Assignment

SUBMITTED TO

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Time Series Analysis & Forecasting
WM-ASDS10, (10th Batch), Section: B
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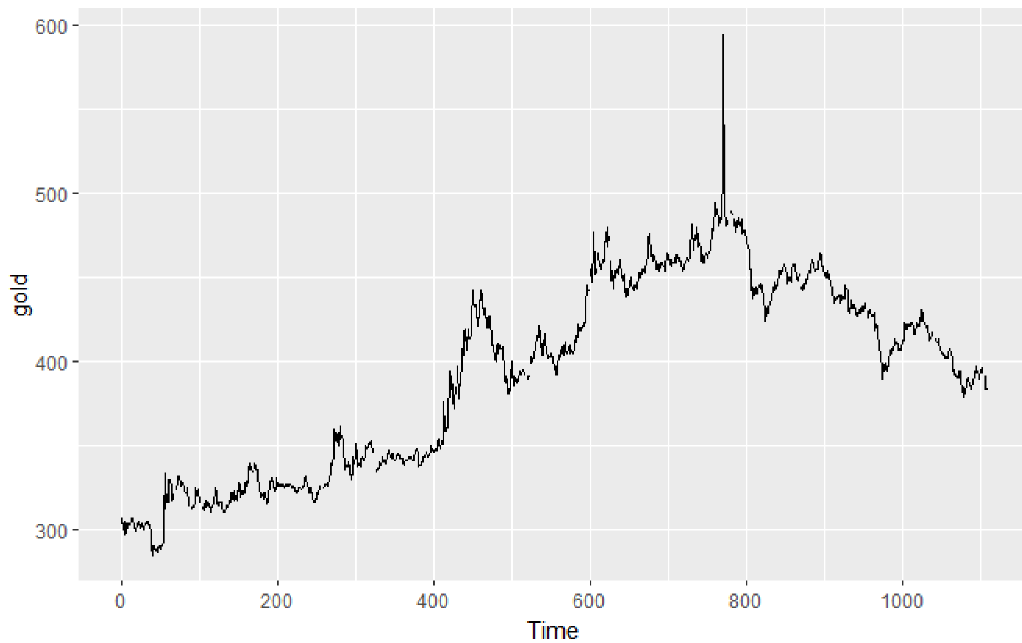
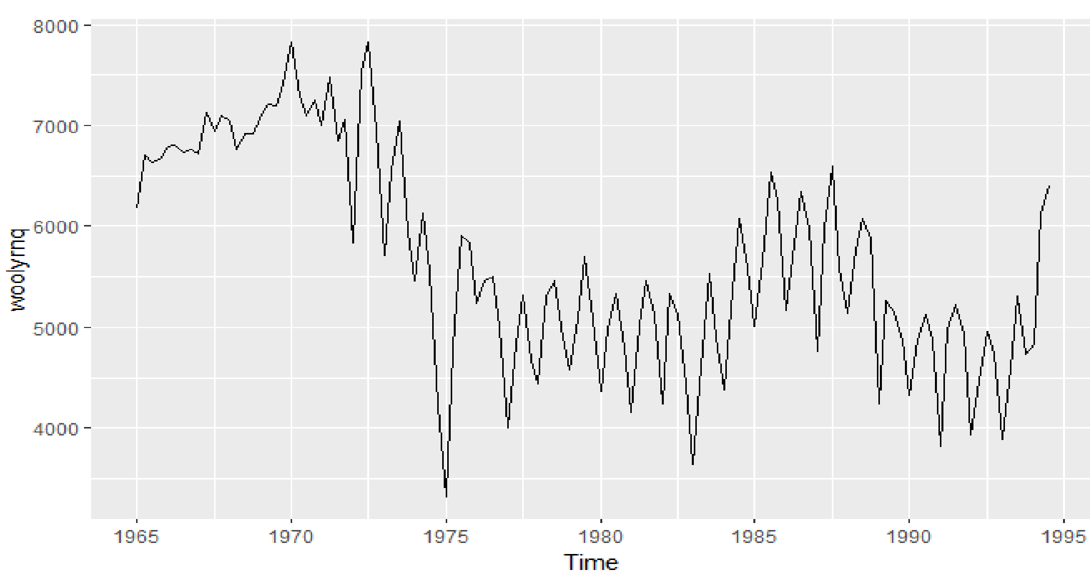
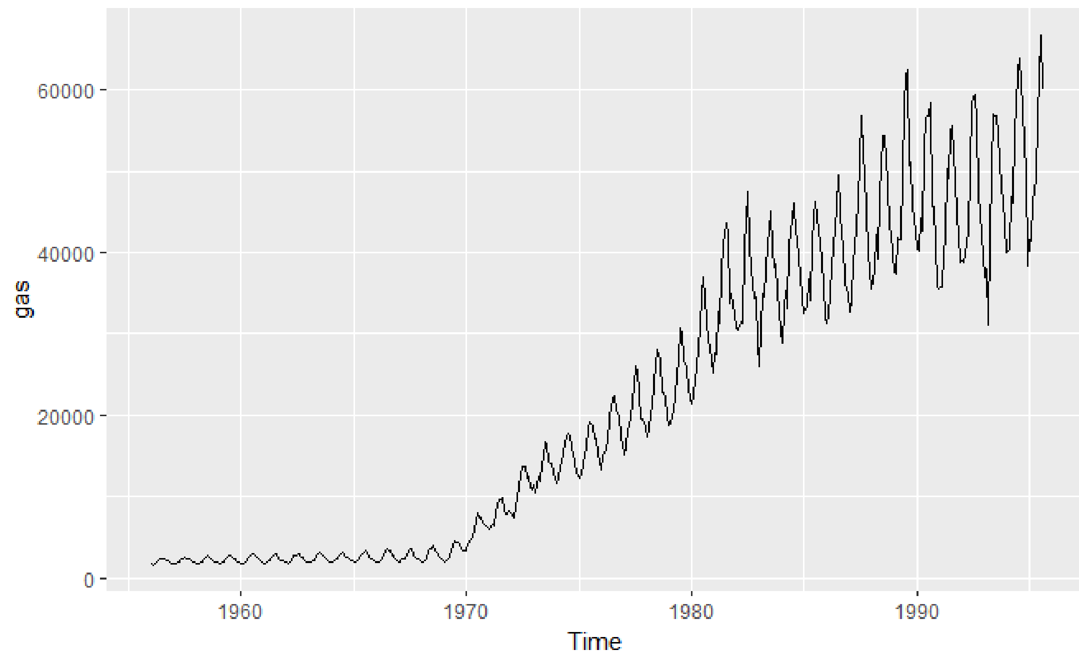
Q1(a) Use autoplot () to plot each of these in separate plots.



Comment: The help functions tell us that gold is the “daily morning gold prices” in US dollars for the time period spanning January 1, 1985 through March 31, 1989. The blurb that appeared with the help function mentioned an example of tsdisplay(gold), so I tried that out and included the output. I’m not quite sure what the bottom two plots are but I’m sure I’ll find out before I finish this assignment. My next step is to use the autoplot () function on the gold t data.





Comment: There are two things that my eyes immediately jump to on this plot; the enormous spike about a quarter of the way in the 700's and the dip shortly after we started at about day 30. It looked to be a consistent dip as opposed the spikes that other valleys show. The next task to to use the frequency function to determine the frequency of the old series.

Code:

autoplot(gold)

autoplot(woolyrnq)

autoplot(gas)

writeLines("")

Q1(b) What is the frequency of each commodity series? Hint: apply the frequency() function.

```
> print("Frequency")
[1] "Frequency"
> print("gold")
[1] "gold"
> frequency(gold)
[1] 1
> print("woolyrnq")
[1] "woolyrnq"
> frequency(woolyrnq)
[1] 4
> print("gas")
[1] "gas"
> frequency(gas)
[1] 12
```

Comment: The frequency is shown to be one but we know from the description of the gold time series data that it is daily information. I assume that the 1 the frequency is stating is daily and not annual. Now to "spot the outlier" in this series. We can see that the woolyrnq provides the data on the "quarterly production of woolen yarn in Australia" for the time period of March 1965 - September 1994. The wool is measured in tones. Lastly, we'll take a look at the gas series, using the help and autoplot functions to see what we can gather.

Code:

print("Frequency")

print("gold")

frequency(gold)

print("woolyrnq")

frequency(woolyrnq)

print("gas")

frequency(gas)

Q1(c) Use which.max() to spot the outlier in the gold series. Which observation was it?

```
> print("When gold got maximum value?")
[1] "When gold got maximum value?"
> which.max(gold)
[1] 770
> print("What was the gold's maximum value?")
[1] "What was the gold's maximum value?"
> gold[which.max(gold)]
[1] 593.7
```

Comment: We see that the gas time series data is the data for the Australia's monthly gas production for 1956 through 1995. The auto plot shows what I think is a dramatic overall increase in the production of gas in Australia that began in 1970.

Code:

print("When gold got maximum value?")

which.max(gold)

print("What was the gold's maximum value?")

gold[which.max(gold)]

Q2(a) You can read the data into R with the following script:

```
> head(tute1)
       X  Sales AdBudget   GDP
1 Mar-81 1020.2    659.2 251.8
2 Jun-81  889.2    589.0 290.9
3 Sep-81  795.0    512.5 290.8
4 Dec-81 1003.9    614.1 292.4
5 Mar-82 1057.7    647.2 279.1
6 Jun-82  944.4    602.0 254.0
```

Code:

tute1 <- read.csv("C:/Users/User/Downloads/tute1.csv", header=TRUE)

head(tute1)

Q2(b) Convert the data to time series.

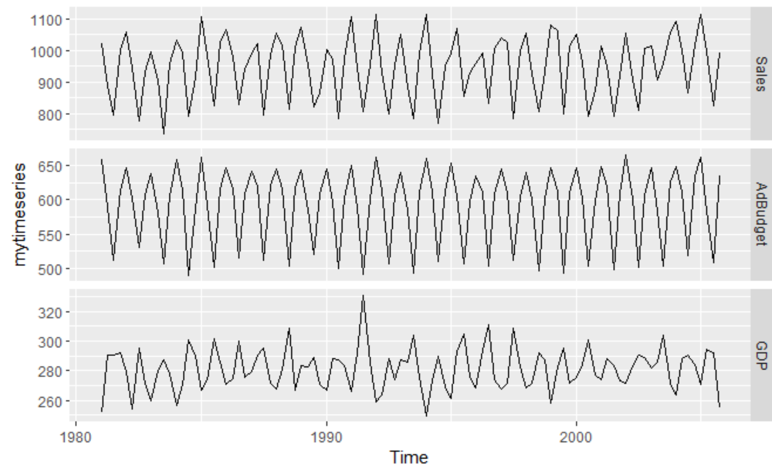
```
> head(mytimeseries)
         Sales AdBudget   GDP
1981 Q1 1020.2    659.2 251.8
1981 Q2  889.2    589.0 290.9
1981 Q3  795.0    512.5 290.8
1981 Q4 1003.9    614.1 292.4
1982 Q1 1057.7    647.2 279.1
1982 Q2  944.4    602.0 254.0
```

Code:

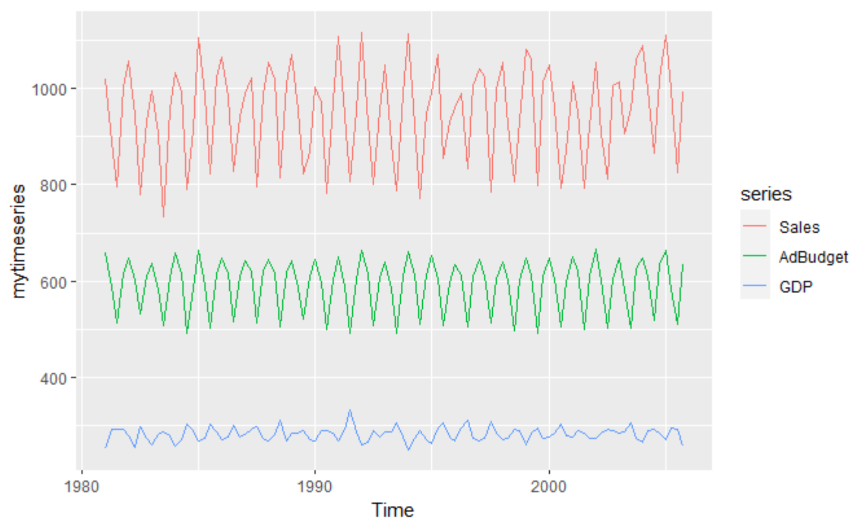
mytimeseries <- ts(tute1[,-1], start=1981, frequency=4)

head(mytimeseries)

Q2(c) Construct time series plots of each of the three series.



Comment: Looking at this output, I would guess that not adding facets = TRUE will generate an output that is not broken down by sales, ad budget, and GDP. Let's try and see



Comment: I was correct I appears that without the facet = TRUE, it's one plot showing the 3 different time series, and not three distinct plots when it is included. A ledgend is required to show which plot goes to which time series.

