Homework 1

Due: Sunday, Sep 24, 23:59

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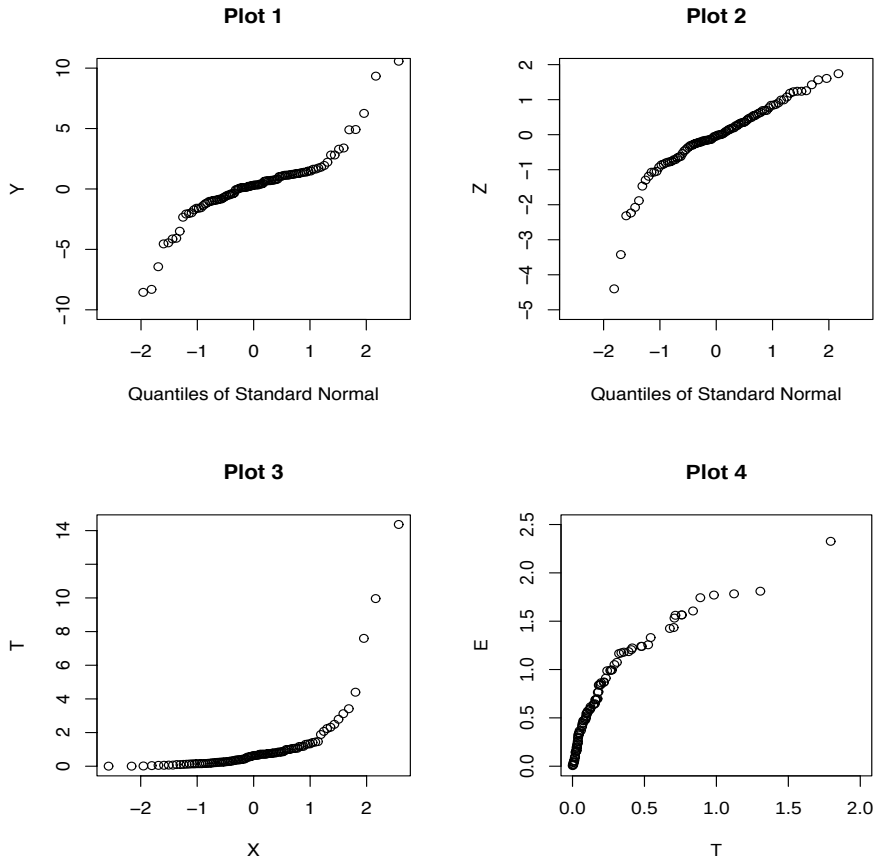
The book by Carmona refers to "Statistical Analysis of Financial Data in R" by René A. Carmona, **2nd edition**.

I. Problem 1.2 on page 63 of the book by Carmona.

II. Give your interpretation of each of the four QQ-plots by filling in the blanks below.

The two plots of the top row were produced with the R command `qqnorm` while the ones in the bottom row were produced with the command `qqplot`.



Plot 1.

• The right tail of Y is _____ (heavier than/lighter than/similarly heavy-tailed to) normal distribution.

• The left tail of Y is _____ (heavier than/lighter than/similarly heavy-tailed to) normal distribution.

Plot 2.
• The right tail of Z is _____ (heavier than/lighter than/similarly heavy-tailed to) normal distribution.
• The left tail of Z is _____ (heavier than/lighter than/similarly heavy-tailed to) normal distribution.

Plot 3.
• The right tail of T is _____ (heavier/lighter) than the right tail of X.

Plot 4.
• The right tail of T is _____ (heavier/lighter) than the right tail of E.

III.

1. Problem 1.9, part 1 on page 66 of the book by Carmona.
2. Use your function `myrexp` to generate a sample of size $N = 1024$ from the exponential distribution with mean 1.5, and use the function `rexp` in R to generate a sample of the same size from the same distribution. Draw a Q-Q plot of the two samples. Are you satisfied with the performance of your simulation function `myrexp`? Explain why.

IV. Download the dataset "**DHSI**" from the course website, which is daily data of Hang Seng Index from 1986-12-31 to 2023-08-18. Conduct the following analysis parallel to what we did in class for S&P500 index.

1. Extract the daily close price of DHSI and name the series as "HSI". Compute log returns of "HSI" and name the series as "DHSILR". Draw time series plots of the index "HSI" and the log returns "DHSILR" (cf. Lect 2 p.4).
2. Draw histograms of DHSILR with bin sizes = 20, 50, 500 and 5000 (cf. Lect 2 p.24).
3. Draw histogram of DHSILR with bin size = 50, and superimpose the fitted normal density curve (cf. Lect 2 p.26).
4. Conduct kernel density estimation of DHSILR with different kernels (Gaussian, rectangular, triangular, and cosine) and plot the results (cf. Lect 2 p.29).
5. Try different choices of bandwidths (0.01, 0.001) for kernel density estimation, and compare the results with histogram with bin size of 100 (cf. Lect 2 p.30).
6. Compute the empirical VaR and the VaR under normal assumption for DHSILR for q=0.01 (cf. Lect 3 p.19).
7. Compute the empirical expected shortfall and the expected shortfall under normal assumption for DHSILR for q=0.01 (cf. Lect 3 p.23).