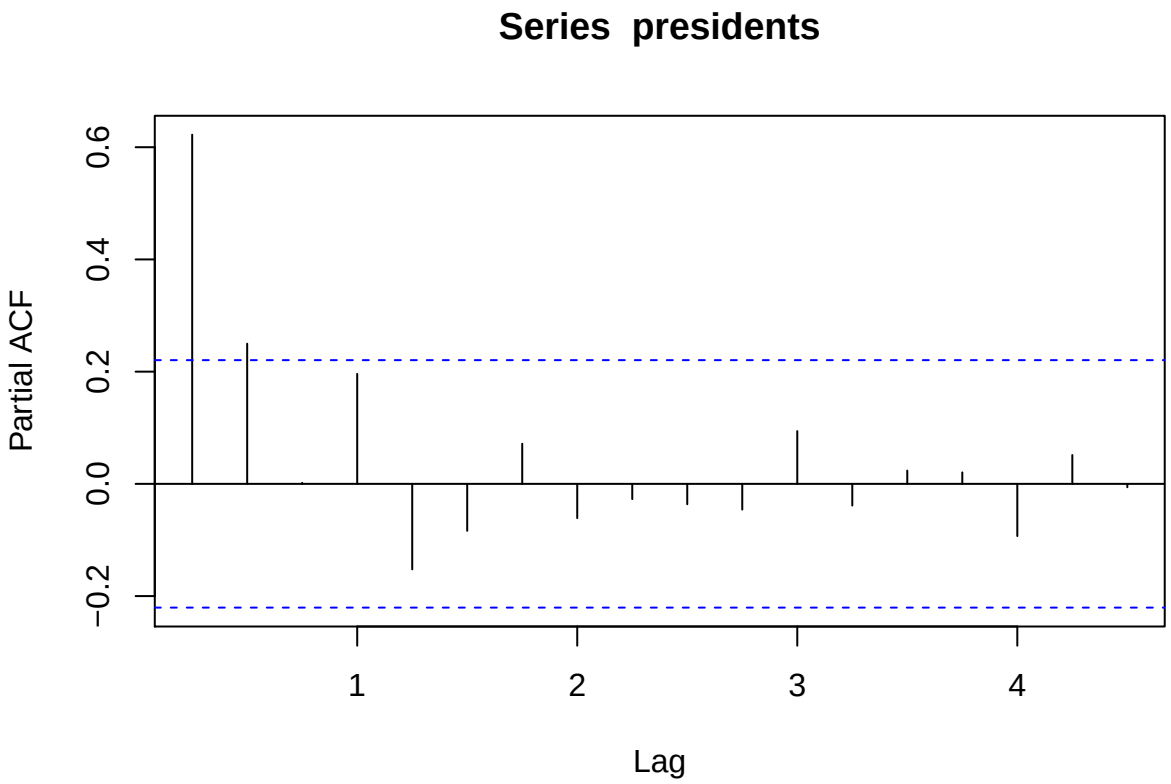

```r
# autocorrelation function
acf(presidents, na.action = na.contiguous)
```