Code:

```
autoplot(mytimeseries, facets=TRUE)

autoplot(mytimeseries)
```

3(a) You can read the data into R with the following script:

```
> head(retaildata)
   Series.ID A3349335T A3349627V A3349338X A3349398A A3349468W A3349336V
1 1982-04-01     303.1      41.7      63.9     408.7      65.8      91.8
2 1982-05-01     297.8      43.1      64.0     404.9      65.8     102.6
3 1982-06-01     298.0      40.3      62.7     401.0      62.3     105.0
4 1982-07-01     307.9      40.9      65.6     414.4      68.2     106.0
5 1982-08-01     299.2      42.1      62.6     403.8      66.0      96.9
  A3349337W A3349397X A3349399C A3349874C A3349871W A3349790V A3349556W
1      53.6     211.3      94.0      32.7     126.7     178.3      50.4
2      55.4     223.8     105.7      35.6     141.3     202.8      49.9
3      48.4     215.7      95.1      32.5     127.6     176.3      48.0
4      52.1     226.3      95.3      33.5     128.8     172.6      48.6
5      54.2     217.1      82.8      29.4     112.3     169.6      51.3
  A3349791W A3349401C A3349873A A3349872X A3349709X A3349792X A3349789K
1      22.2      43.0      62.4     178.0      61.8      85.4     147.2
2      23.1      45.3      63.1     181.5      60.8      84.8     145.6
3      22.8      43.7      59.6     174.1      58.7      80.7     139.4
4      23.2      46.5      61.9     180.2      60.3      82.4     142.7
5      21.4      44.8      60.7     178.1      56.1      80.7     136.8
  A3349555V A3349565X A3349414R A3349799R A3349642T A3349413L A3349564W
1    1250.2     257.9      17.3      34.9     310.2      58.2      55.8
2    1300.0     257.4      18.1      34.6     310.1      62.0      58.4
3    1234.2     261.2      18.1      34.6     313.9      53.8      53.7
4    1265.0     266.1      18.9      35.2     320.2      57.9      56.9
5    1217.6     247.2      19.0      33.8     300.1      59.2      56.7
  A3349416V A3349643V A3349483V A3349722T A3349727C A3349641R A3349639C
1      59.1     173.1      93.6      26.3     119.9     104.2      42.2
2      59.2     179.5      95.3      27.1     122.5     110.2      42.1
3      59.8     167.3      85.2      24.3     109.6      96.7      38.5
4      59.8     174.5      91.6      25.6     117.2     104.6      38.9
5      62.2     178.1      85.2      23.5     108.7      92.5      39.5
  A3349415T A3349349F A3349563V A3349350R A3349640L A3349566A A3349417W
1      15.6      31.6      34.4     123.7      36.4      48.7      85.1
2      15.8      31.5      34.4     123.9      36.2      48.9      85.1
3      15.2      29.6      33.5     116.8      35.7      47.1      82.8
4      15.2      35.2      33.4     122.7      34.6      47.5      82.1
5      14.5      34.7      33.2     122.0      32.5      49.3      81.8
  A3349352V A3349882C A3349561R A3349883F A3349721R A3349478A A3349637X
1     916.2     139.3        NA        NA     161.8      31.8      46.6
2     931.2     136.0        NA        NA     158.7      32.8      49.6
3     887.0     143.5        NA        NA     166.6      34.9      51.4
4     921.3     150.2        NA        NA     172.9      34.6      50.9
5     883.2     144.0        NA        NA     165.9      32.9      51.6
  A3349479C A3349797K A3349477X A3349719C A3349884J A3349562T A3349348C
1      13.3      91.6      28.9      13.9      42.8      67.5      18.4
2      12.7      95.0      30.6      14.7      45.3      69.7      17.7
3      12.9      99.2      30.5      14.5      45.1      60.7      17.7
4      13.9      99.4      27.9      15.2      43.1      67.9      18.4
5      12.8      97.3      27.4      14.1      41.5      66.5      17.8
  A3349480L A3349476W A3349881A A3349410F A3349481R A3349718A A3349411J
1      11.1      22.0      25.8      77.3      18.7      26.7      45.4
2      11.7      21.9      25.9      77.2      19.5      27.3      46.8
3      11.5      22.7      25.9      77.7      18.6      26.2      44.8
4      13.1      24.3      28.7      84.4      22.6      25.2      47.8
5      13.0      23.6      27.7      82.1      22.6      25.6      48.2
  A3349638A A3349654A A3349499L A3349902A A3349432V A3349656F A3349361W
1     486.3      83.5       6.0      11.3     100.8      15.2      16.0
2     492.8      80.6       5.4      11.1      97.1      17.2      19.0
3     494.1      82.3       5.2      11.2      98.7      17.4      18.1
4     515.6      88.2       5.6      12.1     105.9      18.7      20.3
5     501.4      82.3       5.7      11.7      99.7      18.6      19.6
  A3349501L A3349503T A3349360V A3349903C A3349905J A3349658K A3349575C
```

```
1       8.6      39.7      19.1       6.6      25.7      48.9       8.1
2       9.5      45.7      21.6       7.0      28.6      52.2       7.5
3       8.4      43.9      18.3       6.0      24.3      48.9       6.7
4      10.3      49.3      18.6       6.4      25.0      48.3       7.8
5      10.6      48.9      17.1       6.0      23.1      49.4       7.9
  A3349428C A3349500K A3349577J A3349433W A3349576F A3349574A A3349816F
1       6.1       7.2      12.9      34.2      14.3      15.8      30.1
2       6.5       7.5      13.0      34.4      14.2      15.8      30.0
3       6.1       7.5      12.5      32.7      13.4      15.3      28.7
4       6.6       7.9      13.9      36.2      14.5      17.0      31.4
5       6.3       8.3      13.7      36.1      13.6      17.5      31.1
  A3349815C A3349744F A3349823C A3349508C A3349742A A3349661X A3349660W
1     279.4      96.6      12.3      13.1     122.0      19.2      22.5
2     288.0      96.4      11.8      13.4     121.6      21.9      27.8
3     277.2      95.6      11.3      13.5     120.4      19.9      26.7
4     296.1     103.3      12.1      13.8     129.2      19.3      28.2
5     288.4      96.6      12.0      13.3     121.9      19.6      27.4
  A3349909T A3349824F A3349507A A3349580W A3349825J A3349434X A3349822A
1       8.6      50.4      21.4       7.4      28.8      36.5       9.7
2       8.2      57.9      24.1       8.0      32.1      43.7      11.0
3       7.9      54.4      21.4       7.0      28.5      38.0      10.7
4       8.7      56.2      21.8       7.2      29.0      42.0       9.0
5       7.9      55.0      18.7       6.6      25.3      38.5       9.1
  A3349821X A3349581X A3349908R A3349743C A3349910A A3349435A A3349365F
1       6.5      14.6      11.3      42.1       8.0      10.4      18.4
2       7.2      15.2      11.6      45.0       8.0      10.3      18.3
3       6.6      14.5      10.9      42.5       7.3      10.4      17.7
4       7.0      14.6      11.4      42.0       7.8      10.3      18.1
5       6.8      15.3      10.9      42.1       7.6      10.1      17.7
  A3349746K A3349370X A3349754K A3349670A A3349764R A3349916R A3349589T
1     298.3      26.0        NA        NA      28.4       6.1       5.1
2     318.5      25.4        NA        NA      27.7       6.3       4.7
3     301.5      25.3        NA        NA      27.7       6.4       5.2
4     316.4      27.8        NA        NA      30.3       5.9       5.2
5     300.5      26.6        NA        NA      29.0       5.7       4.8
  A3349590A A3349765T A3349371A A3349588R A3349763L A3349372C A3349442X
1       2.4      13.6       6.7       1.9       8.7        NA       2.9
2       2.5      13.4       7.4       1.9       9.3        NA       2.9
3       2.1      13.7       6.7       1.8       8.6        NA       2.9
4       2.7      13.7       7.1       1.8       8.9        NA       3.1
5       2.9      13.4       5.8       1.7       7.5        NA       3.1
  A3349591C A3349671C A3349669T A3349521W A3349443A A3349835L A3349520V
1       1.8       4.0        NA        NA       1.9       3.5       5.4
2       1.9       4.0        NA        NA       2.0       3.5       5.5
3       1.9       3.9        NA        NA       2.0       3.1       5.1
4       1.8       4.4        NA        NA       1.9       3.6       5.5
5       1.8       4.2        NA        NA       1.9       3.6       5.5
  A3349841J A3349925T A3349450X A3349679W A3349527K A3349526J A3349598V
1      79.9        NA        NA        NA        NA        NA        NA
2      78.9        NA        NA        NA        NA        NA        NA
3      77.5        NA        NA        NA        NA        NA        NA
4      82.7        NA        NA        NA        NA        NA        NA
5      78.1        NA        NA        NA        NA        NA        NA
  A3349766V A3349600V A3349680F A3349378T A3349767W A3349451A A3349924R
1        NA        NA        NA        NA        NA        NA        NA
2        NA        NA        NA        NA        NA        NA        NA
3        NA        NA        NA        NA        NA        NA        NA
4        NA        NA        NA        NA        NA        NA        NA
5        NA        NA        NA        NA        NA        NA        NA
  A3349843L A3349844R A3349376L A3349599W A3349377R A3349779F A3349379V
1        NA        NA        NA        NA        NA        NA        NA
2        NA        NA        NA        NA        NA        NA        NA
3        NA        NA        NA        NA        NA        NA        NA
4        NA        NA        NA        NA        NA        NA        NA
```

```
5         NA         NA         NA         NA         NA         NA         NA
  A3349842K A3349532C A3349931L A3349605F A3349688X A3349456L A3349774V
1        NA      12.7       1.2       1.6      15.5       2.7       4.4
2        NA      12.1       1.4       1.6      15.1       3.0       4.9
3        NA      12.5       1.3       1.7      15.5       2.5       4.8
4        NA      13.2       1.4       1.6      16.1       2.8       5.1
5        NA      12.7       1.6       1.6      15.8       2.8       4.6
  A3349848X A3349457R A3349851L A3349604C A3349608L A3349609R A3349773T
1       2.6       9.7       3.7       2.2       5.9      10.3       2.3
2       3.3      11.1       3.8       2.1       5.9      10.6       2.5
3       2.7       9.9       3.2       2.0       5.1       9.9       2.3
4       2.4      10.2       3.4       2.1       5.4       8.8       2.6
5       2.7      10.1       3.1       2.0       5.0       8.8       2.6
  A3349852R A3349775W A3349776X A3349607K A3349849A A3349850K A3349606J
1       1.1       2.5       2.2       8.1       4.4       3.2       7.6
2       1.0       2.5       2.0       8.0       3.4       3.3       6.7
3       1.0       2.5       2.0       7.8       3.6       3.5       7.1
4       1.1       2.6       2.0       8.3       4.0       3.5       7.5
5       0.9       2.8       2.0       8.4       3.6       3.7       7.3
  A3349932R A3349862V A3349462J A3349463K A3349334R A3349863W A3349781T
1      57.1     933.4      79.6     149.6    1162.6     200.3     243.4
2      57.3     920.5      80.8     149.7    1150.9     210.3     268.3
3      55.3     933.6      77.3     149.0    1160.0     198.7     266.1
4      56.3     972.6      80.4     153.5    1206.4     208.7     273.5
5      55.4     923.5      81.6     147.3    1152.5     206.2     262.7
  A3349861T A3349626T A3349617R A3349546T A3349787F A3349333L A3349860R
1     148.6     592.3     268.5      91.4     359.9     460.1     135.1
2     151.0     629.6     289.8      96.8     386.6     502.6     134.9
3     142.6     607.4     261.9      88.6     350.5     443.8     128.2
4     150.1     632.4     267.2      92.1     359.3     459.1     129.9
5     153.7     622.6     241.5      83.7     325.2     438.4     133.0
  A3349464L A3349389X A3349461F A3349788J A3349547V A3349388W A3349870V
1      64.9     125.6     153.5     479.1     146.3     196.1     342.4
2      67.7     128.7     154.8     486.1     145.5     196.6     342.1
3      65.5     125.0     148.8     467.5     140.2     188.5     328.7
4      68.5     136.6     156.1     491.1     146.5     192.0     338.5
5      65.2     134.7     152.8     485.7     138.8     192.7     331.5
  A3349396W NA. NA..1 NA..2 NA..3 NA..4 NA..5 NA..6 NA..7 NA..8 NA..9
1    3396.4  NA    NA    NA    NA    NA    NA    NA    NA    NA    NA
2    3497.9  NA    NA    NA    NA    NA    NA    NA    NA    NA    NA
3    3357.8  NA    NA    NA    NA    NA    NA    NA    NA    NA    NA
4    3486.8  NA    NA    NA    NA    NA    NA    NA    NA    NA    NA
5    3355.9  NA    NA    NA    NA    NA    NA    NA    NA    NA    NA
 [ reached 'max' / getOption("max.print") -- omitted 1 rows ]
```

