

GDPforecast

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```
setwd("/Users/gaurivaidya/Desktop/Whitman/Sem3/Time series/Rcw/gdpf")
Data <- read.csv("GDPC11.csv")
y <- ts(Data$GDPC1, start = c(1947,1), frequency =4)
length(y)
```

```
## [1] 280
```

```
GDP <- ts(diff(log(y), lag=1), start = c(1947,2), frequency =4)
length(GDP)
```

```
## [1] 279
```

```
GDP1 <- window(GDP, end=c(2008,4))
length(GDP1)
```

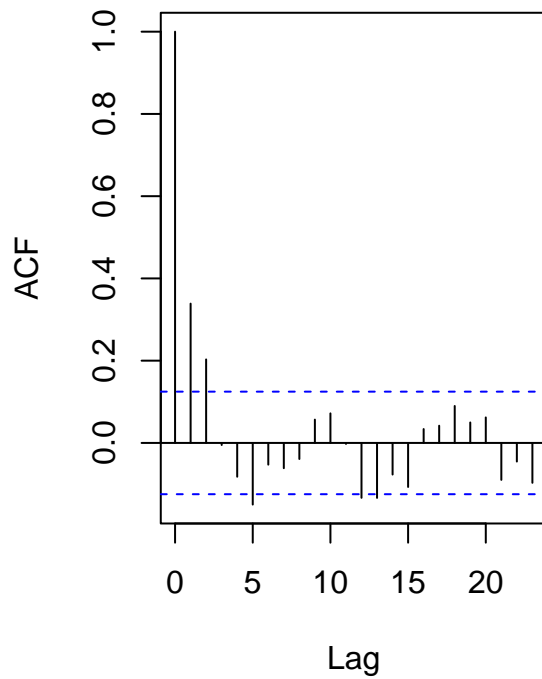
```
## [1] 247
```

```
GDP2 <- window(GDP, start=c(2009,1))
H <- length(GDP2)
H
```

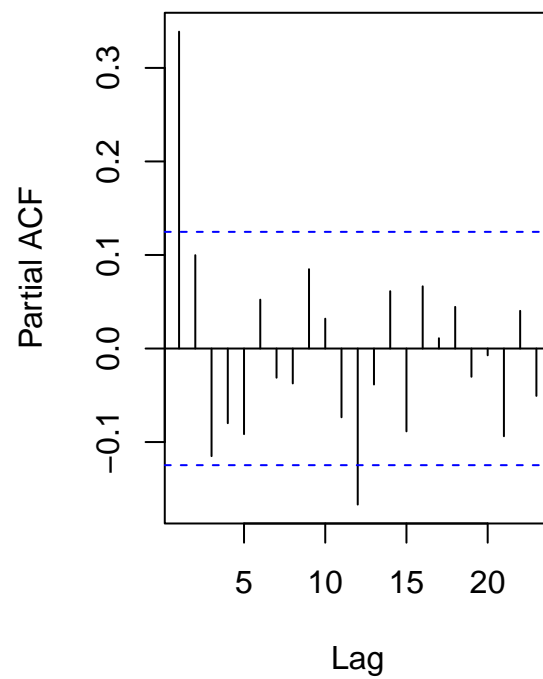
```
## [1] 32
```