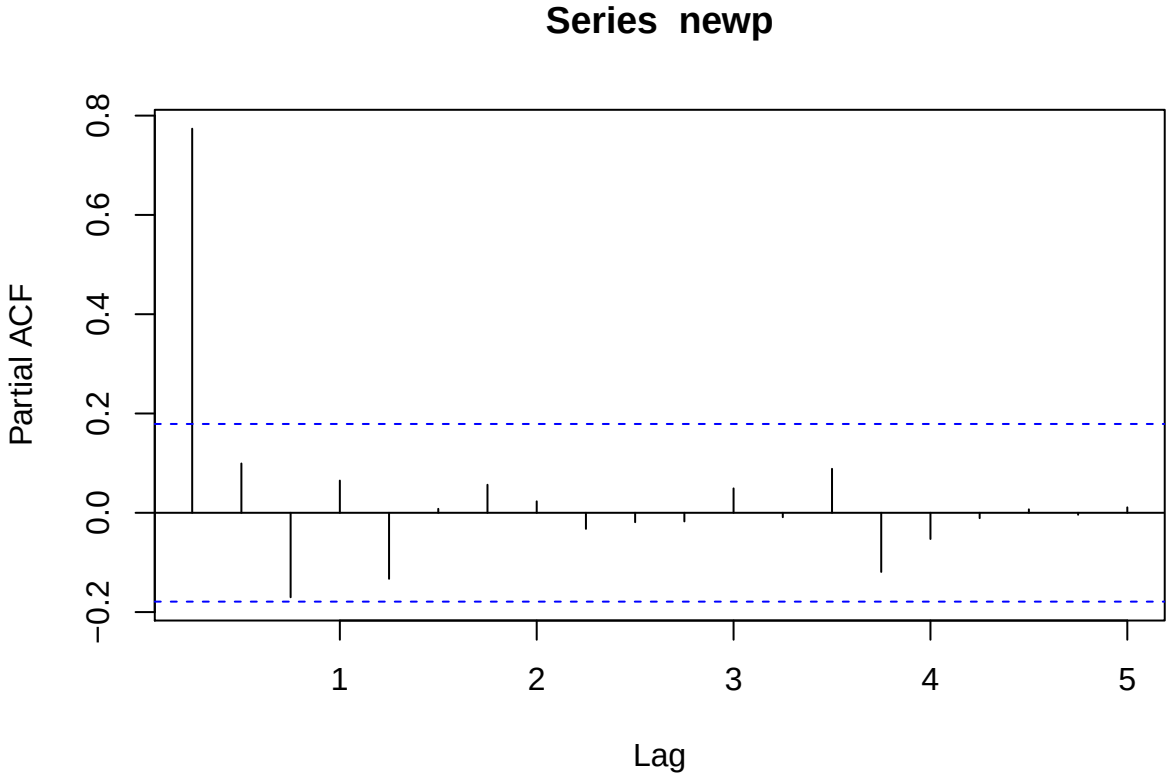
```r
acf(newp)
```




```r
# partial autocorrelations
pacf(presidents, na.action = na.contiguous)
```


Series presidents
Partial ACF
0.6
0.4
0.2
0.0
−0.2
1
2
3
4
Lag

```
pacf(newp)
```


Series newp
Partial ACF
0.8
0.6
0.4
0.2
0.0
−0.2
1
2
3
4
5
Lag

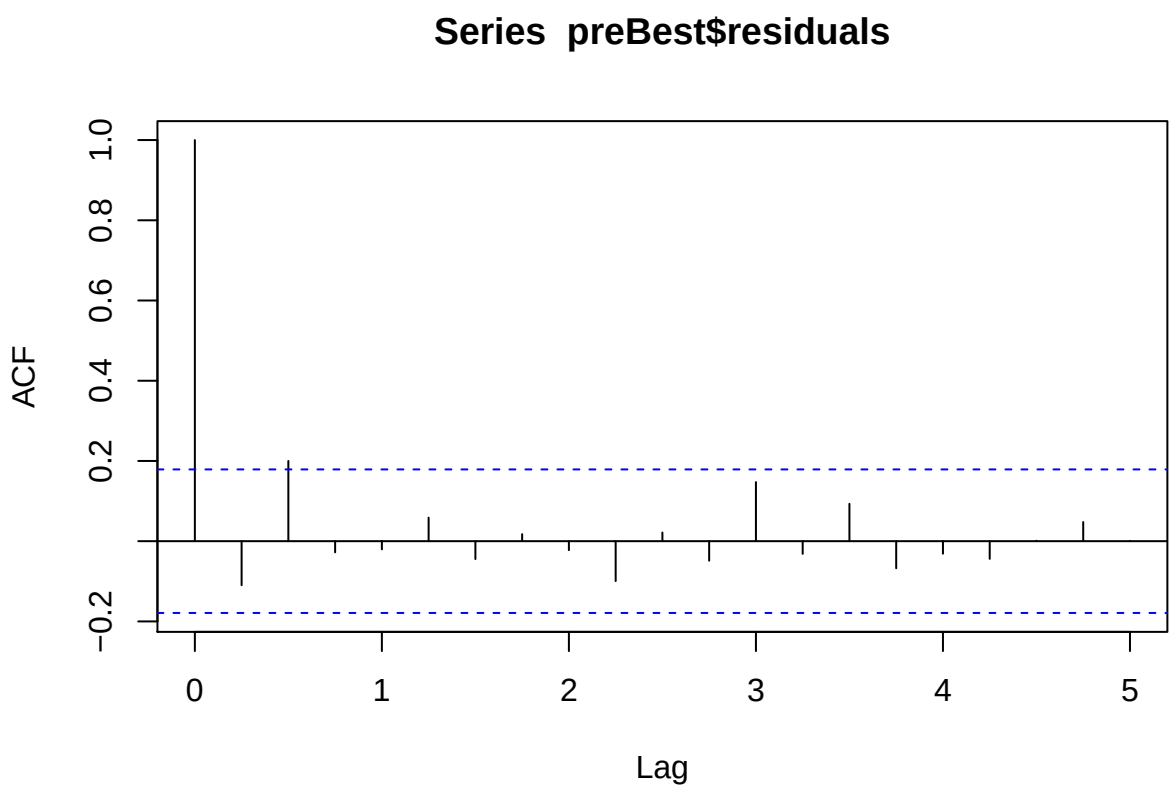
```
ndiffs(x=newp)
```

```
## [1] 0
```