Code:

```
library(xlsx)

retaildata <- xlsx::read.xlsx("C:/Users/User/Downloads/retail.xlsx", sheetIndex = 1, startRow = 2)

head(retaildata)
```

Q3(b) **Select one of the time series as follows (but replace the column name with your own chosen column:**

```
> myts
       Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
1982                    62.4  63.1  59.6  61.9  60.7  61.2  62.1  68.3 104.0
1983  63.9  64.8  70.0  65.3  68.9  65.7  66.9  70.4  71.6  74.9  83.4 122.8
1984  69.0  71.8  74.9  70.2  76.6  68.7  70.1  74.6  70.6  80.5  87.2 121.3
1985  73.3  71.1  75.7  76.0  86.1  75.2  83.4  85.3  81.3  93.9 104.7 143.8
1986  88.5  85.2  86.2  92.4 100.9  90.1  96.1  97.2  96.8 107.7 110.9 161.0
1987  98.1  94.5  97.7  99.3 106.3  98.5 107.1 105.9 108.5 117.1 121.4 170.1
1988 109.0 110.7 115.5 105.7 114.3 107.5 108.8 109.6 118.4 125.5 151.8 232.4
1989 129.4 120.6 133.2 129.3 142.8 127.6 126.0 136.7 144.5 147.8 168.4 242.6
1990 141.2 139.8 152.1 135.8 148.0 135.8 138.7 144.8 139.9 151.6 163.9 215.8
1991 135.1 135.5 142.4 137.3 146.5 137.6 147.0 152.9 157.5 169.3 184.8 250.1
1992 164.4 169.8 171.0 167.5 173.2 150.8 160.9 164.5 173.6 182.7 196.9 255.5
1993 156.1 152.6 162.0 151.5 160.5 144.9 147.0 151.5 161.6 169.4 186.7 270.1
1994 159.6 161.0 171.3 152.6 159.5 157.4 156.9 169.6 186.2 206.3 198.3 269.5
1995 176.6 170.8 179.7 174.9 174.9 169.1 184.9 192.5 201.5 210.5 227.9 316.5
1996 202.2 210.0 204.5 203.3 209.4 194.8 215.7 228.6 226.6 229.8 242.6 336.5
1997 228.4 212.9 222.3 217.2 225.4 217.2 228.2 227.9 234.9 257.6 280.7 390.1
1998 235.6 224.4 219.1 242.2 239.6 230.5 240.5 233.9 242.7 227.3 243.9 337.8
1999 211.2 197.0 194.3 218.5 222.6 195.0 215.2 222.7 232.6 236.7 252.2 364.6
2000 219.2 215.2 221.0 212.6 228.6 239.4 201.0 211.4 241.1 253.9 261.2 362.6
2001 244.9 236.1 249.7 263.4 268.1 248.9 253.3 266.0 262.2 291.6 316.8 445.0
2002 268.6 248.4 272.4 261.5 283.1 254.4 265.3 284.9 291.2 299.7 332.0 454.8
2003 271.8 261.3 266.7 275.8 287.3 277.5 285.4 297.1 314.4 323.0 346.5 456.0
2004 268.5 256.8 270.7 250.9 266.4 255.2 261.0 263.9 276.3 291.2 304.8 427.0
2005 279.4 255.7 268.3 260.6 260.1 254.4 249.9 262.4 269.9 277.8 303.0 417.3
2006 265.8 248.7 273.1 261.0 266.3 260.4 268.3 275.9 278.2 284.1 299.2 429.1
2007 266.0 251.1 269.9 261.7 273.7 254.8 275.2 290.4 306.7 309.8 324.3 472.0
2008 285.9 286.8 275.3 257.2 285.8 259.7 261.2 273.4 275.2 300.5 323.5 457.3
2009 290.8 285.2 300.6 294.4 304.9 292.5 305.3 289.1 296.2 298.6 321.0 408.9
2010 266.2 240.0 267.5 260.7 272.8 260.5 268.5 277.0 278.7 279.0 319.3 400.2
2011 296.2 302.5 310.8 274.8 267.0 263.8 294.6 317.8 320.4 308.6 427.5 463.9
2012 288.6 287.1 315.6 291.2 309.3 330.0 327.0 331.1 344.6 366.0 534.2 535.4
2013 364.5 360.1 400.3 379.4 395.1 373.6 400.1 384.1 388.4 418.2 577.9 564.3
```

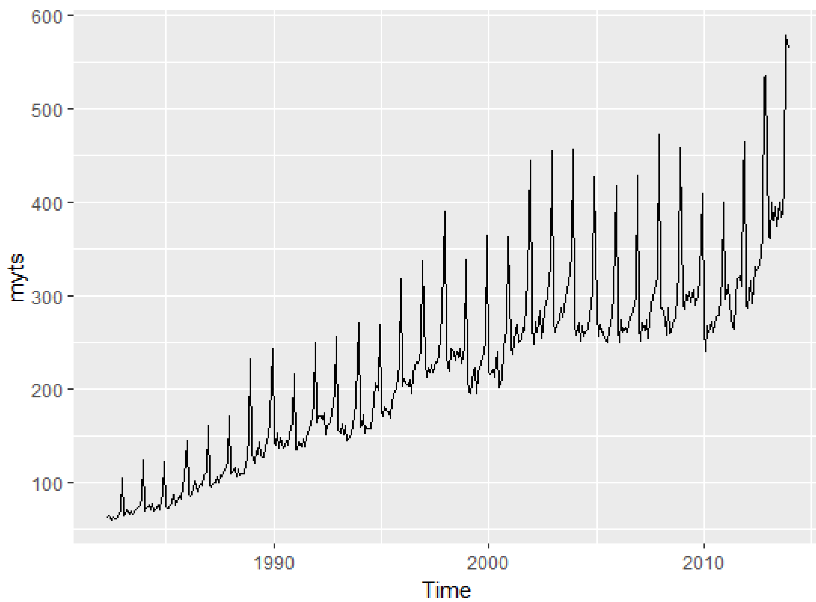
Code:

myts <- ts(retaildata[,"A3349873A"], frequency=12, start=c(1982,4))

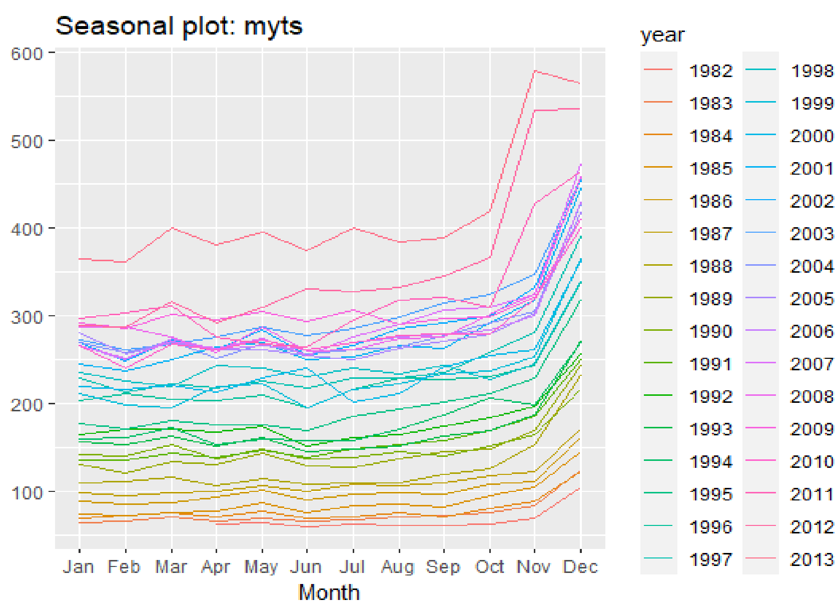
head(myts)

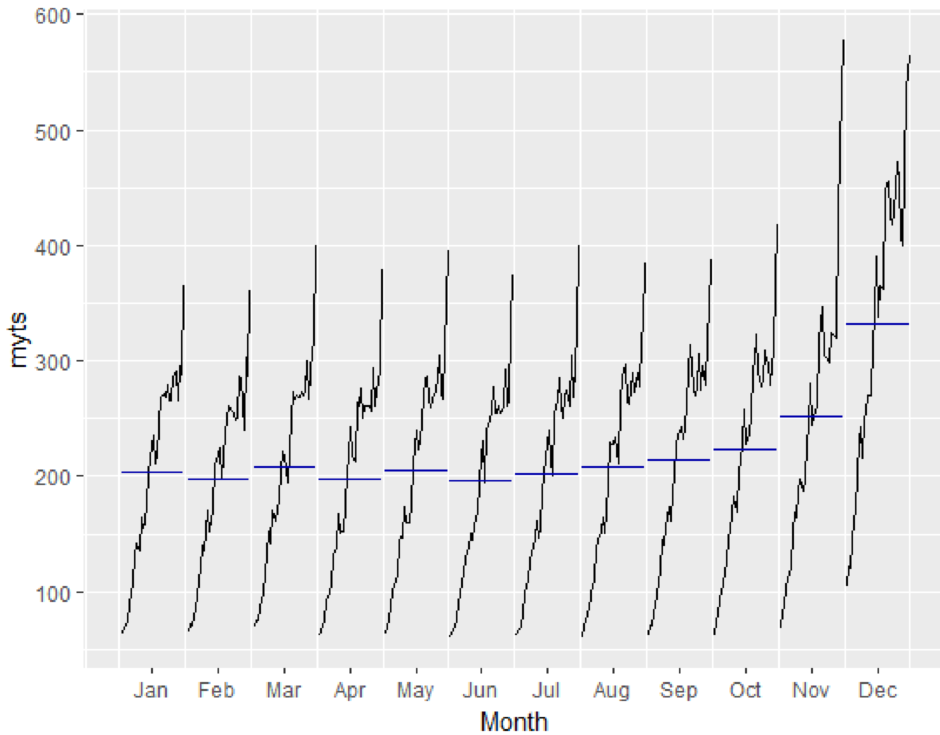
Q3(c) Explore your chosen retail time series using the following functions: autoplot, ggseasonplot, ggsubseriesplot, gglagplot, ggAcf

Can you spot any seasonality, cyclicity, and trend? What do you learn about the series?

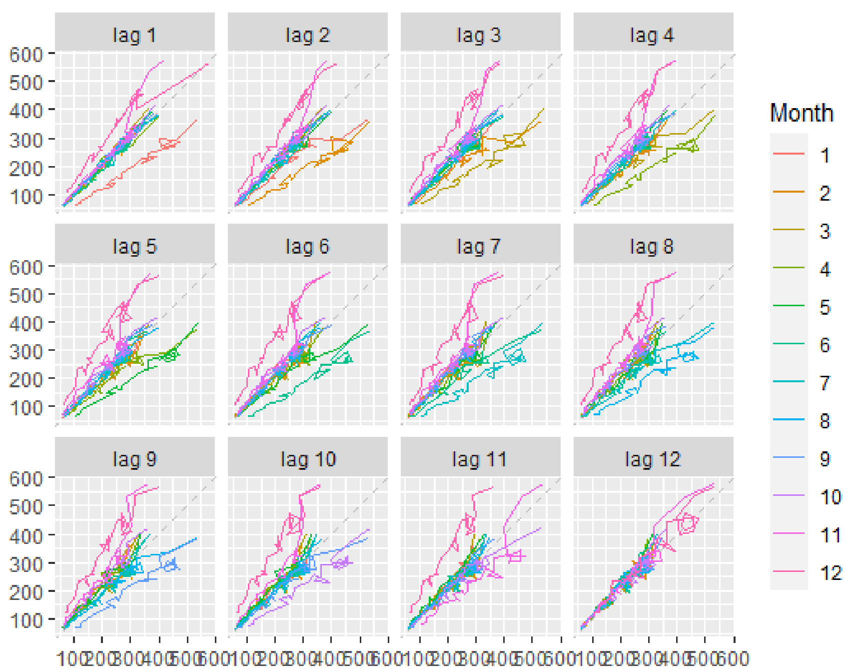


Comment: From what I can gather, the time series I chose is for electronic and electrical goods retailing in New South Wales. There has been an overall upward trend with a spike in 2009.I am seeing some seasonality and not so much a cyclicity. I say this because there’s a frequency to changes that occur.