```
par(mfrow=c(1,2))
acf(ts(GDP1))
pacf(ts(GDP1))
```

Series ts(GDP1)

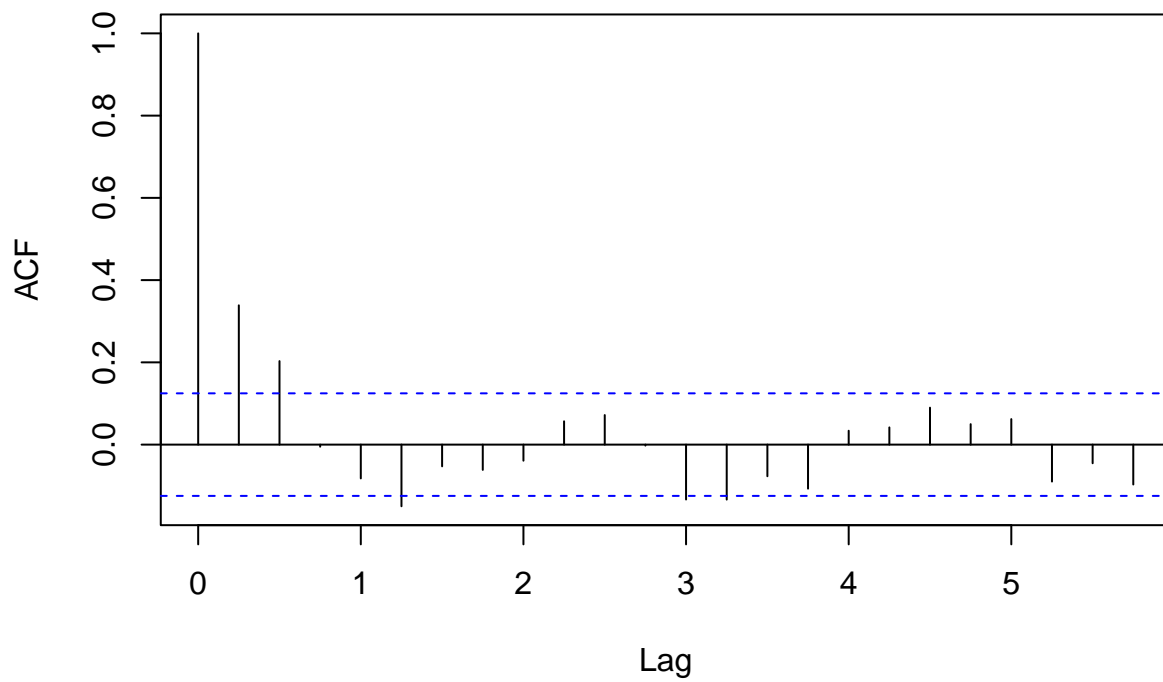


Series ts(GDP1)

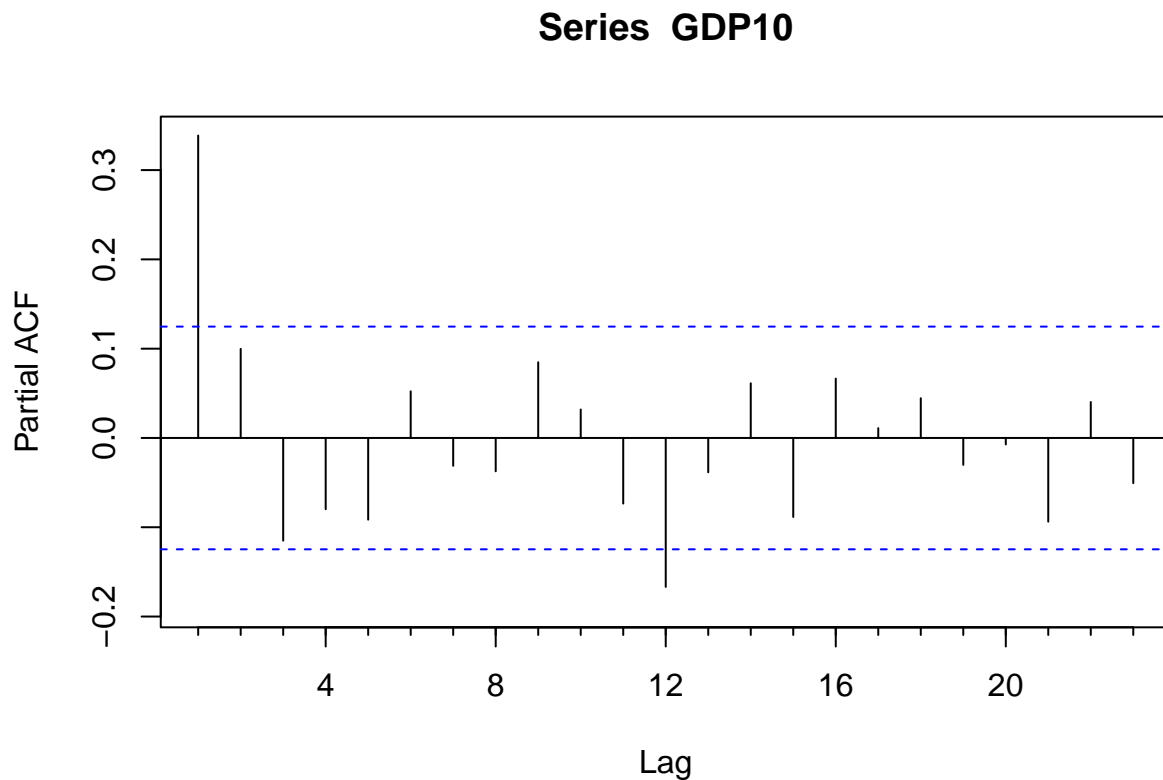


