Exercise solutions: Section 2.10

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Trend

- A trend exists when there is a long-term increase or decrease in the data. It does not have to be linear. Sometimes we will refer to a trend changing direction when it might go from an increasing trend to a decreasing trend.

Seasonal

- A seasonal pattern exists when a series is influenced by seasonal factors (e.g., the quarter of the year, the month, or day of the week). Seasonality is always of a fixed and known period.

Cycle

- A cyclic pattern exists when data exhibit rises and falls that are not of fixed period. The duration of these fluctuations is usually of at least 2 years.

If the fluctuations are not of fixed period then they are cyclic; if the period is unchanging and associated with some aspect of the calendar, then the pattern is seasonal.

```
library(fpp2)
```

Ex 2

Download the file tute1.csv from the book website, open it in Excel (or some other spreadsheet application), and review its contents. You should find four columns of information. Columns B through D each contain a quarterly series, labelled Sales, AdBudget and GDP. Sales contains the quarterly sales for a small company over the period 1981-2005. AdBudget is the advertising budget and GDP is the gross domestic product. All series have been adjusted for inflation.

Import dataset tut1.csv into R-studio Global Environment (There is an alternative way to import the data set from the website but you need the correct https address)

tute1 <- read.csv("https://OTexts.org/fpp2/extrafiles/tute1.csv", header=TRUE)

#View(tute1)

a. You can read the data into R with the following script:

If you download the data and set it to the correct directory, tute1.csv will be in your Global Environment. You may use the following command.

```
tute1 <- read.csv("tute1.csv", header=TRUE)
#View(tute1)
```

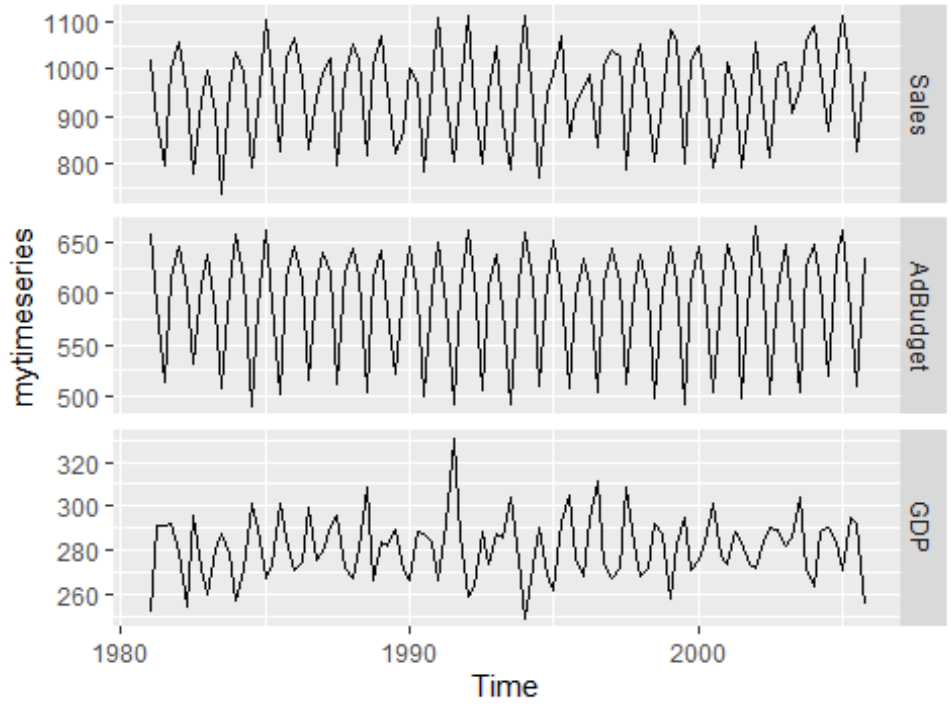
b. Convert the data to time series

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

(The [,-1] removes the first column which contains the quarters as we don't need them now.)

