**National University of Computer & Emerging Sciences, Karachi**
**Final Exam , Spring-2023 FAST School of Computing**
**June 01, 2023 Thursday 08:30 AM - 11:30 AM**

| **Course Code:MT-2005** | **Course Name: Probability & Statistics** |
|---|---|
| **Instructor Names: Dr. Fahad Riaz, Mr. Abdul Basit, Ms. Alishba Tariq, Mr. Nadeem Khan, Mr. Osama Bin Ajaz, Ms. Urooj** | |
| **Student Roll No:** | **Section No:** |

**Instructions:**

- Answer all the questions. Solutions to problems should be fully explained, using clear English sentences where necessary.
- In case of any ambiguity, you may make assumptions. But your assumption should not contradict any statement in the question paper.
- There are **9 questions and 2 pages**. **Maximum points are 100** and examination duration is **180 minutes**.

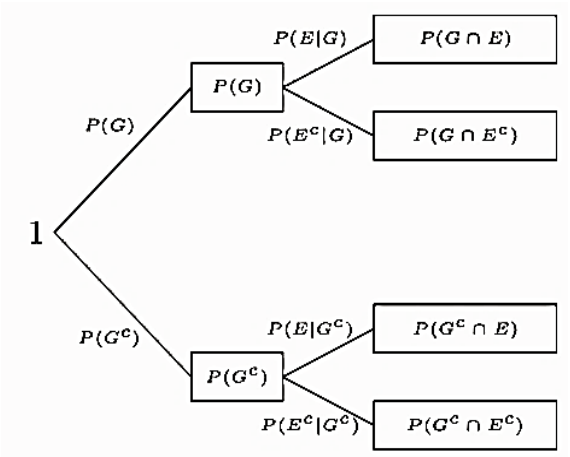
**Question 01: [CLO-1] [10 Marks]**

Find min, max, median, the first quartile, the third quartile, the lower and the upper inner fences and then construct a Box plot for these data.

1196, 785, 1126, 936, 918, 1156, 920, 948, 1067, 1092, 1162, 1170, 929, 950, 905, 972, 1035, 765, 958, 902, 1022, 1333, 811, 1217, 1085, 896, 958, 1311, 1037, 702, 923, 300

**Question 02: [CLO-1] [5+2.5+2.5=10 Marks]**

Consider a communication system. At any given time, the communication channel is in good condition with the probability 0.8 and is in bad condition with probability 0.2. An error occurs in a transmission with probability 0.1 if the channel is in good condition, and with probability 0.3 if the channel is in bad condition. Let G be the event that the channel is in good condition and E be the event that there is an error in transmission.




(a) Complete the tree diagram
(b) Using the tree find $P(E)$
(c) Using the tree find $P(G|E^c)$

**Question 03: [CLO-2] [5+5=10 Marks]**

Suppose that the average household income in some country is 900 coins, and the standard deviation is 200 coins. Assuming the Normal distribution of incomes, compute the proportion of "the middle class," whose income is between 600 and 1200 coins. Further, the government of the country has decided to issue food stamps to the poorest 3% of households. Below what income will families receive food stamps?

| **Z-value** | -1.88 | -1.5 | 1.5 |
|---|---|---|---|
| **Probability** | 0.03 | 0.0668 | 0.9332 |

**Question 04: [CLO-2] [2.5+2.5=5 Marks]**

A program consists of two modules. The number of errors, X, in the first module and the number of errors, Y , in the second module have the joint distribution, P (0, 0) = P (0, 1) = P (1, 0) = 0.2, P (1, 1) = P (1, 2) = P (1, 3) = 0.1, P (0, 2) = P (0, 3) = 0.05. Find

(a) the marginal distributions of X and Y ,
(b) the probability of no errors in the first module.

**Question 05: [CLO-3] [4+6=10 Marks]**

A marketing research analyst collects data for a random sample of 100 customers out of the 4,000 who purchased a particular "coupon special." The 100 people spent a sample average of \$24.57 in the store with a standard deviation of $\sigma = \$6.60$. Before seeing these sample results, the marketing manager had claimed that the average purchase by those responding to the coupon offer would be at least (not less than) \$25.00. (Critical Value= 1.28)

(a) Find the 90% confidence interval for estimating the population mean.
(b) Use critical value approach to check whether this claim can be rejected, using the 10 percent level of significance?

**Question 06: [CLO-3] [4+6=10 Marks]**

An obstacle course was set up on a campus, and 8 randomly selected volunteers were given a chance to complete it while they were being timed. They then sampled a new energy drink and were given the opportunity to run the course again. The "before" and "after" times in seconds are shown. (C.V.=1.895)

| **Student** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| **Before** | 67 | 72 | 80 | 70 | 78 | 82 | 69 | 75 |
| **After** | 68 | 70 | 76 | 65 | 75 | 78 | 65 | 68 |

a) Find the 95% confidence interval for estimating the difference between population mean.

**b)** Is there sufficient evidence at 5% level of significance, to conclude that the students did better the second time? Discuss possible reasons for your results.

**Question 07: [CLO-3] [10 Marks]**

Two salesmen A and B are working in a certain district. From a sample survey conducted by the Head Office, the following results are obtained as shown in Table. State whether there is any significant difference in the average sales between the two salesmen. Assume the populations to be approximately normally distributed. Take level of significance as 10%. Also, interpret the result. (C.V.= 1.688)

| **Salesmen** | **A** | **B** |
|---|---|---|
| Samples size | 20 | 18 |
| Average Sales (Rs. In Thousands) | 170 | 205 |
| Standard Deviation (Rs. In Thousands) | 20 | 25 |

**Question 08: [CLO-3] [10 Marks]**

The independent simple random samples of households energy consumption in the four U.S. regions yielded the data on last year's energy consumptions are shown in the Table. At the 5% significance level, do the data provide sufficient evidence to conclude that a difference exists in last year's mean energy consumption by households among regions? (C.V.= 3.10)

| **Northeast** | **Midwest** | **South** | **West** |
|---|---|---|---|
| 15 | 17 | 11 | 10 |
| 10 | 12 | 7 | 12 |
| 13 | 18 | 9 | 8 |
| 14 | 13 | 13 | 7 |
| 13 | 15 | 10 | 9 |
| 12 | 12 | 8 | 11 |

**Question 09: [CLO-3] [2+(2+5)+3+1+2=15 Marks]**

A study of the amount of rainfall and the quantity of air pollution removed produced the following data shown in Table.

| **Daily Rainfall (0.01 cm)** | 4.3 | 4.5 | 5.9 | 5.6 | 6.1 | 5.2 | 3.8 | 2.1 | 7.5 |
|---|---|---|---|---|---|---|---|---|---|
| **Particulate Removed** | 126 | 121 | 116 | 118 | 114 | 118 | 132 | 141 | 108 |

(a) Plot a scatter diagram of particulate removed as a function of daily rainfall.

(b) Discuss the significance of correlation coefficient at 5% level. ($C.V. = 3.10$)

( c) Find the regression line to predict the particulate removed from the amount of daily rainfall.

(d) Estimate the amount of particulate removed when the daily rainfall is $x$ = 4.8 units.

(e) Find the coefficient of determination and interpret the result.