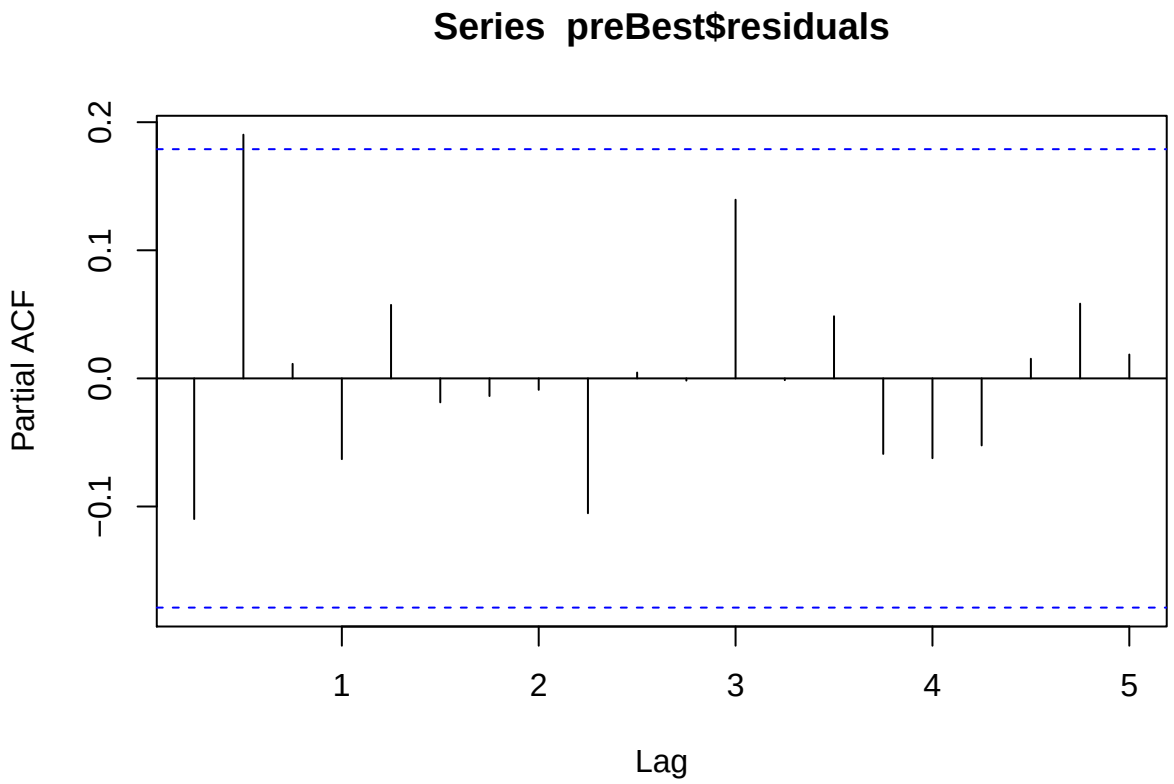
```
# Fit best ARIMA model for Noise
preBest <- auto.arima(newp)
```

```
## Warning in auto.arima(newp): Unable to fit final model using maximum
## likelihood. AIC value approximated
```

```
acf(preBest$residuals)
```




```
pacf(preBest$residuals)
```




```
coef(preBest)
```

```
##        ar1       sar1       sma1       sma2  intercept
##  0.7578710 -0.9021209  1.2411453  0.2810717 55.1679581
```