c. Construct time series plots of each of the three series

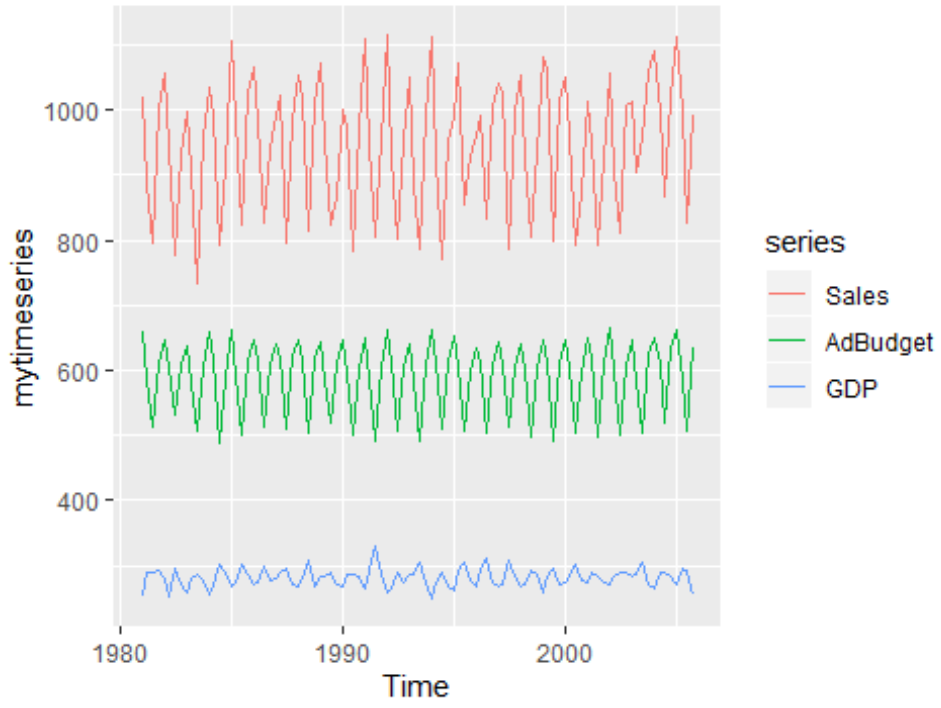
```
autoplot(mytimeseries, facets=TRUE)
```



Check what happens when you don't include facets=TRUE.

Without facets=FALSE, the default is facets=FALSE:

```
autoplot(mytimeseries)
```



Ex 3

Download some monthly Australian retail data from the book website. These represent retail sales in various categories for different Australian states, and are stored in a MS-Excel file.

Import retail.xlsx into the R-Studio Global Environment

a. You can read the data into R with the following script:

```
retaildata <- readxl::read_excel("retail.xlsx", skip=1)
```

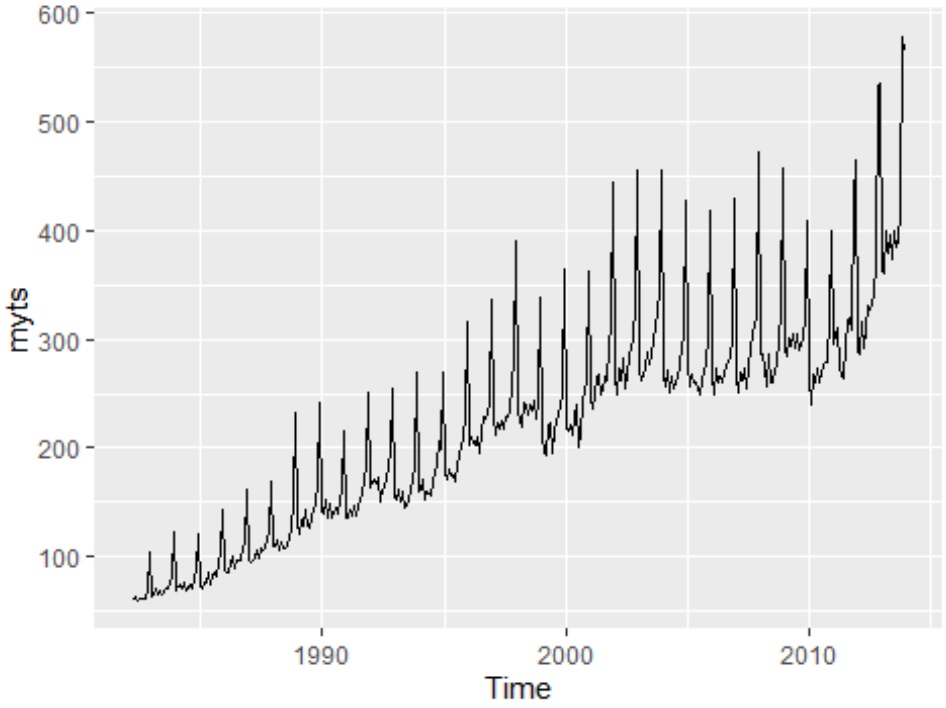
The second argument (skip=1) is required because the Excel sheet has two header rows.

