AFTS - Ch2 - Ex15

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```
setwd('C:\\Program Files\\R\\FinancialData')
```

Upload data

```
data<-read.table('def.txt', header= TRUE)
```

Step 2: Transform the data into a time series object

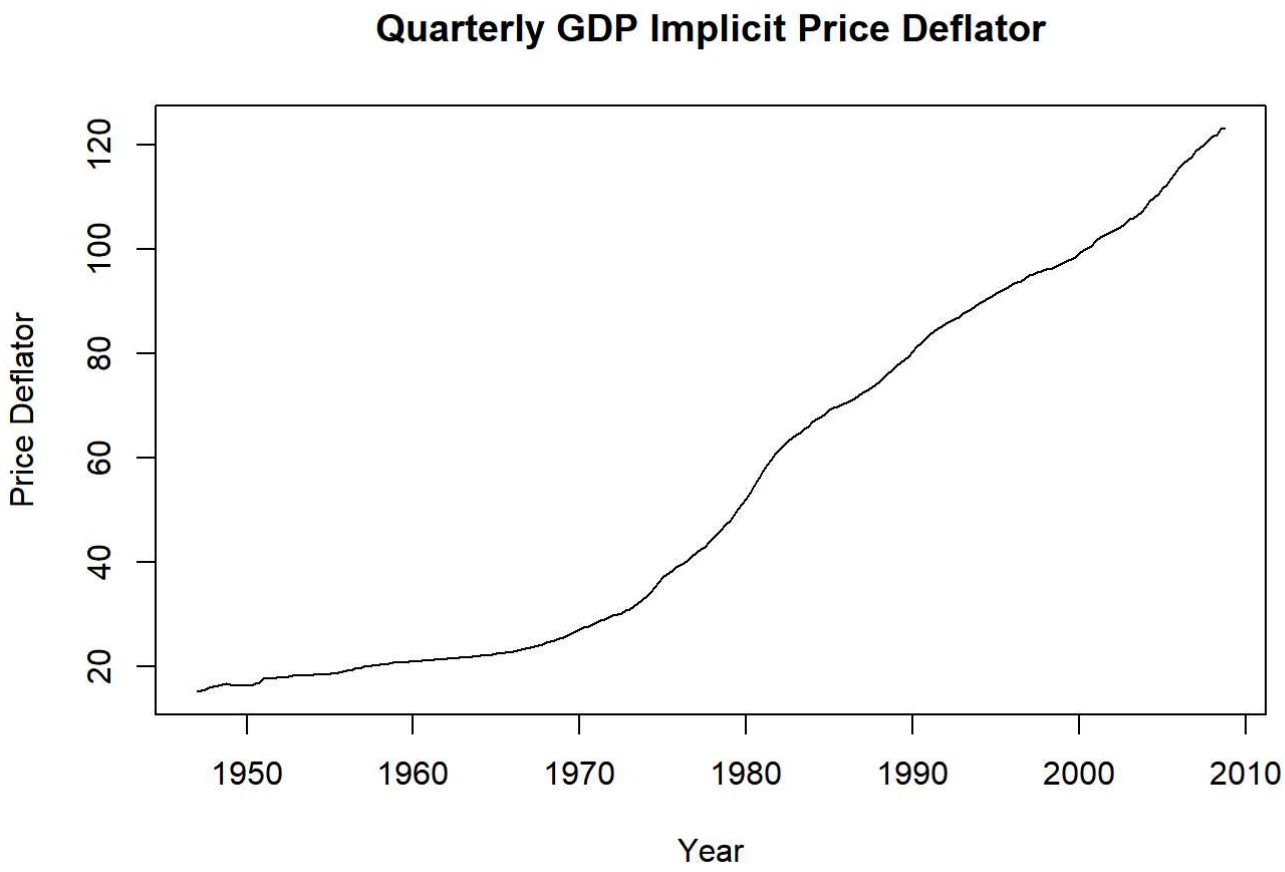
```
ts_data <- ts(data[,4], start = c(1947,1), frequency = 4)