```
GDP10 <- ts(GDP1, start = c(1947,2), end = c(2008,4), frequency=4)
acf(GDP10)
```

Series GDP10



```
Pacf(GDP10)
```

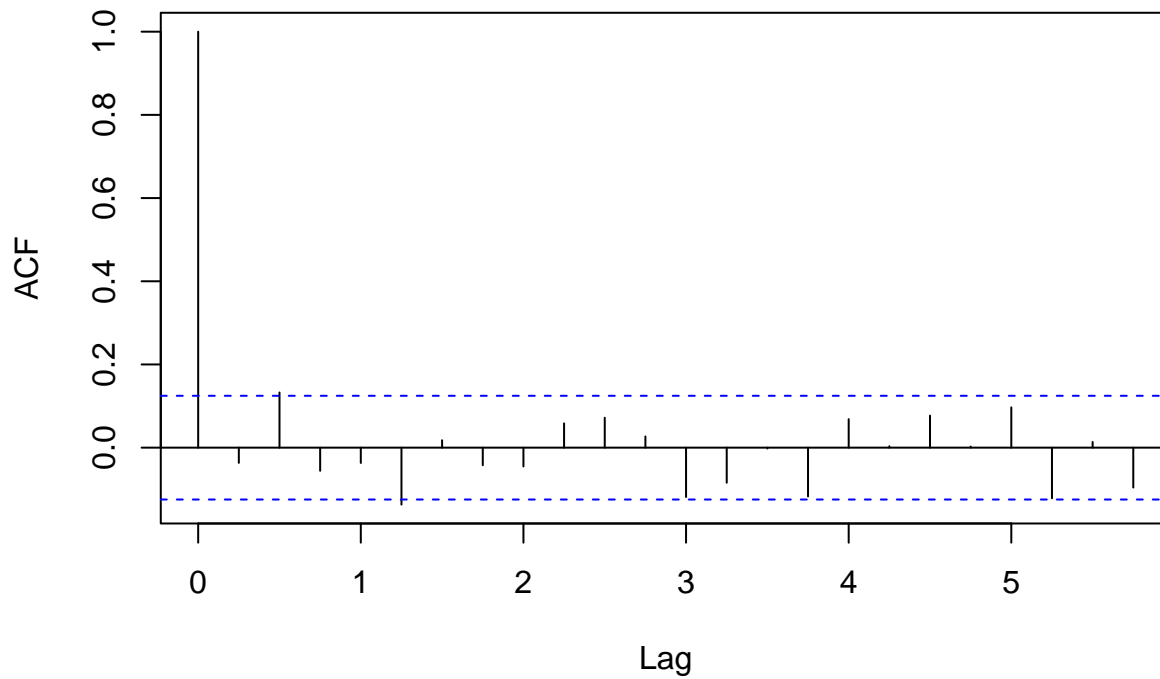


```
m1 <- Arima(GDP1, order=c(1,0,0),include.mean = TRUE)
m1
```

```
## Series: GDP1
## ARIMA(1,0,0) with non-zero mean
##
## Coefficients:
##          ar1      mean
##          0.3527  0.0081
## s.e.      0.0609  0.0009
##
## sigma^2 = 8.537e-05:  log likelihood = 807.47
## AIC=-1608.93   AICc=-1608.83   BIC=-1598.4
```