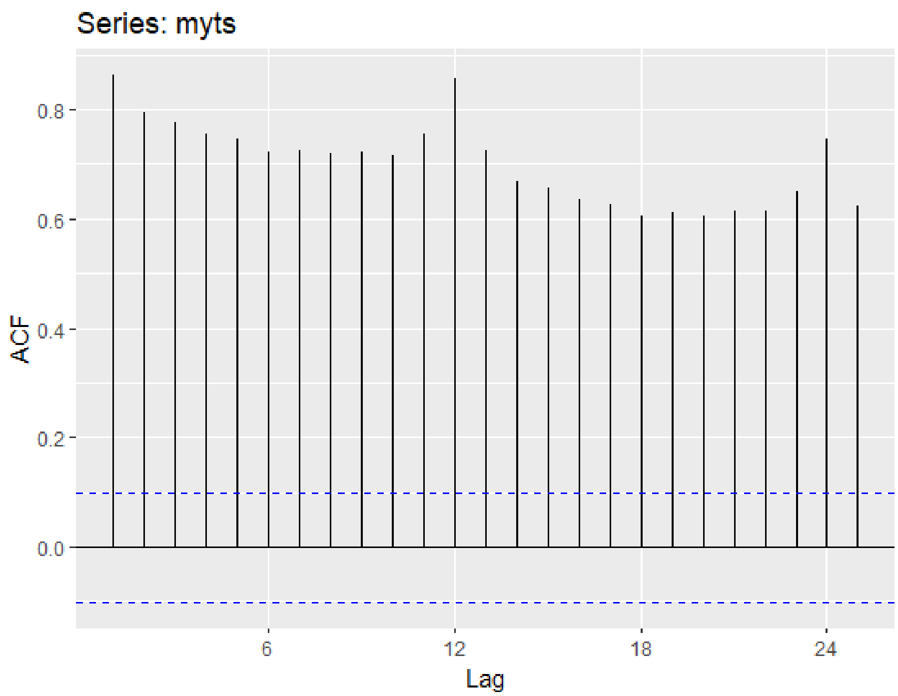




600
500
400
300
200
100
myts
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month



lag 1
lag 2
lag 3
lag 4
lag 5
lag 6
lag 7
lag 8
lag 9
lag 10
lag 11
lag 12
Month
1
2
3
4
5
6
7
8
9
10
11
12



Comment: The plots show that there are definite seasonality. The monthly average is about the same and jumps in December. Lag 12 jumps out at me as it looks very different from the others. They all show a positive relationship. The ACF plot blows my “overall trend” theory as it does not show this, although it shows the seasonality.

Code:

autoplot(myts)

ggseasonplot(myts)

ggsubseriesplot(myts)

Code:

help(bicoal)

help(chicken)

help(dole)

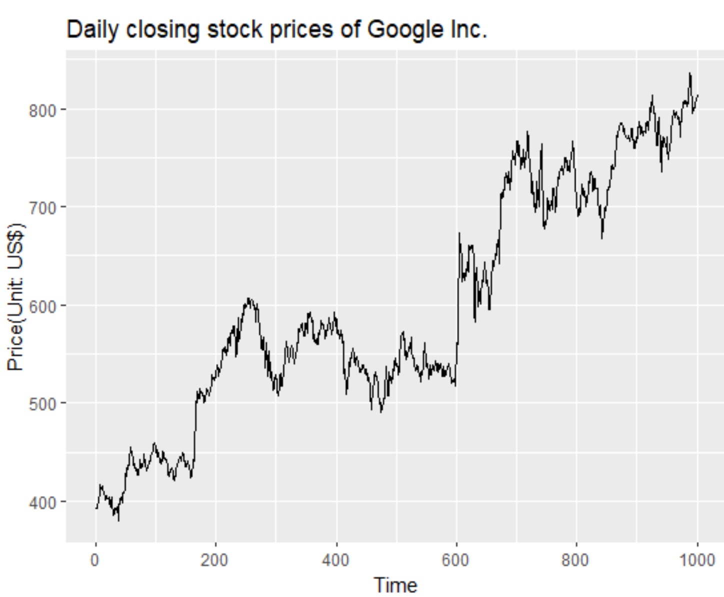
help(usdeaths)

help(lynx)

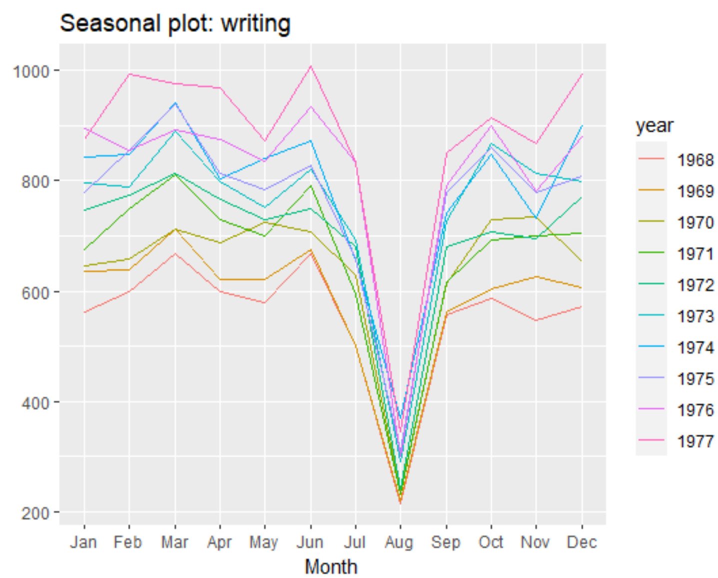
help(goog)

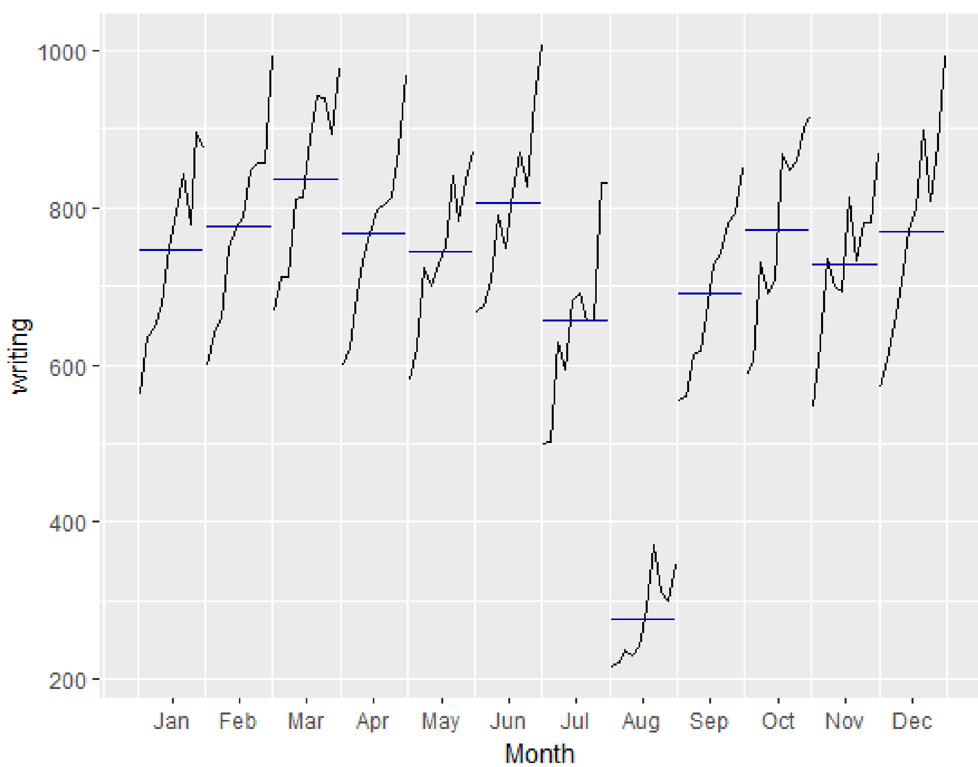
```
help(writing)

help(fancy)

help(a10)

help(h02)


autoplot(goog) +
  ggtitle("Daily closing stock prices of Google Inc.") +
  xlab("Time") +
  ylab("Price(Unit: US$)")
gglagplot(myts, lags = 12)ggAcf(myts)
```

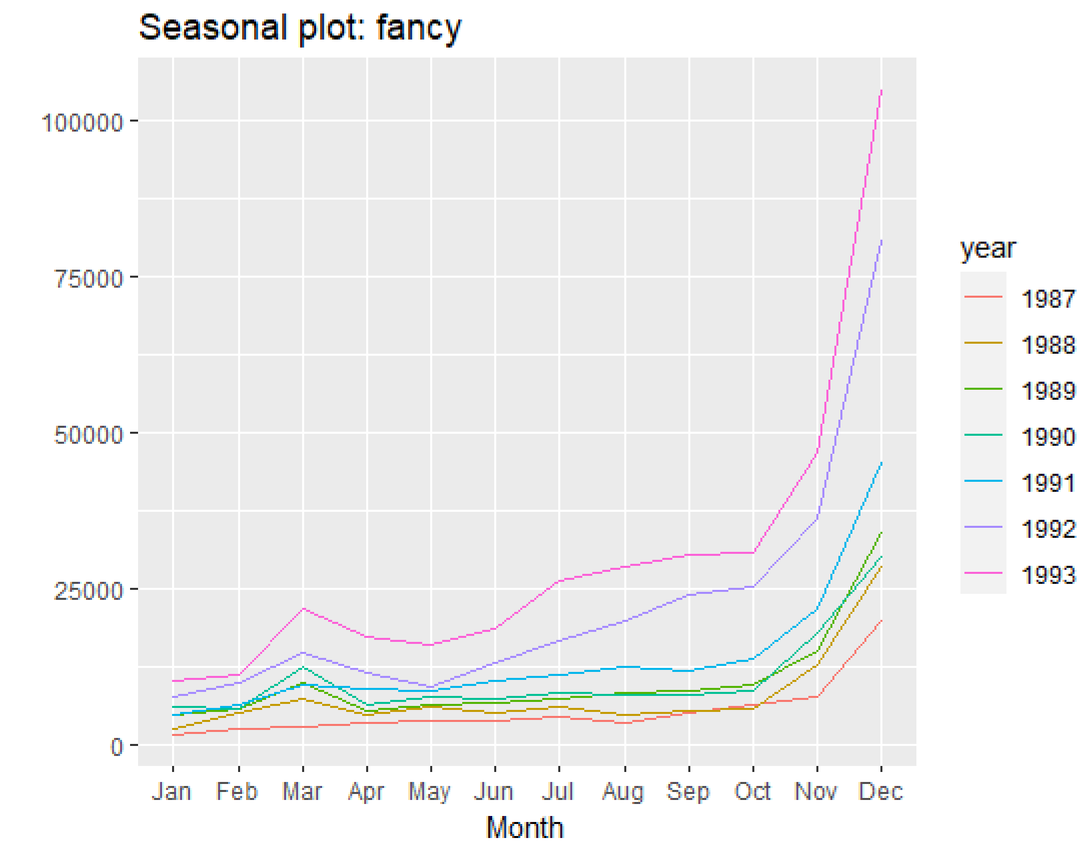
Q4. Create time plots of the following times series: bicoal, chicken, dole, usdeaths, lynx, goog, writing, fancy, a10, h02

