In this homework, you will need to down load data using quantmod's `getSymbols`. There are 5 sets of stock quotes required for the first part of assignments (ticker symbols are in parentheses):
S&P 500 (^GSPC), Cisco Systems (CSCO), Citigroup (C), Chevron Corp, (CVX), Amazon(AMZN)

- Please download these stock quotes by setting `from = "1991-01-01", to = "2021-02-01"`
- All the price series should be adjusted closing prices.
- All the returns should be log returns based on the adjusted closing price.
- Use `fig.height` or/and `fig.width` at the beginning of a chunk to change the dimensions of plots when necessary.

1. The NASDAQ Composite and S&P 500 are the two most watched indices for representing the US market. The NASDAQ is heavily weighted towards information technology companies. Thus there may have some difference in the series behavior.

   (a) Plot the adjusted closing price and the daily log returns of S&P:
   ```
   plot(Ad(GSPC))
   plot(dailyReturn(Ad(GSPC), type = "log"))
   ```
   You can change the plot title by setting `main`, for example, `main = "Daily Return"`. It is also a good idea to use the 2×1 multiple-plot layout.

   (b) Describe what you see from these two plots. You should include the impacts of those major economic crises/events and the stylized facts. Compare them to those shown in the plots of the NASDAQ on pages 15-16 of Handout 2. If you like to plot your own NSDAQ series for the same period, its ticker symbol is ^IXIC.

2. Consider the 3 individual company stocks, Cisco, Citigroup, Chevron, which are from 3 different industries, tech, banking and oil & gas.

   (a) Plot the adjusted closing price and the daily log returns of each stock.

   (b) Describe the features of these series from the graphs. Find the information (should be easy with internet search) about those prominent features in the series (by comparing to the stock index returns and other sectors).

3. We will focus on the COVID-19 impact by exploring only the period after July 1, 2019, the stock quotes downloaded with `getSymbols()` can be subset. For example,
   ```
   GSPC["2019-07-01::2021-02-01"]
   ```
   will give the quots of S&P 500 of the period of interest.

   (a) Plot the adjusted closing price and the daily log returns of S&P 500 of this period. Describe what you see about the impact of COVID-19 from the plots.

(b) For the individual company stocks, we will add one more company Amazon. Plots the adjusted closing price and the daily log returns of Cisco, Citigroup, Chevron and Amazon. Compare the COVID-19 impact to the that of S&P 500 index and among these 4 stocks.

4. Consider only Chevron in this question (from 1991-01-01 to 2021-02-01, do not subset) .

(a) For Chevron, plot histogram (pages 18-20, Handout 2) and normal probability plot (page 25) of daily-, weekly- and monthly-returns. See Figure 2.3 on page 18 of Handout 2, but we will plot them horizontally. Use a 2×3 multiple plot layout instead of 3×2 with histograms in one row and normal probability plots in another. At the beginning of the chunk, set

```
{r, fig.width = 7, fig.asp = 0.8, echo=FALSE}
```

Some tips for R code.

- The commend `par(mfrow = c(2,3))` will plot 6 plots by rows, command `par(mfcol = c(2,3))` will plot 6 plots by columns.
- You can change the title of a plot by setting `main = "Title you like"`. Change the labels of x-axis (y-axis) by setting `xlab = "Label you like"` (`ylab = "Label you like"`).
- It will be convenient to create an R object including the three return series. The three return series are in different length, can not be put into a matrix. We should use a vector with the "list" model. For example,

```
Rt = list(Daily = dailyReturn(Ad(CVX), type = "log"),
          Weekly = weeklyReturn(Ad(CVX), type = "log"),
          Monthly = monthlyReturn(Ad(CVX), type = "log"))
```

The command `Rt$Daily` or `Rt[[1]]` will return the daily return of Citi, the command `names(Rt)[1]` will return `"Daily"`. You should be able to retrieve weekly and monthly returns. Try writing a loop in R to plot all 6 plots. It is also helpful for part(c).

(b) Compare and comment on the plots you generate in part (a).

(c) Compute the skewness and kurtosis for each return series of Chevron. Test each return series for normality using both the Shapiro-Wilk test and Jarque-Bera tests. You should summarize these statistics. Comment on these statistics, do they agree with your finding from part (b)?

Note: R's shapiro.test does not work for $n > 5000$, skip it if necessary. It also does not take `xts` object, use `as.vector()` or `as.numeric()` to remove `class` of an `xts` object.

Questions 5-6 are based on the daily return of S&P 500 you have downloaded only (from 1991-01-01 to 2021-02-01, do not subset) .

5. Problems 4-5 of RLab §4.10 but with the daily returns of S&P 500 only. Plot the Q-Q plots as describe on the first paragraph of page 79 with a few changes:

- The code in the book is for plotting 4 series and there are 6 plots for each series. We only have one series, thus we will not need double loops. Carefully modify the code. You should have the value

of degrees of freedom as the title for each plot, but the code requires modification (we do not have `index.names[i]`).

- Set `df_grid = 2:7`
- For the plots, both `qqplot()` and `lm()` require changing the daily return to a regular vector using `as.vector()` or `as.numeric()`.
- Use the same multiple layout as part(b) of Problem 2 to have a better aspect ratio.

6. Problems 6-7 of Rlab §4.10 but with the daily returns of S&P 500. Plot the density plot described on page 79 below problem 5. The df in the R code should be the best one you chose in the last problem.

7. §5.20 Exercise 3 and Exercise 5:(a),(b). Equation (5.15) is on page 43 of Handout 3.