```
res1 <- m1$residuals
acf(res1)
```

Series res1



```
adf.test(res1)
```

```
## Warning in adf.test(res1): p-value smaller than printed p-value
```

```
##
```

```
## Augmented Dickey-Fuller Test
```

```
##
```

```
## data: res1
```

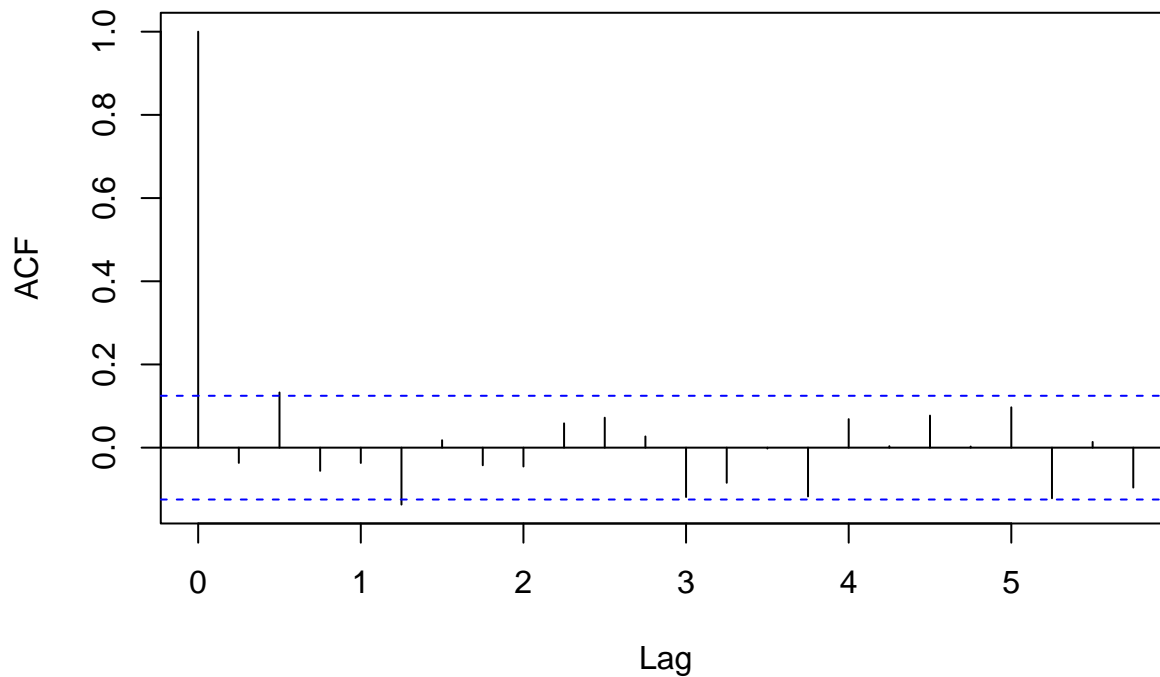
```
## Dickey-Fuller = -6.376, Lag order = 6, p-value = 0.01
```

```
## alternative hypothesis: stationary
```

```
res1 <- m1$residuals
```

```
acf(res1)
```

Series res1



```
adf.test(res1)
```

```
## Warning in adf.test(res1): p-value smaller than printed p-value
```

```
##
```

```
## Augmented Dickey-Fuller Test
```

```
##
```

```
## data: res1
```

```
## Dickey-Fuller = -6.376, Lag order = 6, p-value = 0.01
```

```
## alternative hypothesis: stationary
```

```
Box.test(res1, lag=8, type = "Ljung-Box")
```

```
##
```

```
## Box-Ljung test
```

```
##
```

```
## data: res1
```

```
## X-squared = 11.703, df = 8, p-value = 0.165
```

```
Box.test(res1, lag=16, type = "Ljung-Box")
```

```
##
```

```
## Box-Ljung test
```

```
##
```

```
## data: res1
```

```
## X-squared = 24.573, df = 16, p-value = 0.07771
```

```
Box.test(res1, lag=32, type = "Ljung-Box")
```

```
##
```

```
## Box-Ljung test
```

```
##
```

```
## data:  res1
## X-squared = 44.302, df = 32, p-value = 0.07259
coeftest(m1)

