Stat 577 Homework 2

Due in Canvas using SubmitHW2

Name:

**Total points: 30**

**Note: R code should be provided as an Appendix at the very end of your completed homework. Please write your answers in complete sentences and do not just copy and paste R output in your writings.**

## Question #1 [15 points]

In this problem, we will generated samples to form a bivariate normal data set and verify its normality.

First, set seed to 1234 and generate a random sample of size 50 from a Normal ) distribution. Generate another random sample of size 50 from Normal a ) distribution. Now let us introduce parameters , , , and . Then, use the following transformations to define and variable.

Note that using the above transformations, the variables form jointly a bivariate normal , where ,

Answer the following questions:

1. [5 points] Form data D where first and second column of D are respectively X and Y vector. Find the mean vector and sample covariance matrix for D. (Please do not print data D in your answer)
2. [5 points] Find the Mahalanobis distance for each observation in D and draw a Chi-squared QQ plot of Mahalanobis distance versus the corresponding chi-squared quantiles. Make sure to use appropriate degrees of freedom. Correctly label the axes of your graph and provide the graph below. Does your finding from the graph indicate that jointly follows a bivariate normal distribution? (Note: please do not print Mahalanobis distance in your answer, only provide the QQ plot and your comment)
3. [5 points] Now perform the multivariate Shapiro test for testing multivariate normality at level of significance. Write down the null hypothesis, alternative hypothesis, p-value for the test and your conclusion.

## Question # 2

Various aspects of economic cycles were measured for consumers’ goods and producers’ goods by Tintner (1946). The variables are

= length of cycle, = percentage of rising prices, = cyclical amplitude, and = rate of change.

The data for several items are given in the data “goods” in Canvas Data module. The data is given in text file. The value 1 in column 1 denotes the consumer goods and value 2 denotes the producer goods. If you are new to R and do not know how to import external data in R, follow the steps below:

1. Download the data “goods” from Canvas site and save it in a folder in your device.
2. Open a new R file and import the data using the command goods=read.table(“goods.txt”, header=F). Print goods data to see if it has been uploaded in your R program successfully.
3. Now save this R program in the same folder where you have saved goods data.

Use this data to answer the following questions:

1. [5 points] For the goods data, draw the QQ plot for the Mahalanobis distance and theoretical quantiles from a chi-squared distribution with appropriate degrees of freedom. Label the axes of your plot and paste your figure below. What is your findings about the graph relating to multivariate normality of goods data?
2. [5 points] Perform the Multivariate Shapiro test by writing the null hypothesis, alternative hypothesis, test statistic value, p-value and your conclusion at .
3. [5 points] Now perform univariate Shapiro test to check the normality of each variable in goods data. Write down the p-value for each test and report your conclusion at level of significance, .