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

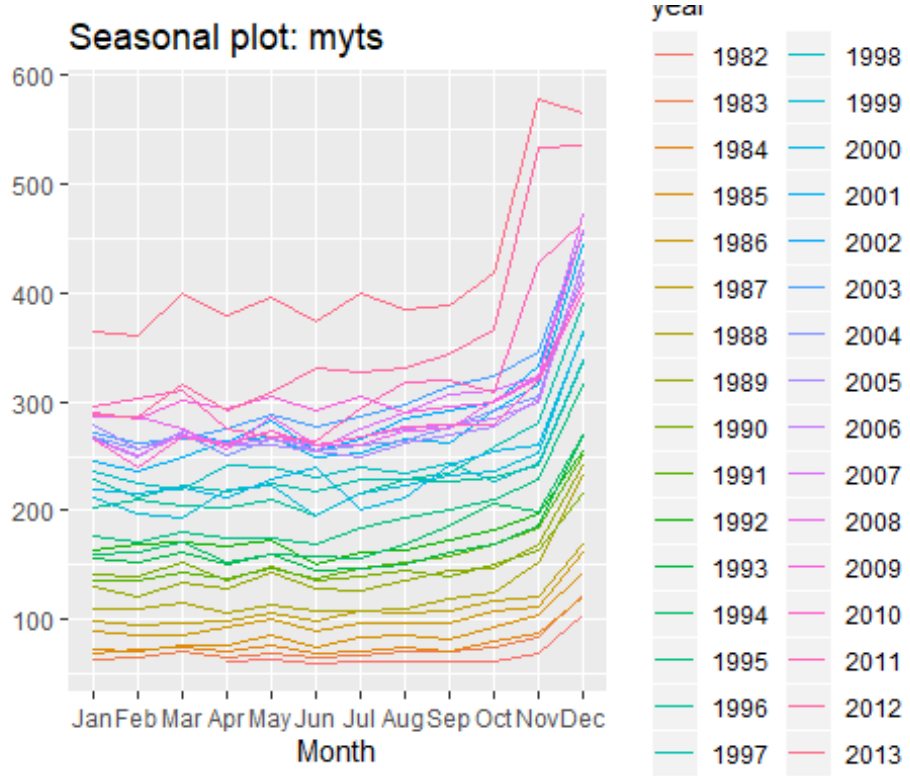
```
myts <- ts(retaildata[,"A3349873A"], frequency=12, start=c(1982,4))
```