ts_data
```

```
##         Qtr1    Qtr2    Qtr3    Qtr4
## 1947  15.105  15.329  15.597  15.989
## 1948  16.111  16.254  16.556  16.597
## 1949  16.531  16.350  16.256  16.272
## 1950  16.222  16.286  16.630  16.950
## 1951  17.582  17.690  17.700  17.896
## 1952  17.879  17.913  18.119  18.172
## 1953  18.172  18.206  18.276  18.316
## 1954  18.375  18.392  18.425  18.477
## 1955  18.566  18.644  18.783  18.973
## 1956  19.165  19.276  19.524  19.599
## 1957  19.876  20.012  20.131  20.133
## 1958  20.355  20.419  20.553  20.656
## 1959  20.704  20.704  20.753  20.840
## 1960  20.931  21.004  21.084  21.146
## 1961  21.192  21.237  21.303  21.375
## 1962  21.501  21.533  21.585  21.653
## 1963  21.702  21.745  21.788  21.951
## 1964  22.016  22.073  22.160  22.270
## 1965  22.383  22.480  22.563  22.707
## 1966  22.855  23.048  23.291  23.505
## 1967  23.612  23.741  23.975  24.241
## 1968  24.506  24.763  25.008  25.362
## 1969  25.626  25.958  26.332  26.675
## 1970  27.056  27.428  27.647  28.004
## 1971  28.425  28.798  29.089  29.322
## 1972  29.781  29.959  30.250  30.652
## 1973  31.020  31.500  32.114  32.750
## 1974  33.376  34.162  35.166  36.218
## 1975  37.050  37.614  38.313  38.987
## 1976  39.418  39.840  40.385  41.122
## 1977  41.796  42.401  42.917  43.852
## 1978  44.505  45.321  46.072  47.047
## 1979  47.876  49.058  50.115  51.117
## 1980  52.195  53.349  54.560  56.071
## 1981  57.517  58.598  59.641  60.729
## 1982  61.555  62.302  63.182  63.863
## 1983  64.388  64.853  65.517  66.012
## 1984  66.837  67.414  67.953  68.385
## 1985  69.155  69.550  69.838  70.289
## 1986  70.652  71.015  71.426  71.893
## 1987  72.487  72.882  73.425  73.958
## 1988  74.587  75.300  76.141  76.712
## 1989  77.580  78.324  78.879  79.425
## 1990  80.375  81.311  82.031  82.646
## 1991  83.626  84.165  84.762  85.206
## 1992  85.721  86.190  86.580  87.029
## 1993  87.707  88.190  88.570  89.038
## 1994  89.578  89.954  90.530  90.952
## 1995  91.530  91.859  92.289  92.733
## 1996  93.328  93.659  93.951  94.450
## 1997  95.054  95.206  95.534  95.846
## 1998  96.089  96.249  96.600  96.934
## 1999  97.328  97.674  98.013  98.432
## 2000  99.317  99.745 100.259 100.666
```

```
## 2001 101.478 102.252 102.675 103.191
## 2002 103.568 103.938 104.328 104.907
## 2003 105.724 106.062 106.611 107.190
## 2004 108.175 109.178 109.793 110.671
## 2005 111.765 112.346 113.468 114.525
## 2006 115.533 116.317 117.107 117.732
## 2007 118.956 119.547 119.997 120.743
## 2008 121.508 121.890 123.056 123.244
```

Step 3: Plot the time series

```
plot(ts_data, main = "Quarterly GDP Implicit Price Deflator",
     xlab = "Year", ylab = "Price Deflator")
```



Check for stationarity