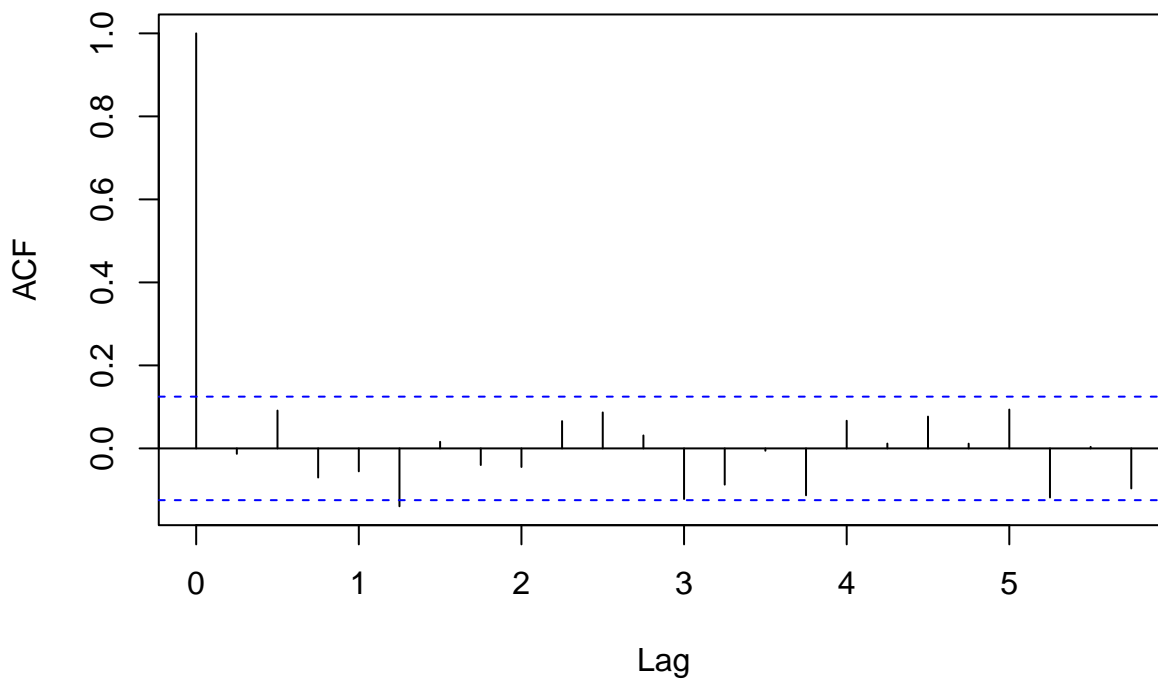
##
## z test of coefficients:
##
##           Estimate Std. Error z value Pr(>|z|)
## ar1         0.35273068 0.06085262  5.7965 6.772e-09 ***
## intercept 0.00809578 0.00090518  8.9438 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

m2 <- Arima(GDP1, order=c(1,0,1),include.mean = TRUE)
m2

## Series: GDP1
## ARIMA(1,0,1) with non-zero mean
##
## Coefficients:
##          ar1          ma1          mean
##          0.4976    -0.1609    0.0081
## s.e.    0.1179     0.1254    0.0010
##
## sigma^2 = 8.519e-05:  log likelihood = 808.23
## AIC=-1608.45  AICc=-1608.29  BIC=-1594.42

res2 <- m2$residuals
acf(res2)
```

Series res2



```

adf.test(res2)

## Warning in adf.test(res2): p-value smaller than printed p-value
##
## Augmented Dickey-Fuller Test
##
## data: res2
## Dickey-Fuller = -6.6147, Lag order = 6, p-value = 0.01
## alternative hypothesis: stationary
Box.test(res2, lag=8, type = "Ljung-Box")

##
## Box-Ljung test
##
## data: res2
## X-squared = 10.074, df = 8, p-value = 0.2599
Box.test(res2, lag=16, type = "Ljung-Box")

##
## Box-Ljung test
##
## data: res2
## X-squared = 23.856, df = 16, p-value = 0.09269
Box.test(res2, lag=32, type = "Ljung-Box")

##
## Box-Ljung test
##
## data: res2
## X-squared = 43.802, df = 32, p-value = 0.07982
coeftest(m2)

##
## z test of coefficients:
##
##              Estimate Std. Error z value Pr(>|z|)
## ar1          0.49759038 0.11787021  4.2215 2.427e-05 ***
## ma1          -0.16094690 0.12540078 -1.2835  0.1993
## intercept    0.00806514 0.00097468  8.2747 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

m4 <- Arima(GDP1, order=c(12,0,1),include.mean = TRUE)
fixed = c(NA,0,0,0,0,0,0,0,0,0,NA,NA,NA)
m4