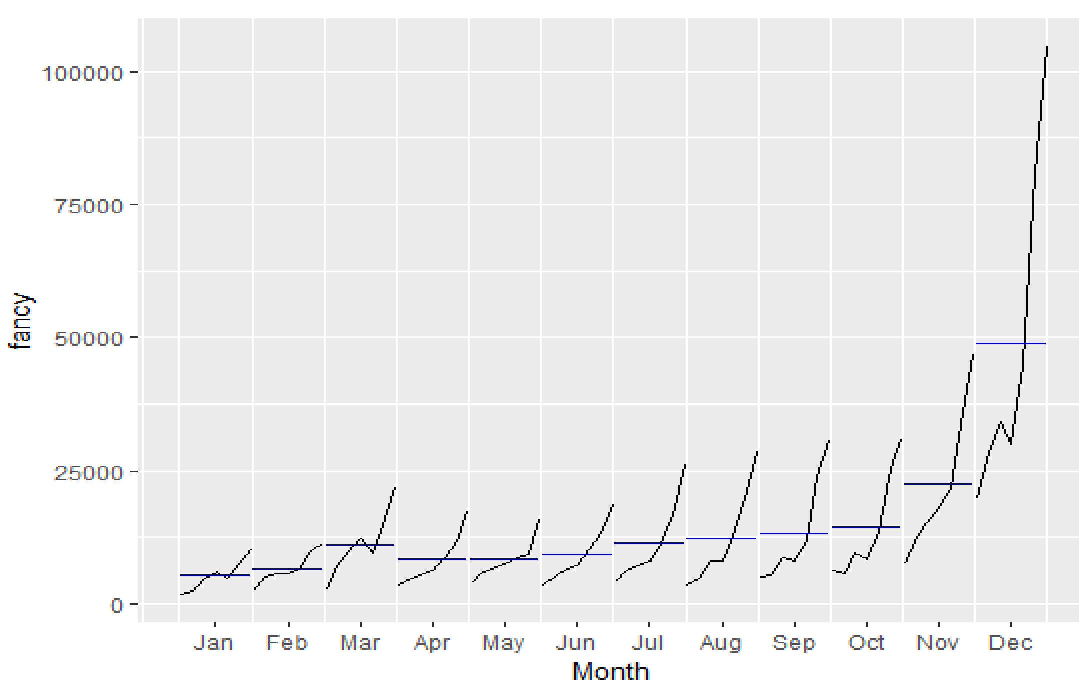


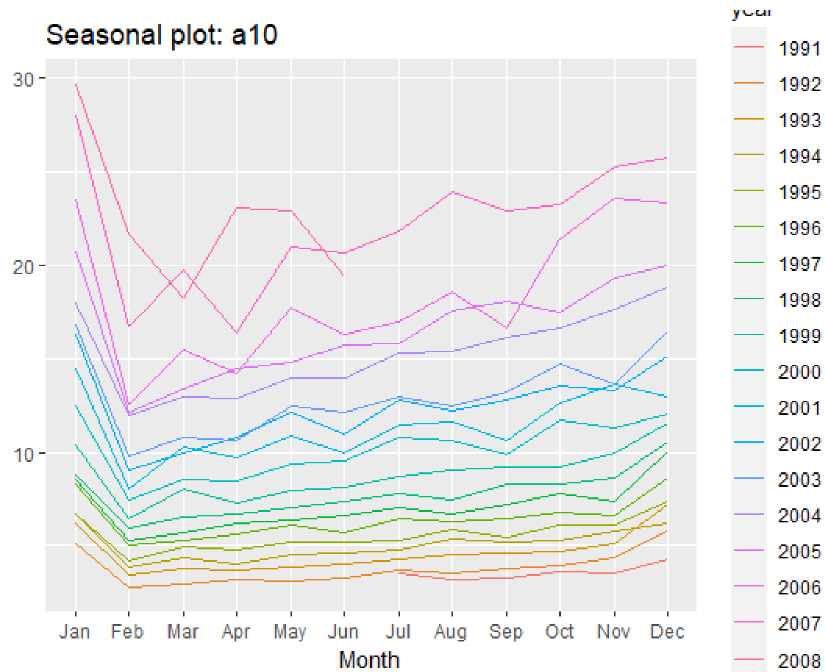
Q5. Use the ggseasonplot and ggsubseriesplot functions to explore the seasonal patterns in the following time series: writing, fancy, a10, h02.

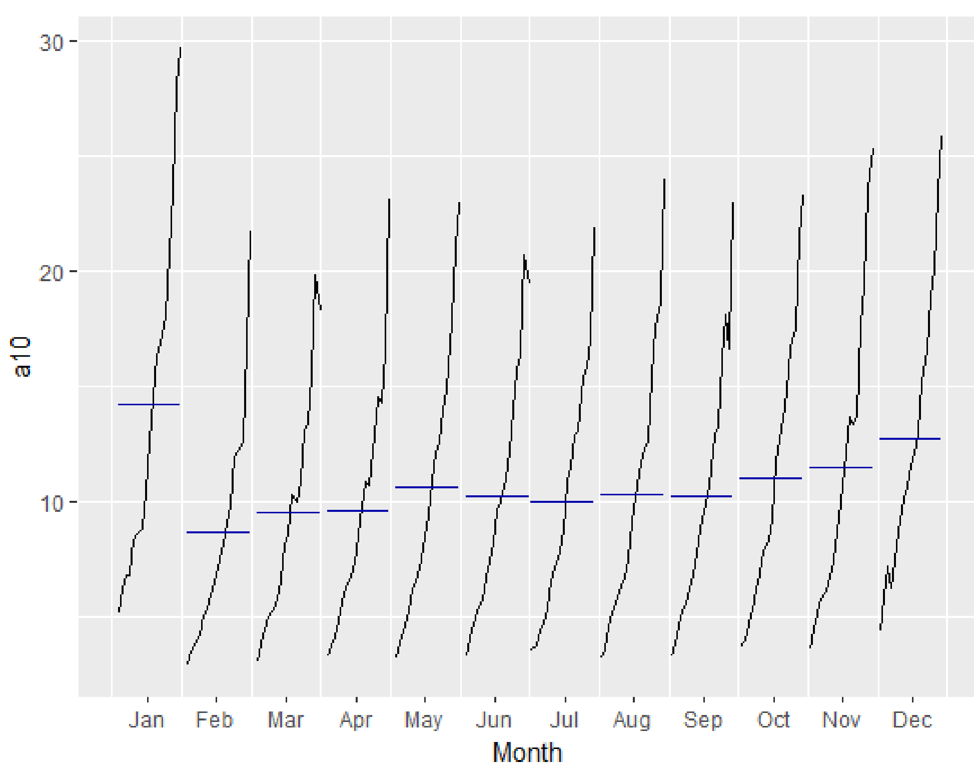


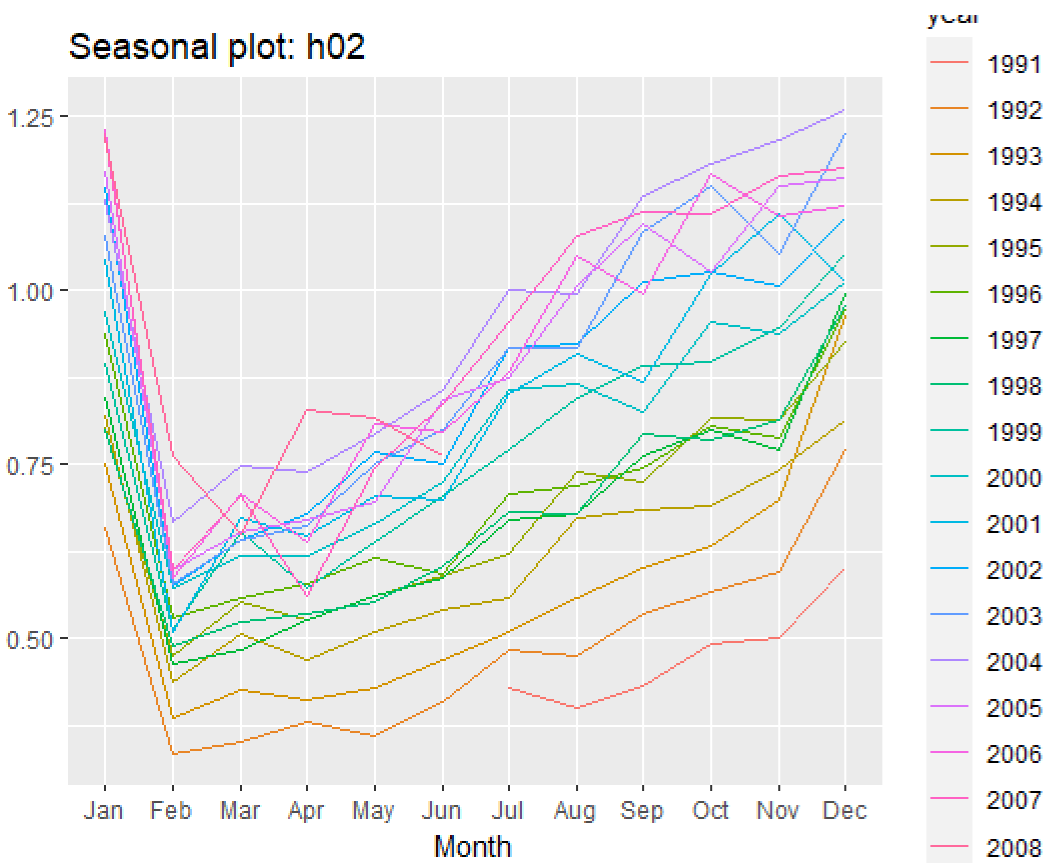



Seasonal plot: fancy
100000
75000
50000
25000
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
year
1987
1988
1989
1990
1991
1992
1993

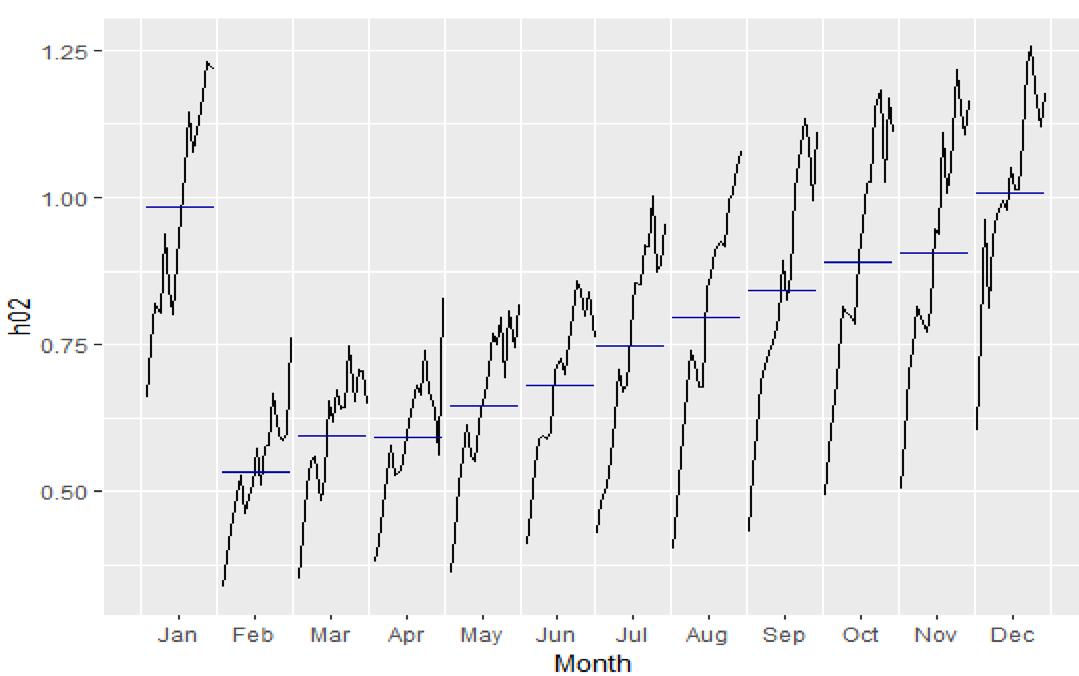

fancy
100000
75000
50000
25000
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month


Seasonal plot: a10
year
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
30
20
10
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Month


a10
30
20
10
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Month



Seasonal plot: h02
year
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
1.25
1.00
0.75
0.50
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month



h02
1.25
1.00
0.75
0.50
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

Codes:

ggseasonplot(writing)

ggsubseriesplot(writing)

The sales amount of paper falls down in August annually

ggseasonplot(fancy)

ggsubseriesplot(fancy)

In December, 1992 the monthly sales for a souvenir shop increased dramatically compared to the same month of the last year

ggseasonplot(a10)

ggsubseriesplot(a10)

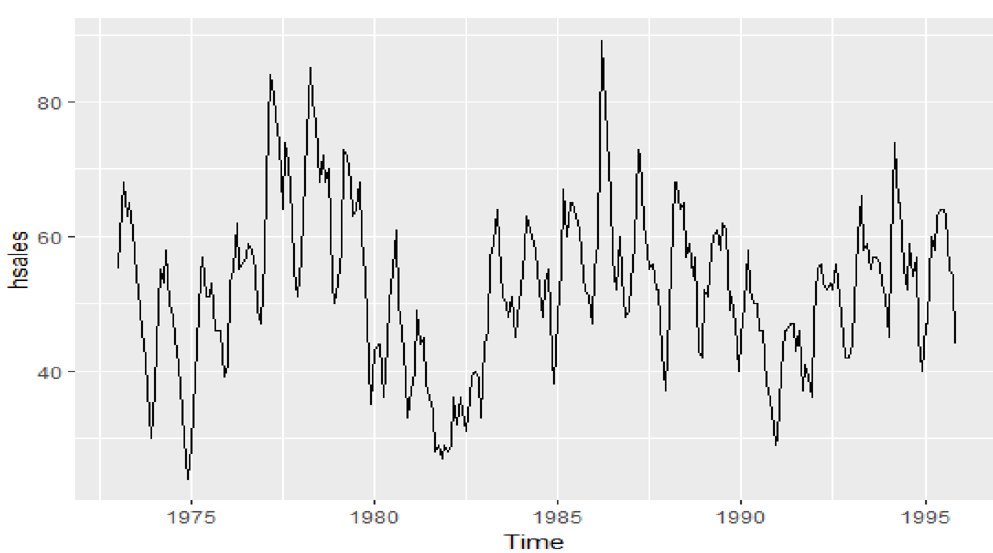
The amount of antidiabetes monthly scripts falls down in February annually