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

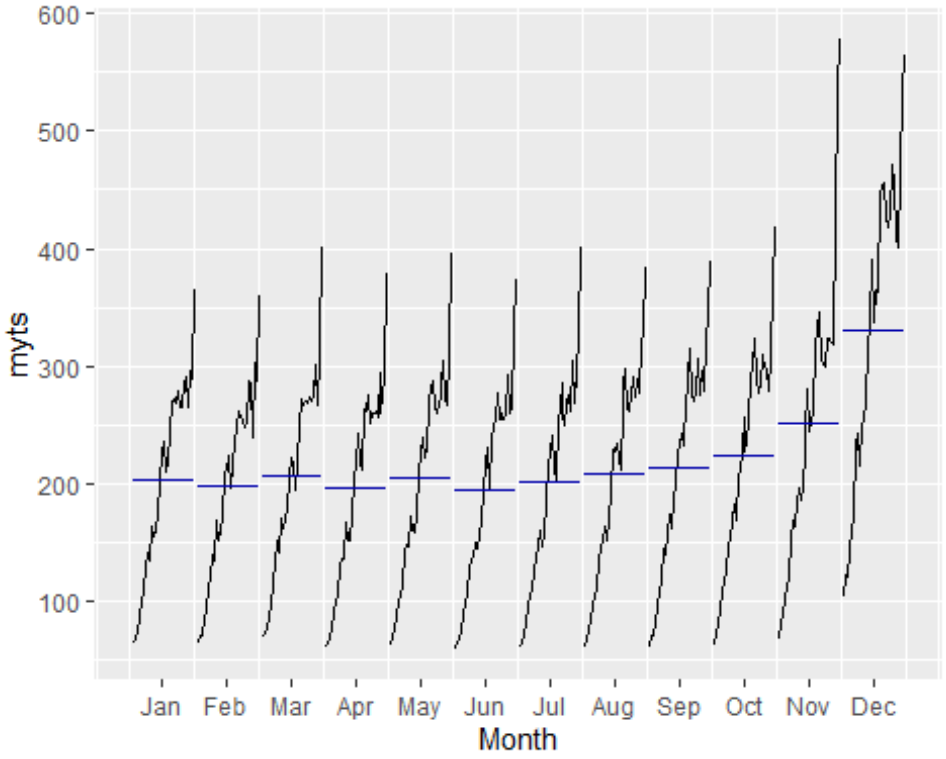
```
autoplot(myts)
```



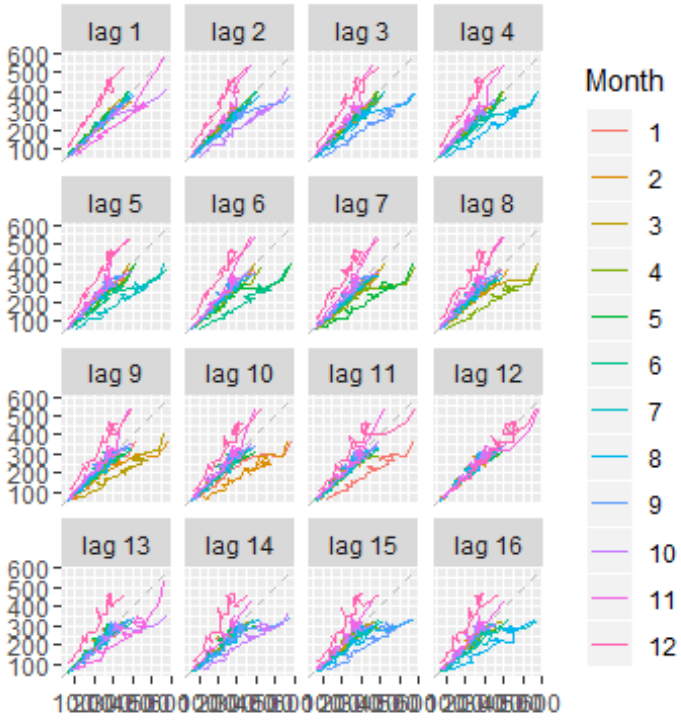

```
ggseasonplot(myts)
```



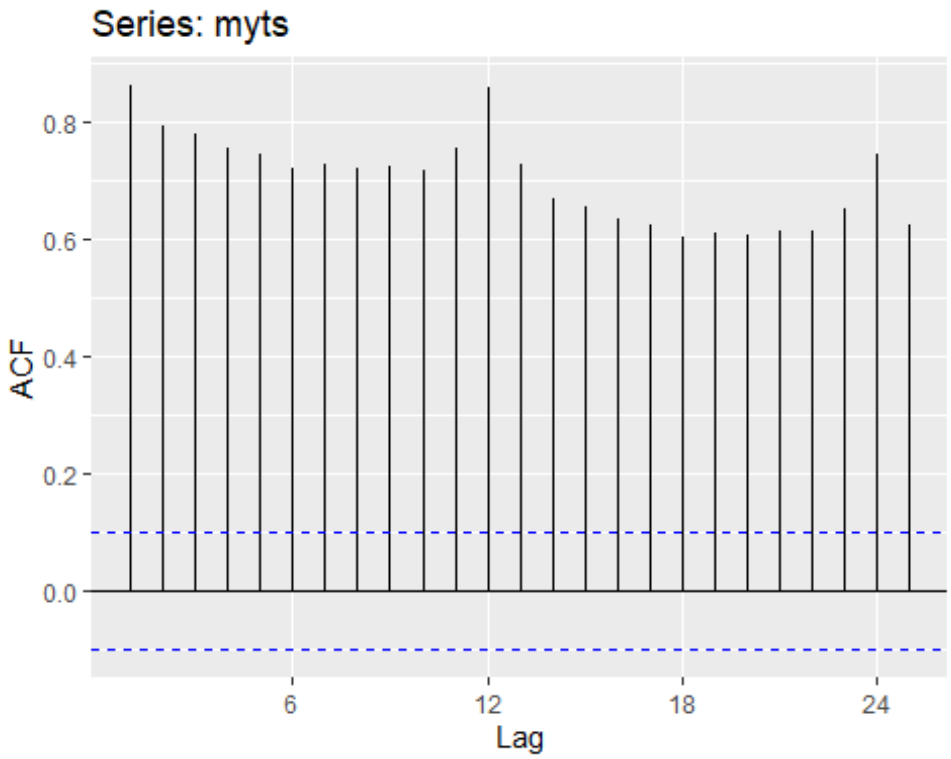

```
ggsubseriesplot(myts)
```



gglagplot(myts) is optional but majority of the students included the graph.



ggAcf(myts)



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

In this example (and yours might be different):

- There is clearly an increasing trend;
- Strong (monthly) seasonality; and
- Increasing variance as the level increases.
- There is little evidence of cyclicity.

Other students discussed the higher end of year sales due to the festive (Christmas) season in Australia.