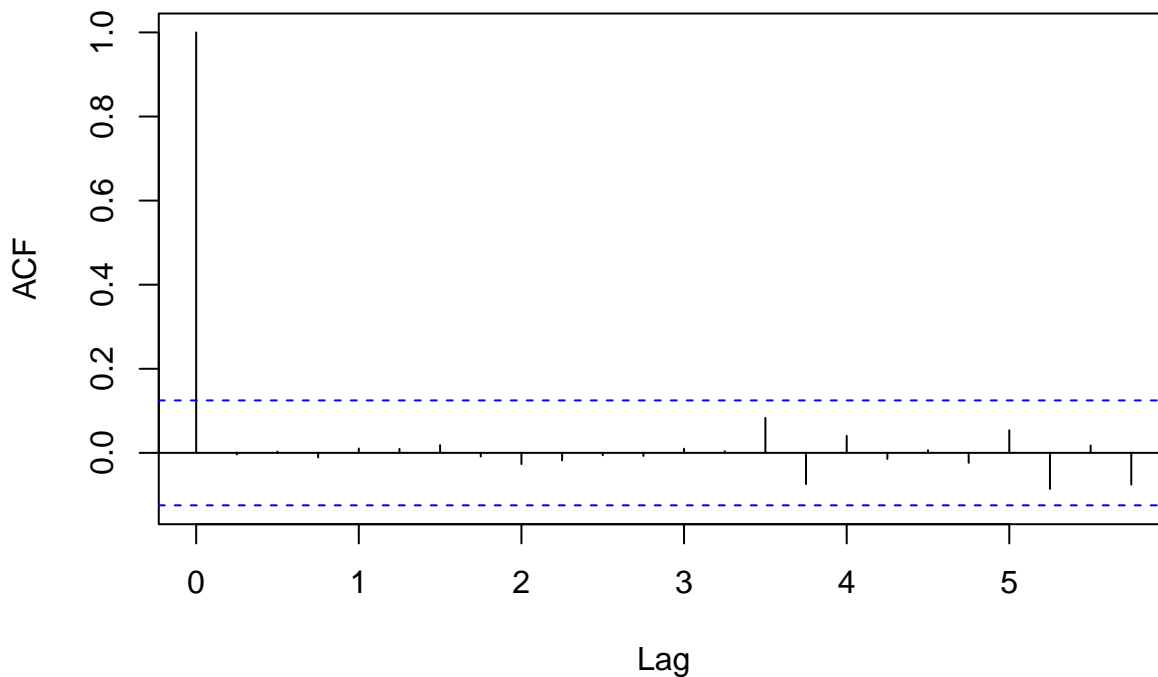
## Series: GDP1
## ARIMA(12,0,1) with non-zero mean
##
## Coefficients:
##          ar1      ar2      ar3      ar4      ar5      ar6      ar7      ar8
##          0.4701  0.1190 -0.1037 -0.0585 -0.0979  0.1011 -0.0645 -0.0714
## s.e.      0.2790  0.1121  0.0828  0.0751  0.0725  0.0753  0.0730  0.0714

```

```
##          ar9      ar10      ar11      ar12      ma1      mean
##          0.0853  0.0666  -0.0166  -0.1923  -0.1674  0.0082
## s.e.    0.0737  0.0758   0.0737   0.0725   0.2832  0.0006
##
## sigma^2 = 8.105e-05:  log likelihood = 819.66
## AIC=-1609.32  AICc=-1607.24  BIC=-1556.68
```

```
res4 <- m4$residuals
acf(res4)
```

Series res4



```
adf.test(res4)
```

```
## Warning in adf.test(res4): p-value smaller than printed p-value
```

```
##
## Augmented Dickey-Fuller Test
##
## data:  res4
## Dickey-Fuller = -5.7004, Lag order = 6, p-value = 0.01
## alternative hypothesis: stationary
```

```
Box.test(res4, lag=8, type = "Ljung-Box")
```

```
##
## Box-Ljung test
##
## data:  res4
## X-squared = 0.37633, df = 8, p-value = 1
```

```
Box.test(res4, lag=16, type = "Ljung-Box")
```

```
##
```



```
## Box-Ljung test
##
## data: res4
## X-squared = 4.2337, df = 16, p-value = 0.9984
Box.test(res4, lag=32, type = "Ljung-Box")

##
## Box-Ljung test
##
## data: res4
## X-squared = 18.013, df = 32, p-value = 0.9778
coeftest(m4)

##
## z test of coefficients:
##
##              Estimate Std. Error z value Pr(>|z|)
## ar1          0.47014716 0.27896709  1.6853 0.091928 .
## ar2          0.11904714 0.11205024  1.0624 0.288034
## ar3         -0.10367666 0.08279467 -1.2522 0.210492
## ar4         -0.05845442 0.07512225 -0.7781 0.436496
## ar5         -0.09785695 0.07252879 -1.3492 0.177268
## ar6          0.10111653 0.07525471  1.3437 0.179059
## ar7         -0.06450860 0.07297346 -0.8840 0.376696
## ar8         -0.07141881 0.07139313 -1.0004 0.317136
## ar9          0.08534130 0.07369791  1.1580 0.246869
## ar10         0.06664166 0.07578422  0.8794 0.379206
## ar11        -0.01659690 0.07368600 -0.2252 0.821794
## ar12        -0.19231859 0.07247658 -2.6535 0.007966 **
## ma1         -0.16741664 0.28316839 -0.5912 0.554369
## intercept    0.00820818 0.00062056 13.2270 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Box.test(res4, lag=32, type = "Ljung-Box")