```
library(tseries)
```

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

```
adf.test(ts_data)
```

```
##
##  Augmented Dickey-Fuller Test
##
## data:  ts_data
## Dickey-Fuller = -2.6022, Lag order = 6, p-value = 0.3223
## alternative hypothesis: stationary
```

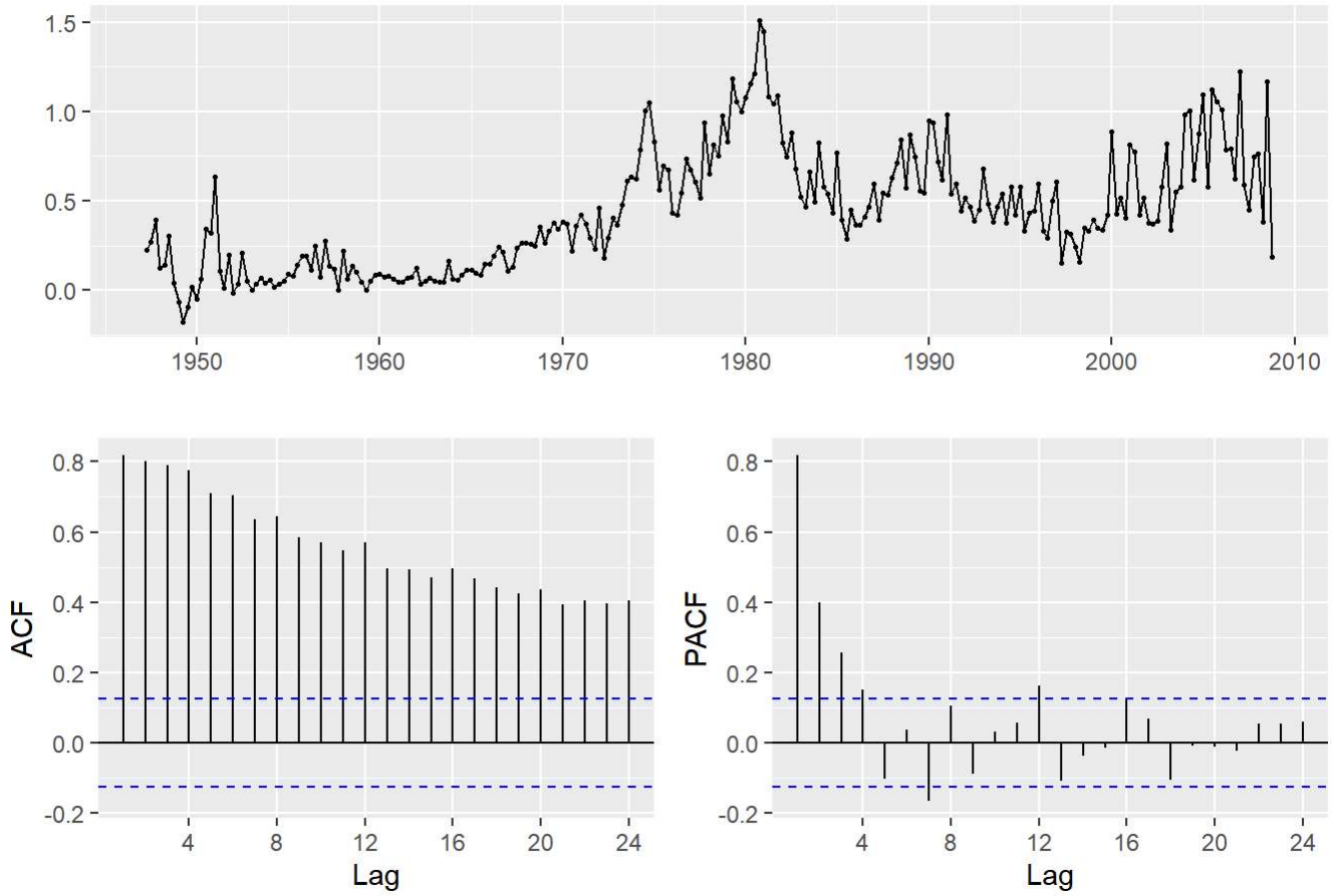
The p-value of the ADF test is 0.3223, which suggests that the series is not stationary.

Apply differencing to make the series stationary

```
diff_ts_data <- diff(ts_data, differences = 1)
```

Plot the ACF and PACF to determine the order of the ARIMA model

