Assignment 2

Question 1 : 50 points

1.1 Find the attached **JPM.csv** file. Use **as.Date()** function to change the first column to **Date** object.

1.2 Plot the adjusted close price against the date object (i.e. date object as x-axis and close price as y-axis) in red line (require no points). Set the title as **JPM**, the label for x-axis as **Date** and the label for y-axis as **Adjusted Close Price**.

1.3 Create a scatter plot of close price against open price (i.e. open prices as x-axis, and close prices as y-axis). Set the x label as "Open Price" and y label as "Close Price".

1.4 Use **cut()** function to divide adjusted close price into 4 intervals. Generate a barplot for the frequencies of these intervals.

1.5 Generate a boxplot of volume against the 4 intervals of adjusted close prices.

1.6 Use **par()** function to create a picture of 4 subplots. Gather the 4 figures from 1.2 - 1.5 into **ONE** single picture. Please arrange the 4 subplots into a 2 by 2 frame, i.e. a frame consists of 2 columns and 2 rows. (*Hint.* par(mfrow = c(1,3)) will create a picture of three subplots. In the picture, the subplots are arranged into a 1 by 3 frame.)

Question 2 : (20 points)

Estimate the volume of the unit sphere (which is just $\frac{4\pi}{3}$) by simulation.Suppose we draw N points from three dimensional uniform distribution. In a 3-D coordinate system, the position for the points inside the 1/8 unit sphere is given by

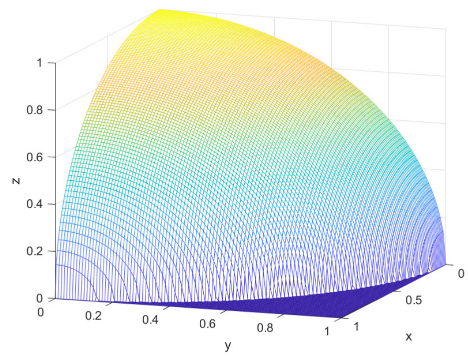
$$x^2 + y^2 + z^2 \leq 1, \qquad x, y, z \geq 0 \tag{1}$$

We can use the frequency of inner points to estimate the volume of 1/8 sphere.

$$\text{volume of } \frac{1}{8} \text{ unit sphere} = \frac{\text{number of inner points}}{\text{number of total points}} \times 1 \tag{2}$$

Then we have the volume of the volume of unit sphere.

$$\text{volume of unit sphere} = 8 \times \text{volume of } \frac{1}{8} \text{ unit sphere} \tag{3}$$



Question 3: (30 points)

3.1 Implement a Linear Congruential Generator (LCG)

$$X_{n+1} = (a * X_n + b) \ mod \ m \tag{4}$$

which generates pseudo-random number from uniform distribution using $m = 244944, a = 1597, b = 51749$. (*Hint.* See details in lecture 5 and example codes.)

3.2 Use the LCG in the previous problem, generate 10000 random numbers from chi-square distribution with 10 degrees of freedom (i.e. df = 10), and assign to a variable. (*Hint.*: X = qnorm(LCG(10000)) will generate a sample of 10000 numbers X which follows normal distribution. For chi-square case, please consider another function **qchisq()**.)

3.3 Visualize the resulting sample from 3.2 using a histogram with 40 bins.