##
## Box-Ljung test
##
## data: res4
## X-squared = 18.013, df = 32, p-value = 0.9778
coeftest(m4)

##
## z test of coefficients:
##
##              Estimate Std. Error z value Pr(>|z|)
## ar1          0.47014716 0.27896709  1.6853 0.091928 .
## ar2          0.11904714 0.11205024  1.0624 0.288034
## ar3         -0.10367666 0.08279467 -1.2522 0.210492
## ar4         -0.05845442 0.07512225 -0.7781 0.436496
## ar5         -0.09785695 0.07252879 -1.3492 0.177268
## ar6          0.10111653 0.07525471  1.3437 0.179059
## ar7         -0.06450860 0.07297346 -0.8840 0.376696
```

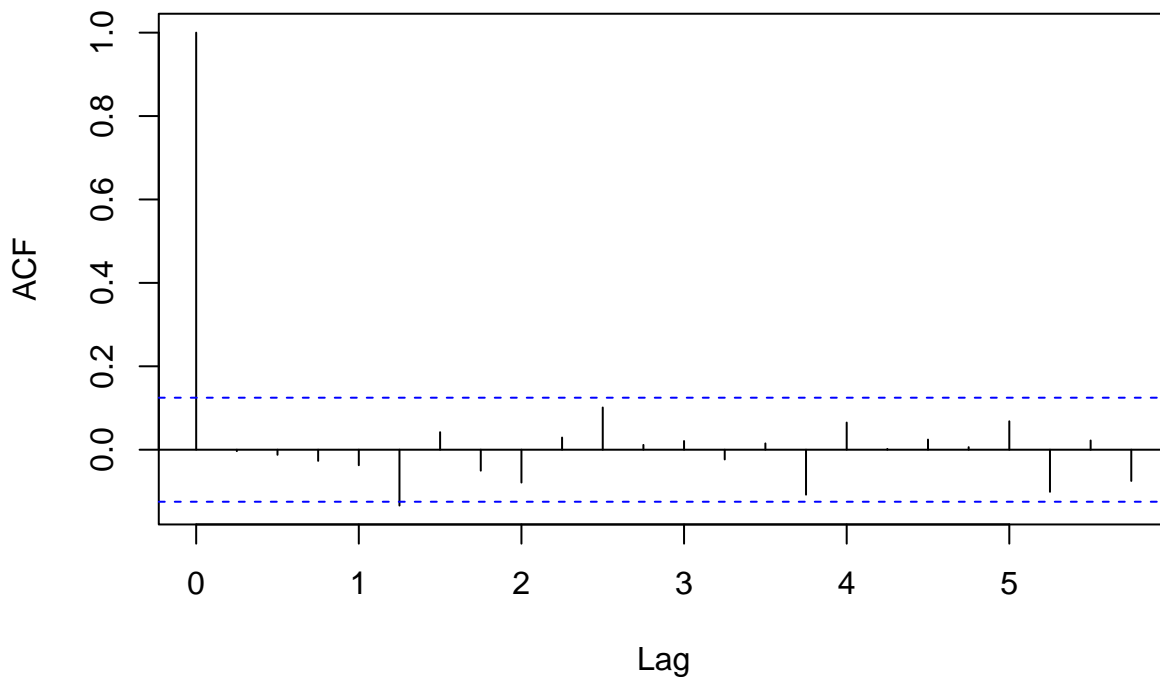
```
## ar8      -0.07141881  0.07139313 -1.0004  0.317136
## ar9      0.08534130  0.07369791  1.1580  0.246869
## ar10     0.06664166  0.07578422  0.8794  0.379206
## ar11     -0.01659690  0.07368600 -0.2252  0.821794
## ar12     -0.19231859  0.07247658 -2.6535  0.007966 **
## ma1      -0.16741664  0.28316839 -0.5912  0.554369
## intercept 0.00820818  0.00062056 13.2270 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

m5 <- Arima(GDP1, order = c(12,0,2), fixed = c(NA, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, NA, NA, NA, NA), inclu
m5
```