```
library(forecast)
ggtsdisplay(diff_ts_data)
```



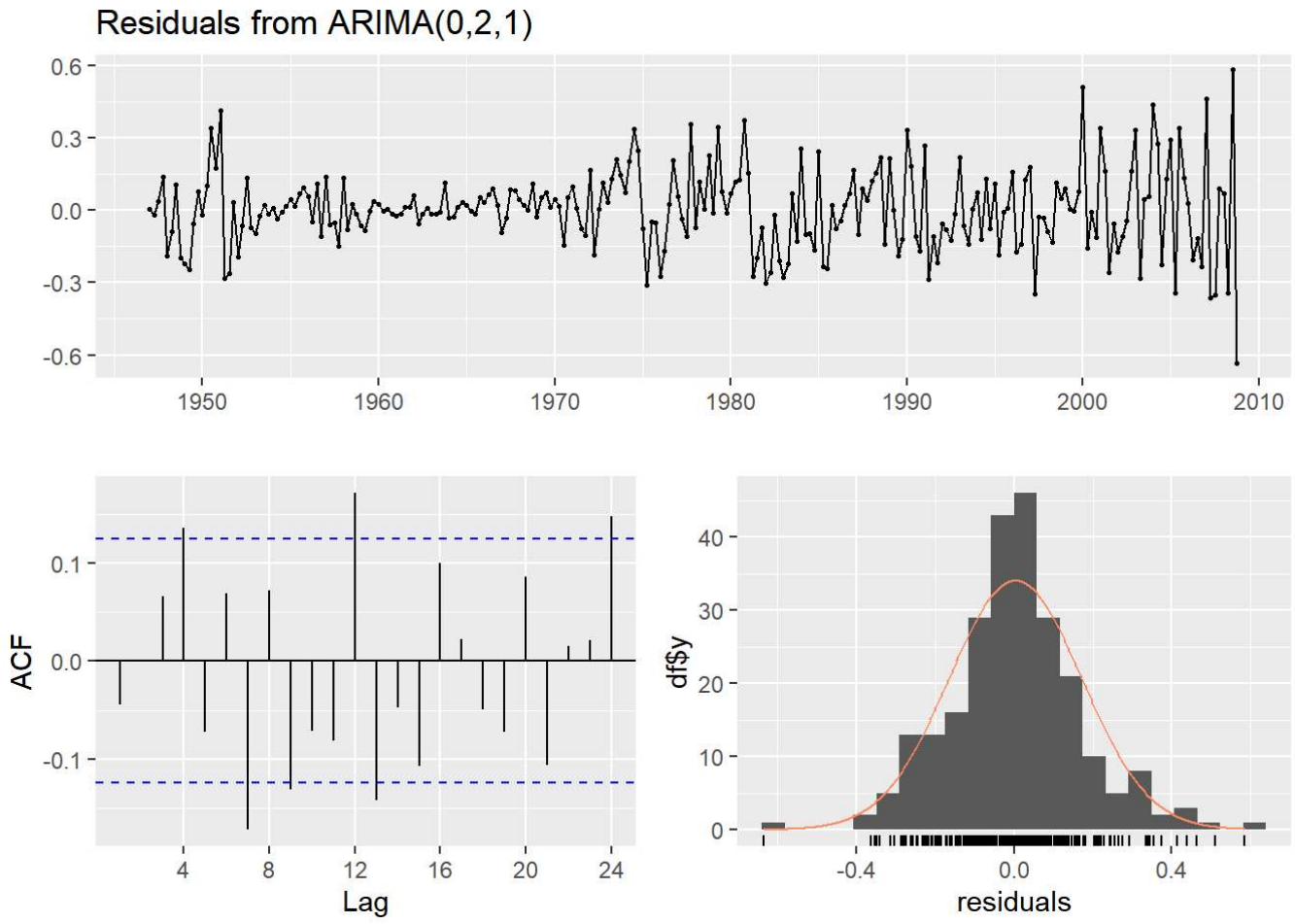
Fit the ARIMA model to the time series

```
fit <- auto.arima(ts_data, ic = "bic")
summary(fit)
```

```
## Series: ts_data
## ARIMA(0,2,1)
##
## Coefficients:
##           ma1
##       -0.5862
## s.e.   0.0486
##
## sigma^2 = 0.02873:  log likelihood = 87.86
## AIC=-171.72   AICc=-171.67   BIC=-164.7
##
## Training set error measures:
##                       ME      RMSE       MAE         MPE      MAPE       MASE
## Training set 0.003095975 0.1684768 0.1243017 0.01220345 0.285456 0.07058748
##                      ACF1
## Training set -0.04402516
```

Check the residuals of the fitted model for white noise

```
checkresiduals(fit)
```



```
##
##  Ljung-Box test
##
## data:  Residuals from ARIMA(0,2,1)
## Q* = 17.801, df = 7, p-value = 0.0129
##
## Model df: 1.   Total lags used: 8
```

Make forecasts for the next few quarters

```
fc<-forecast(fit, h = 4)
```

Plot the forecasts

```
autoplot(fc, main = "Forecast of Quarterly GDP Implicit Price Deflator",
         xlab = "Year", ylab = "Price Deflator")
```