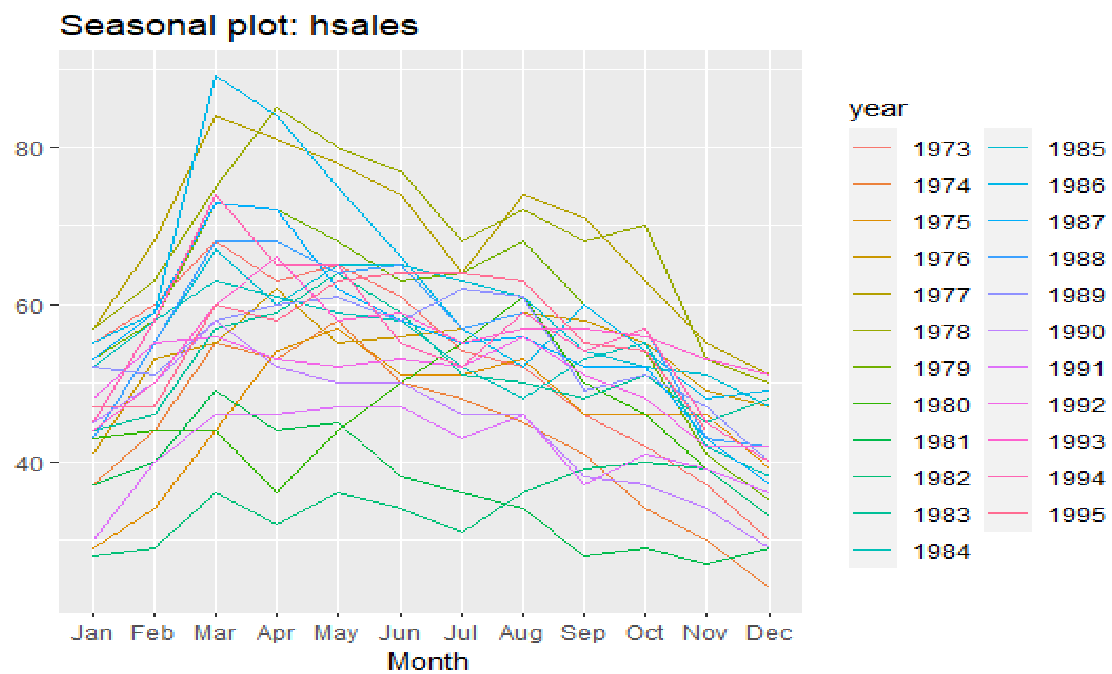
ggseasonplot(h02)

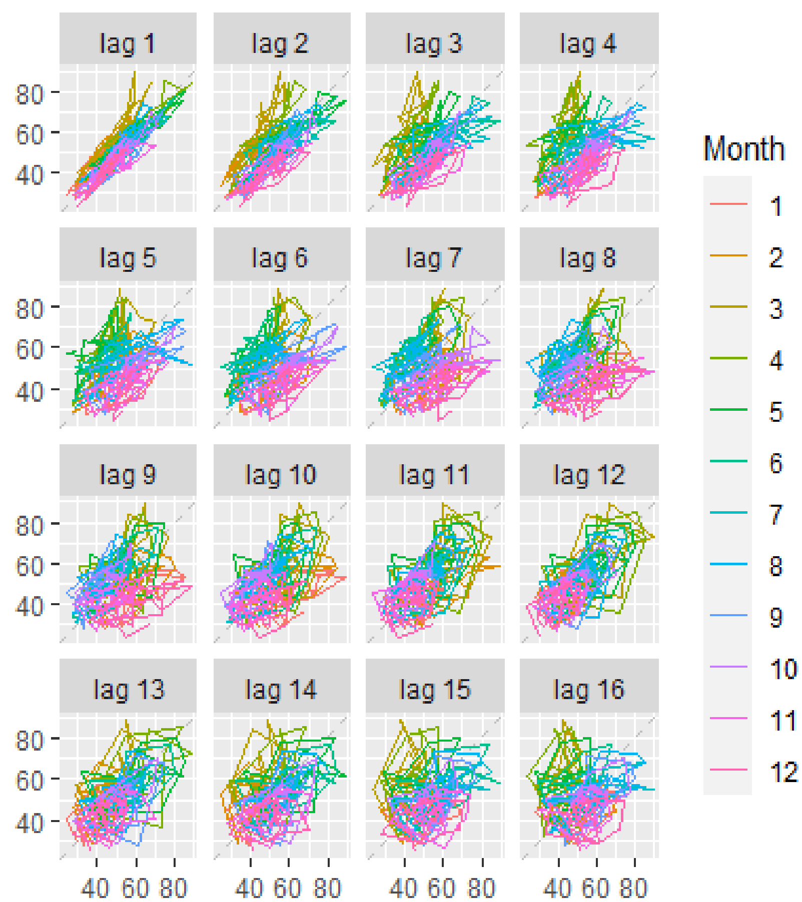
ggsubseriesplot(h02)

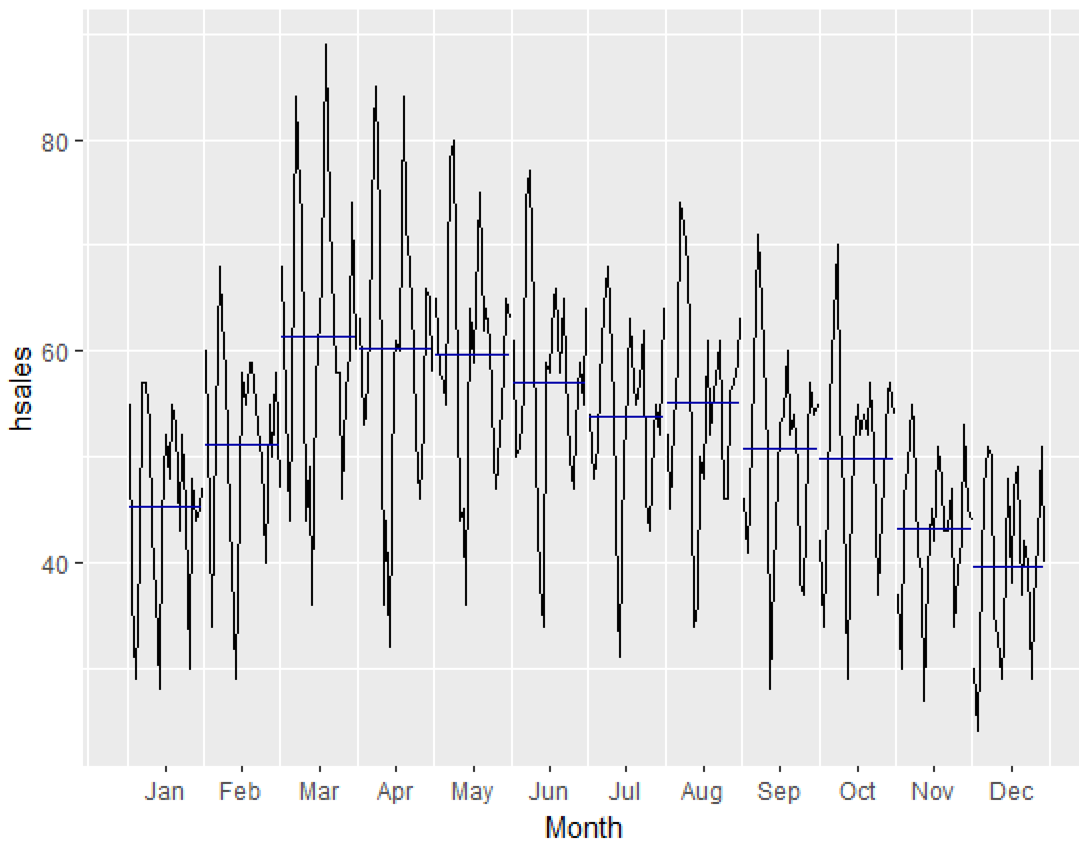
The amount of corticosteroid monthly scripts also falls down in February annually

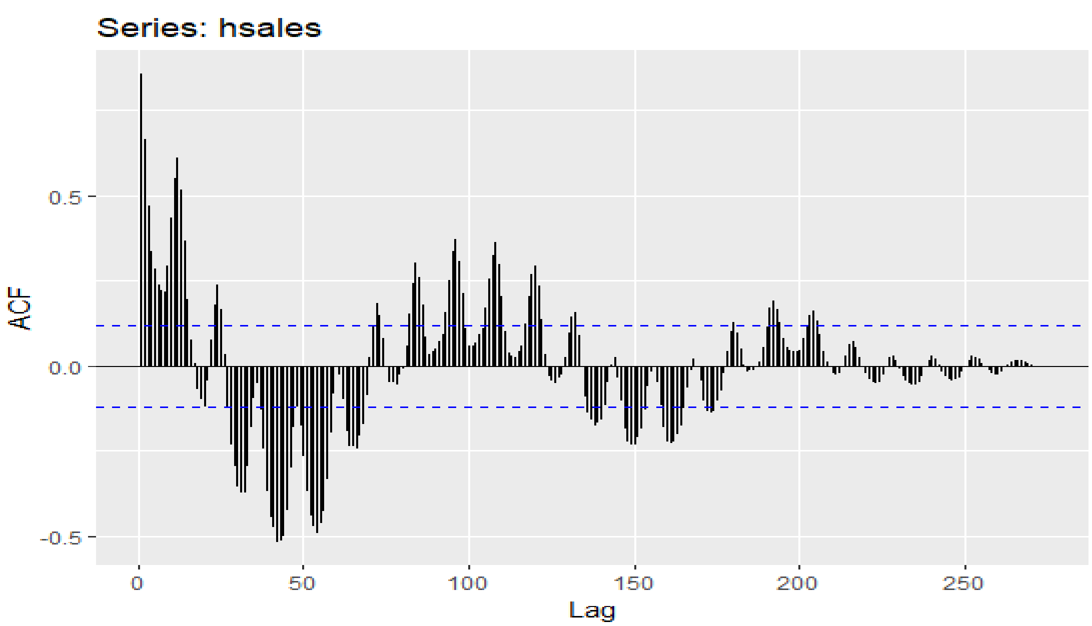
Q6. Can you spot any seasonality, cyclicity and trend? What do you learn about the series?




Seasonal plot: hsales
80
60
40
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Month
year
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995


lag 1
lag 2
lag 3
lag 4
lag 5
lag 6
lag 7
lag 8
lag 9
lag 10
lag 11
lag 12
lag 13
lag 14
lag 15
lag 16
80
60
40
40 60 80
Month
1
2
3
4
5
6
7
8
9
10
11
12


80
60
40
hsales
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month


Series: hsales
0.5
0.0
-0.5
ACF
0
50
100
150
200
250
Lag

Comment:

We can spot seasonality and cyclicity. The cycle period is about 4 years(100 months) for hsales. can spot little seasonality and strong trend for bricksq. can spot strong cyclicity for sunspotarea. The number of weeks is 52 and it looked like it is too much for subseriesplot in gasoline data. We can spot seasonality and trend.

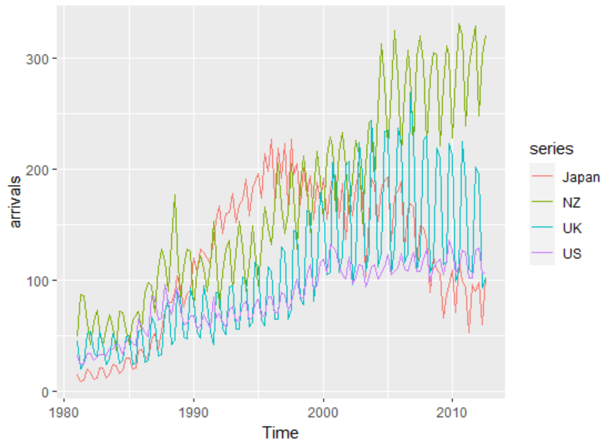
Code:

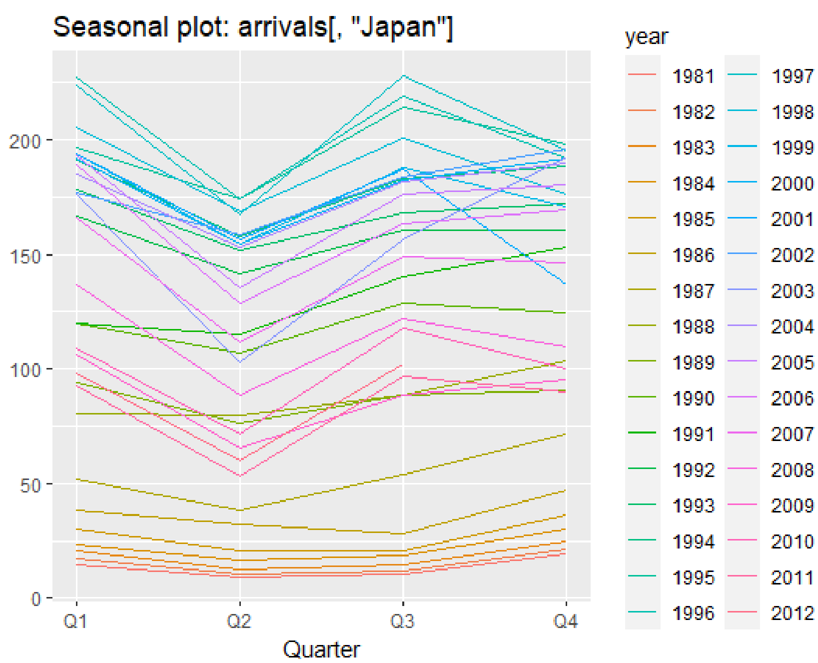
```
autoplot(hsales)
ggseasonplot(hsales)
ggsubseriesplot(hsales)
gglagplot(hsales)
ggAcf(hsales, lag.max = 400)
autoplot(usdeaths)
ggseasonplot(usdeaths)
ggsubseriesplot(usdeaths)
gglagplot(usdeaths)
ggAcf(usdeaths, lag.max = 60)

autoplot(bricksq)
ggseasonplot(bricksq)
ggsubseriesplot(bricksq)
gglagplot(bricksq)
ggAcf(bricksq, lag.max = 200)

autoplot(sunspotarea)
gglagplot(sunspotarea)
ggAcf(sunspotarea, lag.max = 50)

autoplot(gasoline)
ggseasonplot(gasoline)
```

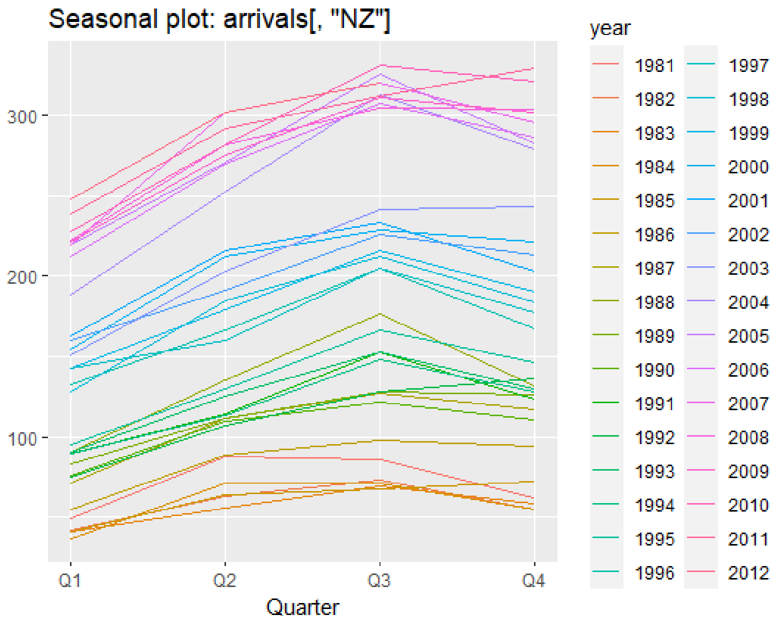
gglagplot(gasoline)

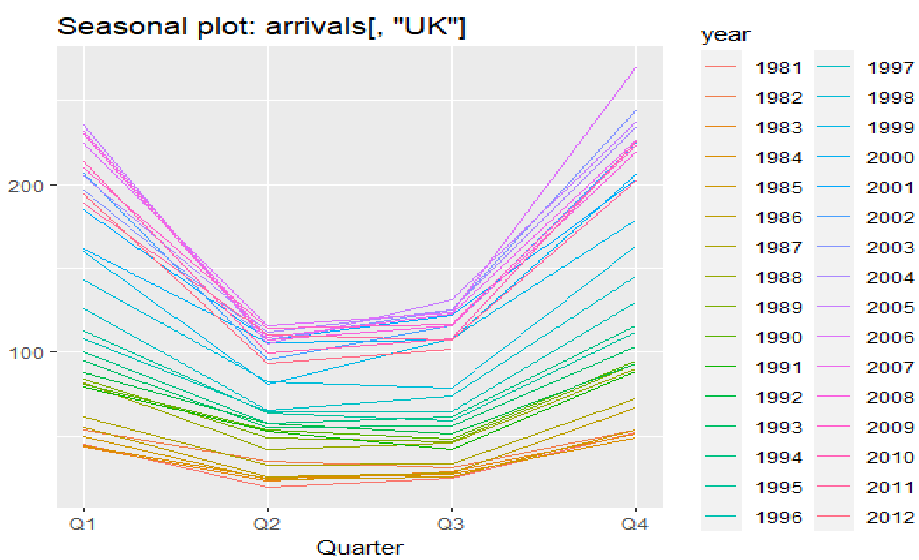
ggAcf(gasoline, lag.max = 1000)

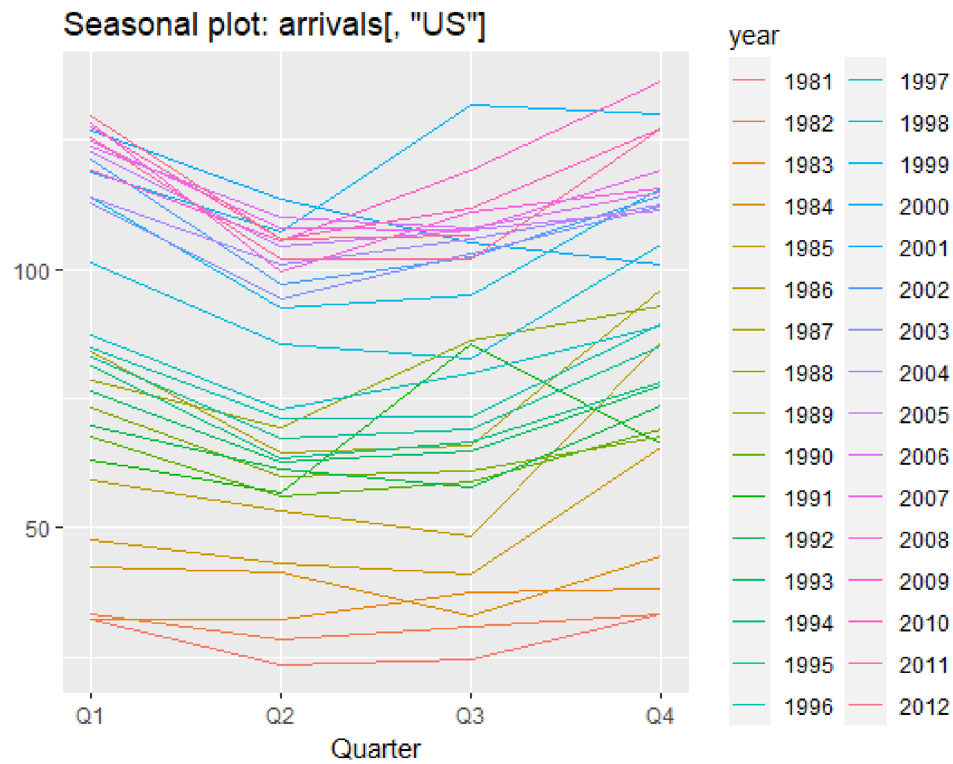
Q7. The arrivals data set comprises quarterly international arrivals (in thousands) to Australia from Japan, New Zealand, UK and the US.

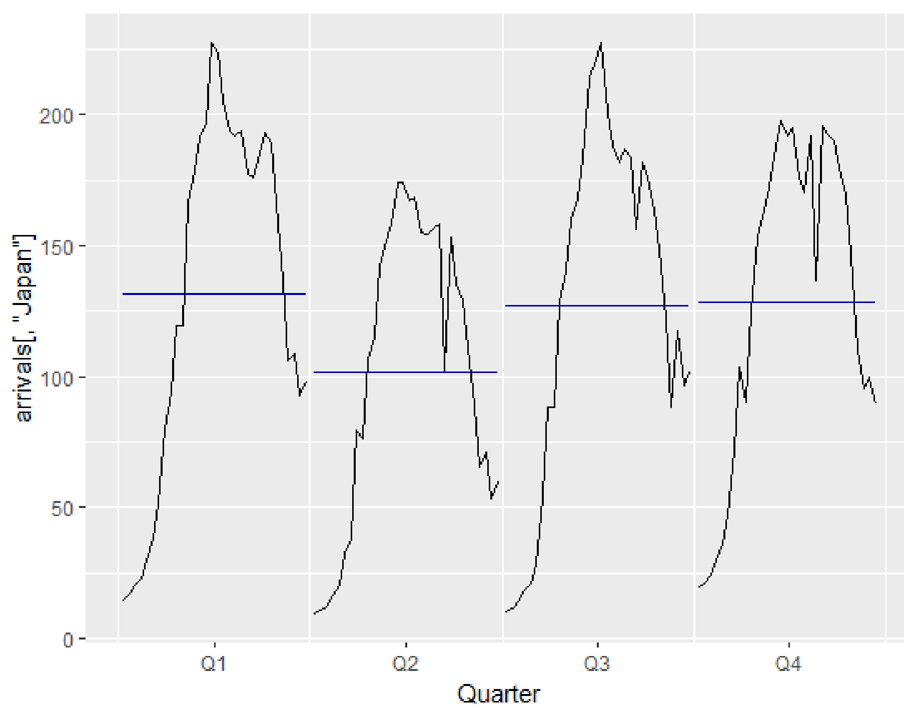


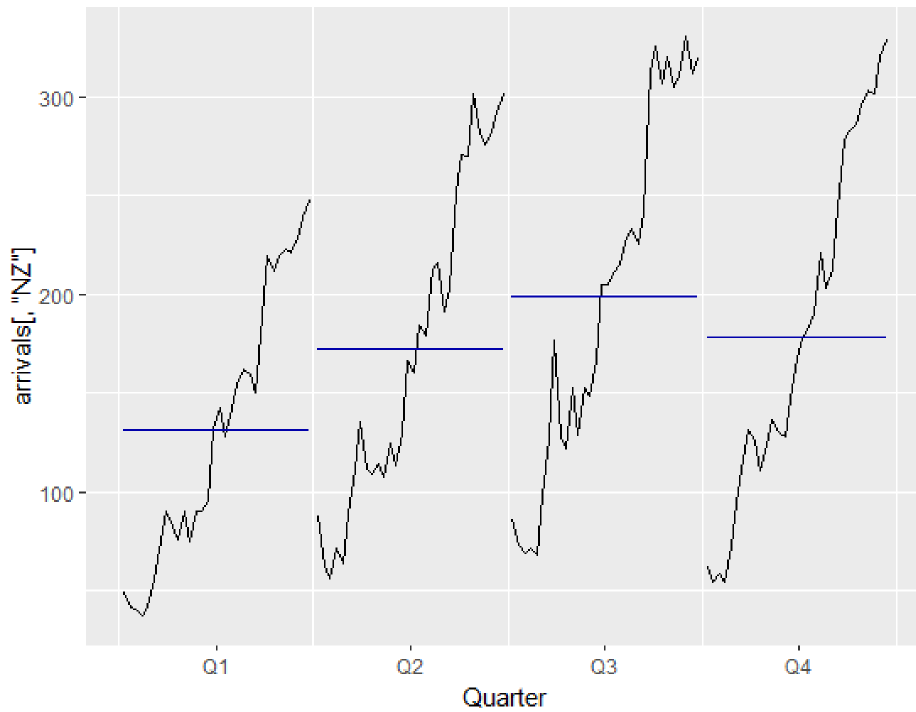



Seasonal plot: arrivals[, "NZ"]
300
200
100
Q1
Q2
Q3
Q4
Quarter
year
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

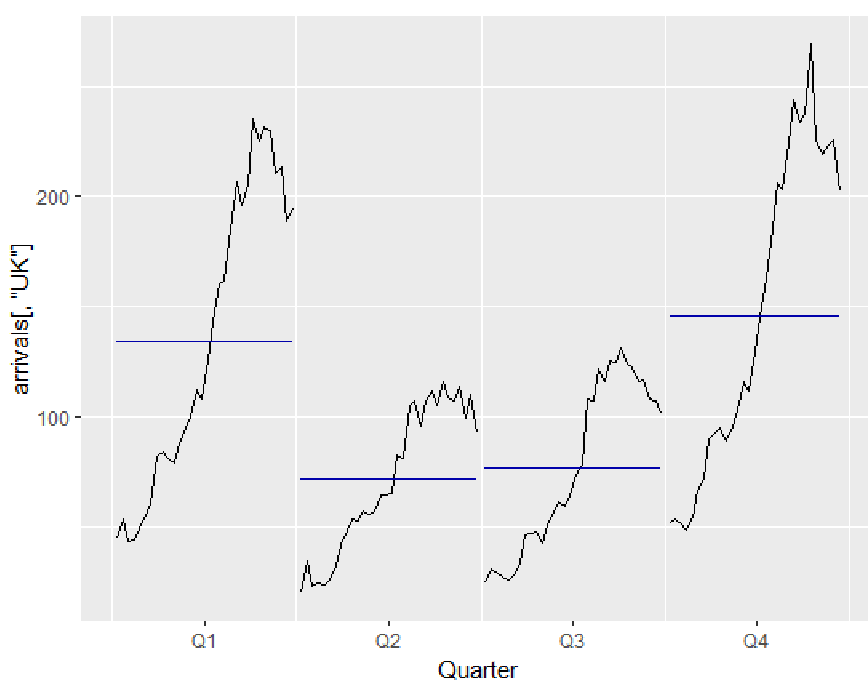

Seasonal plot: arrivals[, "UK"]
200
100
Q1
Q2
Q3
Q4
Quarter
year
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012


