2023

Course: Forecasting Engineering

Class: Logistics, ISE

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HCMUT

Instruction: In this 'Lab1' section, guidelines and questions are provided. Students are required to copy these questions into a new MS Word document and type their answers directly below each question. Please name the files as follows:

For the report in Word:

File Report WORD: *Student_Name_Student_ID_Report_ClassID_2023*

(Note: In the filename, replace 'ClassID' with your specific class ID, which could be CC01, L01, or L02)

For the Minitab file:

File Minitab: *Student_Name_Student_ID_Minitab_ClassID_2023*

Note: Ensure that students replace placeholders like Student_Name, Student_ID, and ClassID with their actual details when naming the files.

1. Minitab and Describing Data

Generate one random number and calcuate random variable Z

1. Open Minitab. Generate **ONE random numbers** from a normal distribution with a mean of **JX** and a standard deviation of **JY**, where JX=three last digits of your student ID and JY is an average of 4 last digits of your student ID. For example, a student with the student ID as 2053118 will have JX=118 and JY=3.25; the third digit of your ID = 5

   To do this, here are instructions: Using Minitab: Select "Calc > Random Data > Normal …" In the box labeled "Number of rows of data to generate" type 1. In the box labeled "Store in column(s):" type "C1". In the box labeled "Mean" type JX. In the box labeled "Standard deviation" type JY. Hit enter.

2. Now suppose that number is the mean of a normal distribution that has a standard deviation of 3.4. Submit your answers to the following questions, **showing your work**.

Question 1. *Using following formula 4-10, compute the Z value for that distribution when X = JX - (the third digit of your student ID). For example, a student with the student ID as 2053118 will have X=113.*

If X is a normal random variable with $E(X) = \mu$ and $V(X) = \sigma^2$, the random variable

$$Z = \frac{X - \mu}{\sigma} \tag{4-10}$$

is a normal random variable with $E(Z) = 0$ and $V(Z) = 1$. That is, Z is a standard normal random variable.

Question 2. *Now, using your intuition, determine how many standard deviations (i.e., what multiple of JY) X is from your mean. Using the procedure at formula 4-11 find the p-value of the Z value you found.*

Suppose X is a normal random variable with mean μ and variance σ^2. Then,

$$P(X \leq x) = P\left(\frac{X - \mu}{\sigma} \leq \frac{x - \mu}{\sigma}\right) = P(Z \leq z) \tag{4-11}$$

where Z is a **standard normal random variable,** and $z = \dfrac{(x - \mu)}{\sigma}$ is the **z-value** obtained by **standardizing** X. The probability is obtained by using Appendix Table III with $z = (x - \mu)/\sigma$.

2. Working with Random Variables

1. Open Minitab. Generate 500 random numbers from **a normal distribution** with a mean of JX and a standard deviation of JY, where JX=three last digits of your student ID and JY is an average of 4 last digits of your student ID and store the results in column C1. Label column C1 as "NormX". For example, a student with the student ID as 2053118 will have JX=118 and JY=3.25; the third digit of your ID = 5

2. Make a histogram or stem-and-leaf plot of NormX, using either Graph > Histogram or Graph > Character Graphs > Stem-and-Leaf.

3. The MINITAB command for making a probability plot is Graph > Probability Plot. You specify the theoretical distribution being tested by clicking the button Distribution... and choosing from the list. Also, when you press Distribution... there is a second tab titled Data Display, under that uncheck the box Show confidence interval. Make probability plots for the data “NormX”

4. Bootstrapping is a method used to estimate the sampling distribution by taking multiple samples with replacement from a single random sample. These repeated samples are termed 'resamples'. Each resample is of the same size as the original sample. To perform a resample, navigate to Calc > Resampling > Bootstrapping for 1-sample. Under 'Statistic', select 'Mean'; for 'Sample', choose “NormX”; and for 'Number of resamples', enter '500'."

5. Generate 500 random numbers from a normal distribution with a mean and a standard deviation obtained form **the Bootstrap sample for mean** and store the results in column C5. Label column C5, Norm2.

Question 1. *Describe the distribution of NormX. Does this variable look like it was drawn from a normal distribution? Why is that?*

Question 2. *How does the probability plot for NormX compare to the plot for Norm2? How well do the observations fall along a straight line in each of the two plots?*

6. To generate random data from a Uniform(0,1) distribution, select Calc > Random Data > Uniform. Indicate that you want 1000 rows of data stored in columns C10. Make a histogram or stem-and-leaf plot of the data in column C10. Make a probability plot of the data in column C10. Note: Keep the “Distribution” selection as “Normal”.

Question 3. *Does the plot match the plots you drew in the previous question?*

7. Select Stat > Basic Statistics > Display Descriptive Statistics. Select “NormX”; and click OK.

Question 4. *Describe the distribution of “NormX”; in terms of N (the number of data values), Mean, Median, StDev, Minimum, Maximum, Q1, and Q3 peaks, skewness and outliers.*

8. Go to the Stat > Time Series > Select Autocorrelation. In the dialog box that appears, select the column where you've entered your time series data as “NormX”. Click OK. Minitab will produce an autocorrelation plot, typically showing lags on the x-axis and correlation coefficients on the y-axis. Minitab also provides the Ljung-Box Q test in the session window, which tests the hypothesis that autocorrelations up to a certain lag are equal to zero.

Question 5. *Does the data exhibit specific patterns or significant spikes at various lags? What is your conclusion regarding this series?*

Question 6. *In the Ljung-Box Q test table, are there any significant p-values suggesting the data is not random? Describe a test for the hypothesis that the autocorrelations up to the highest lag are equal to zero.*