```
## Series: GDP1
## ARIMA(12,0,2) with non-zero mean
##
## Coefficients:
##          ar1  ar2  ar3  ar4  ar5  ar6  ar7  ar8  ar9  ar10  ar11      ar12
##          0.3101   0   0   0   0   0   0   0   0   0   0   0  -0.1713
## s.e.    0.1662   0   0   0   0   0   0   0   0   0   0   0   0.0631
##          ma1      ma2      mean
##          0.0093  0.1861  0.0082
## s.e.    0.1656  0.0823  0.0008
##
## sigma^2 = 8.189e-05:  log likelihood = 813.89
## AIC=-1615.78  AICc=-1615.43  BIC=-1594.72

res5 <- m5$residuals
acf(res5)
```

Series res5



```

adf.test(res5)

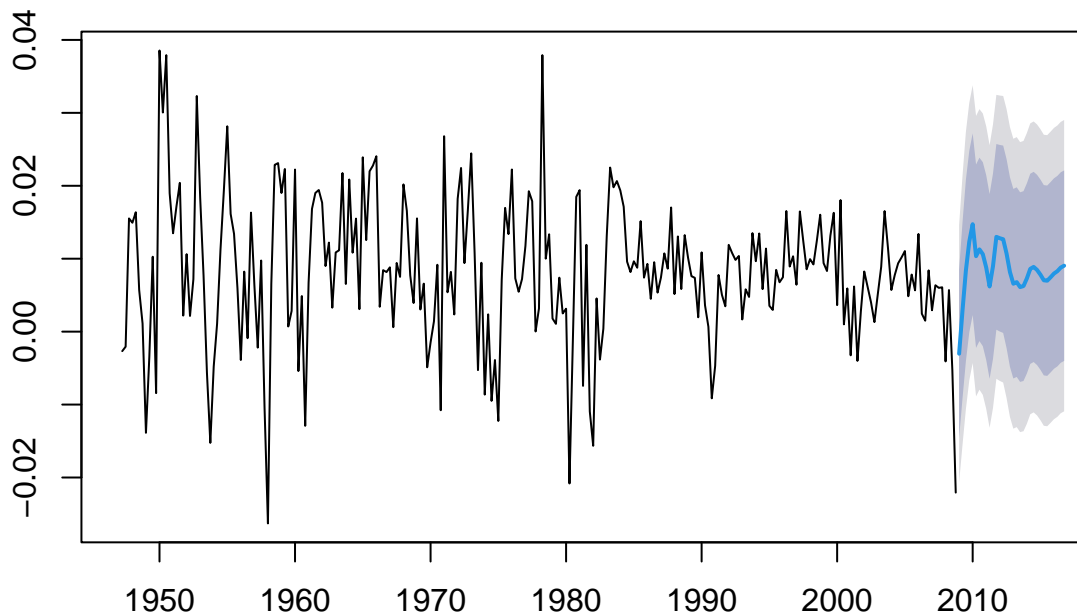
## Warning in adf.test(res5): p-value smaller than printed p-value
##
## Augmented Dickey-Fuller Test
##
## data: res5
## Dickey-Fuller = -6.8023, Lag order = 6, p-value = 0.01
## alternative hypothesis: stationary
Box.test(res5, lag=8, type = "Ljung-Box")

##
## Box-Ljung test
##
## data: res5
## X-squared = 7.818, df = 8, p-value = 0.4514
#ARIMA12,0,2
first<-1947.25
last<- 2008.75
GDP11<-window(GDP,end=last)
GDP22<-window(GDP,start=last+0.25)

m4.mf<-forecast(m4,h=H,level=c(80,95))
plot(m4.mf,xlim=c(1947,2016))

```

Forecasts from ARIMA(12,0,1) with non-zero mean



```

m4.rol <- zoo()
for (i in 1:length(GDP2))
{
  yy<- window(GDP,end=last+(i-1)/4)
  m4_updt <-Arima(yy,order=c(12,0,1),fixed=c(NA,0,0,0,0,0,0,0,0,0,0,NA,NA,NA), include.mean=TRUE)
}

```

```

  m4.rol<- c(m4.rol,forecast(m4_updt,h=1)$mean)
}
m4.rol<-ts(m4.rol,start=c(2009,1),frequency=4)
plot(m4.rol,type="o",pch=15,xlim=c(2005,2016), ylim =c(-0.03,0.04))

lines(m4.rol, type="p",pch=15, col="red")

lines(GDP,type="o",pch=16, lty="dotted")

lines(GDP,type="o",pch=16, lty="solid")

```