Seasonal plot: arrivals[, "US"]
year
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
100
50
Q1
Q2
Q3
Q4
Quarter

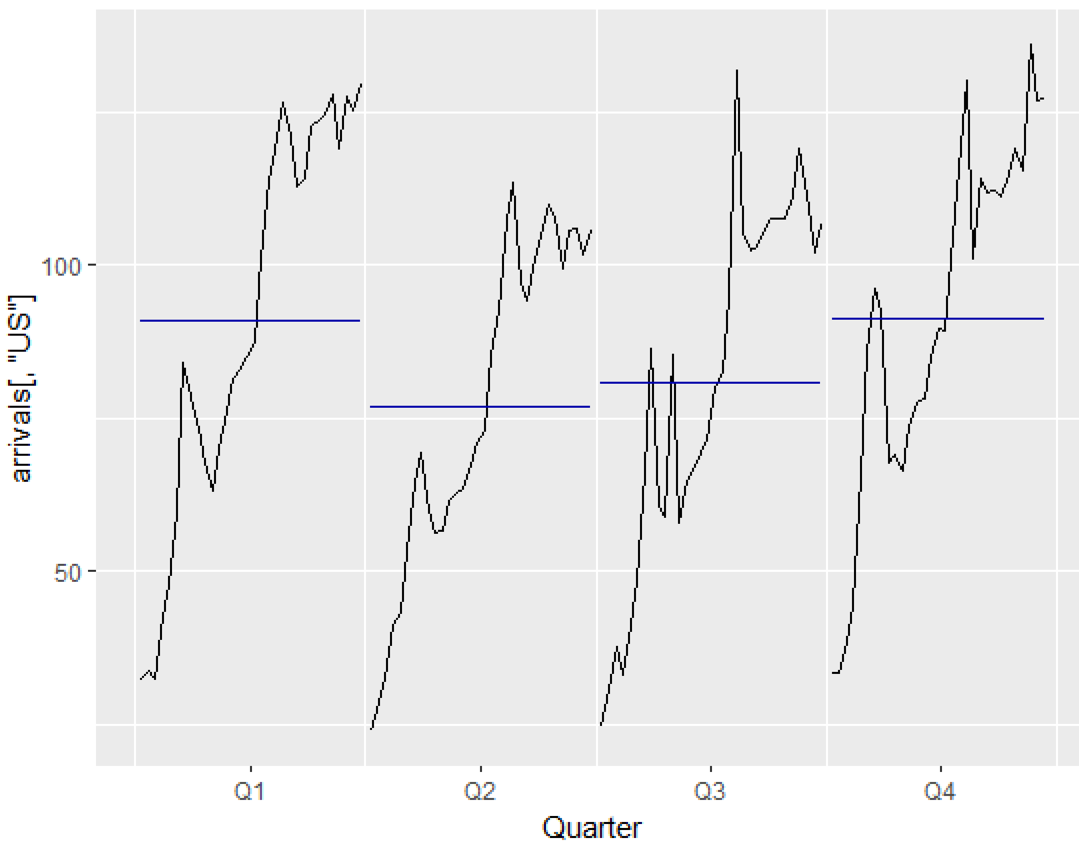

arrivals[, "Japan"]
200
150
100
50
0
Q1
Q2
Q3
Q4
Quarter



300
200
100
arrivals[, "NZ"]
Q1
Q2
Q3
Q4
Quarter



200
100
arrivals[, "UK"]
Q1
Q2
Q3
Q4
Quarter



Comment:

The arrivals from Japan decrease a lot in 2nd quarter compared to the other quarteres.

The arrivals from New Zealand are highest in 3rd quarter and lowest in 1st quarter.

The arrivals from UK and US are low in 2nd and 3rd quarters and high in 1st and 4th quarters.

Code:

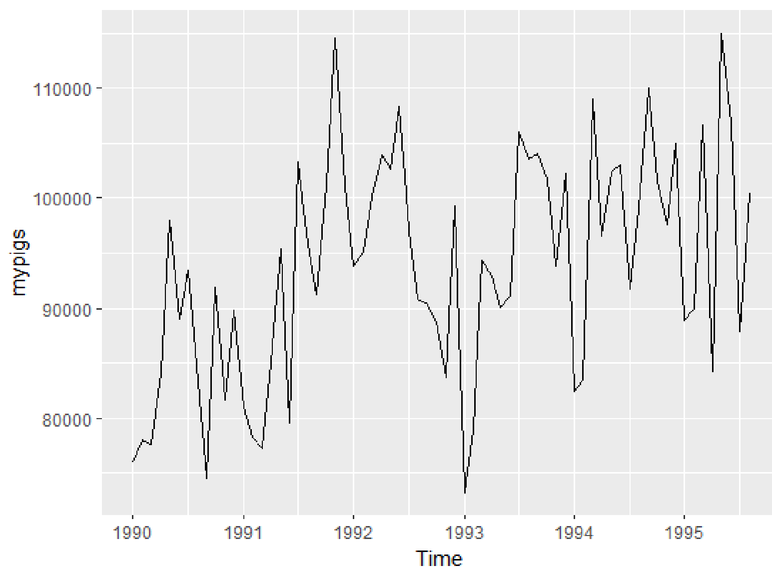
```
ggseasonplot(arrivals[, "Japan"])

ggseasonplot(arrivals[, "NZ"])

ggseasonplot(arrivals[, "UK"])

ggseasonplot(arrivals[, "US"])


ggsubseriesplot(arrivals[, "Japan"])
```

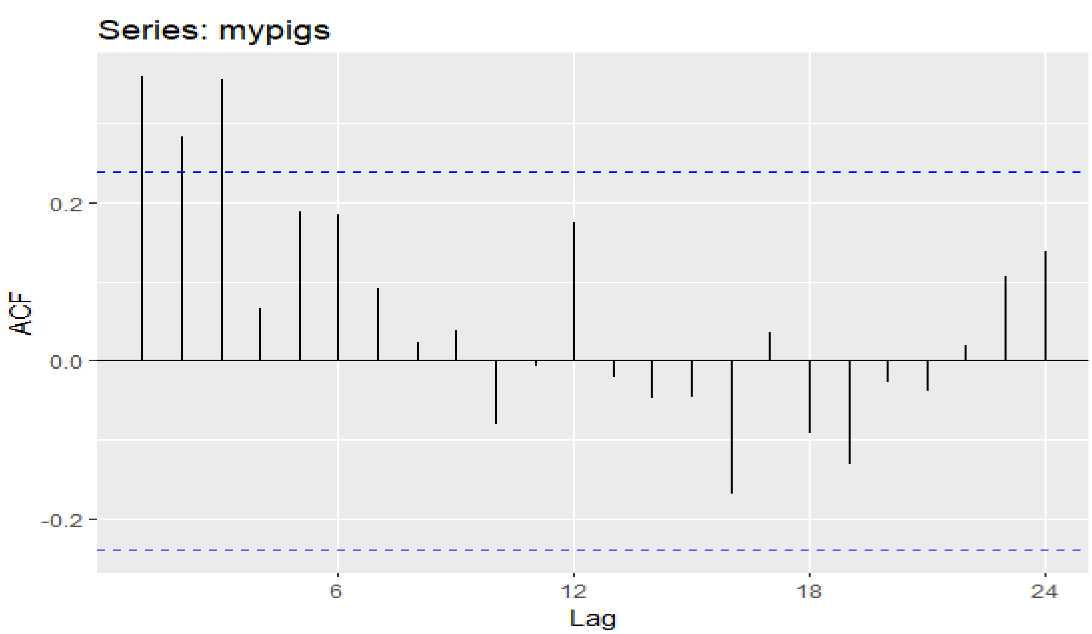
ggsubseriesplot(arrivals[, "NZ"])

ggsubseriesplot(arrivals[, "UK"])

ggsubseriesplot(arrivals[, "US"])

Q8. Use autoplot and ggAcf for mypigs series and compare these to white noise plots from Figures 2.15 and 2.16.





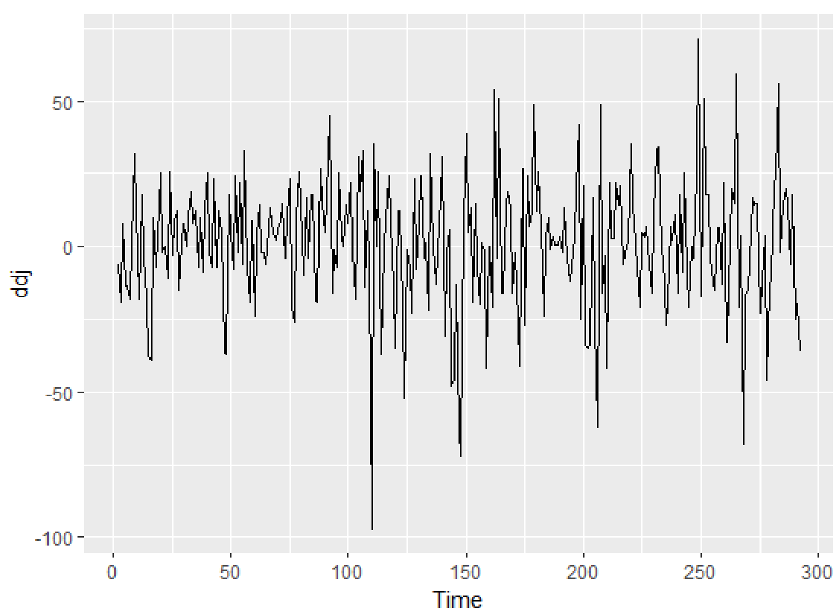
Comment:

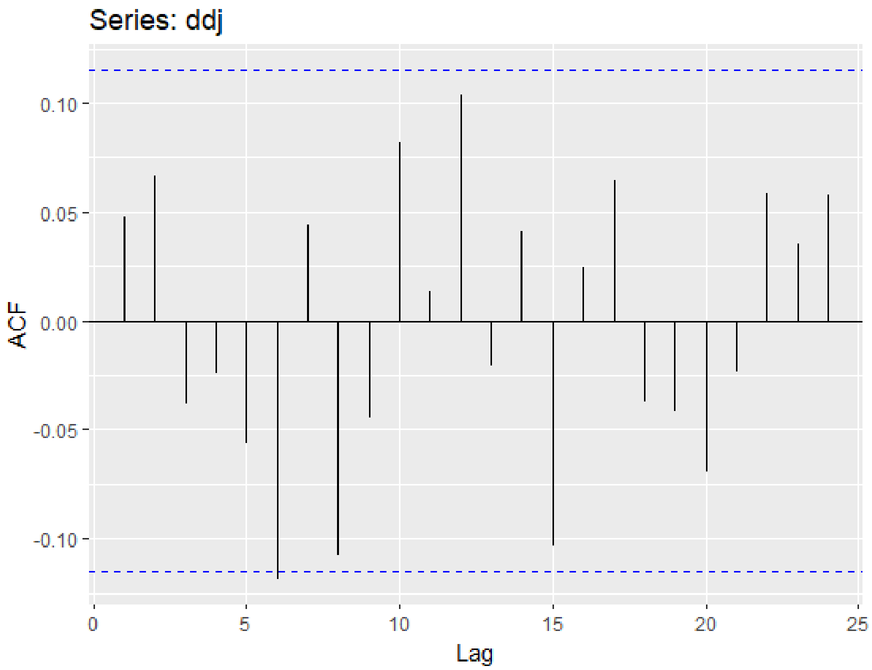
We can find that 3 autocorrelation values were outside of bounds. Therefore mypigs isn't probably white noise.

Code:

```
mypigs <- window(pigs, start=1990)

str(mypigs)


autoplot(mypigs)

ggAcf(mypigs)
```

Q10. **dj contains 292 consecutive trading days of the Dow Jones Index. Use ddj <- diff(dj) to compute the daily changes in the index. Plot ddj and its ACF. Do the changes in the Dow Jones Index look like white noise?**





Comment:

We can find that substantially less than 5% of autocorrelation values were outside of bounds. Therefore ddj can be white noise.

Code:

```
ddj <- diff(dj)

str(ddj)

autoplot(ddj)

ggAcf(ddj)
```