Rubric

National University of Computer and Emerging Sciences, Lahore Campus				
	Course:	Probability and Statistics	Course Code:	MT2005
	Program:	BS(Computer Science)	Semester:	Spring-2025
	Instructor:	Ms. Kanwal Saleem	Total Marks:	30
	Submission Date:	05-05-2025	Weight	4%
	Section:	BCS-4E	Page(s):	2
	Evaluation:	Assignment-3	Roll No:	
Instruction/Notes:	Attempt All Questions			

Instructions *Follow the instructions carefully otherwise you will lose few marks.*

1. Use A4 size blank pages for solving the assignment.
2. Use only blue/black pen for solving the assignment.

QUESTION 1: (Marks=7+8)

Comparing Execution Times in Two Programming Languages

Your university is evaluating two popular programming languages — Python and JavaScript — for student coding assignments. You've collected data on how long it takes to run code snippets submitted by students. After running performance tests:

- Python execution times are normally distributed with:
  - Mean = 3.2 seconds
  - Standard deviation = 0.6 seconds
- JavaScript execution times are normally distributed with:
  - Mean = 2.8 seconds
  - Standard deviation = 0.5 seconds

The team wants to analyze how efficiently each language performs, especially under a time constraint of under 4 seconds.

Task 1: Efficiency Check (Comparative)

a) What percentage of Python submissions are completed in under 4 seconds?
b) What percentage of JavaScript submissions are completed in under 4 seconds?
c) Which language is more likely to meet the 4-second execution time goal? Support your answer with calculations and interpretation.

Task 2: Identifying Slowest Code Submissions

The IT department wants to focus on improving the slowest 10% of code runs in each language.

a) For Python, what execution time marks the top 10% slowest submissions?
b) For JavaScript, what execution time marks the top 10% slowest submissions?
c) Based on the above, which language has better performance consistency in terms of execution time?

QUESTION 2: **(Marks=7)**

Each time a modem transmits one bit, the receiving modem analyzes the signal that arrives and decides whether the transmitted bit is 0 or 1. It makes an error with probability p, independent of whether any other bit is received correctly. If the probability of error is $p = 0.01$ and the modem transmits 200 bits, what is the probability that at most 3 errors will be observed? (Note: use poisson approximation)

QUESTION 3: **(Marks=8)**

The operations manager of a plant making cellular telephones has proposed rearranging the production process to be more efficient. He wants to estimate the average time to assemble the telephone using the new arrangement. For this purpose, a sample of 15 time points used to assemble the cellular telephone under the new arrangement is provided below:

Assembling Time (in minutes)														
8	6	8	5	9	10	14	15	13	8	11	13	11	10	7

What is a reasonable range of values for the population mean assembling time? Also, interpret the results.

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Sol:

Q1: Task efficiency:

7 Python

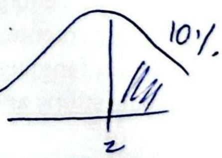
$$P(X<4) = P\left(\frac{X-\mu}{\sigma} < \frac{4-3.2}{0.6}\right) = P(Z<1.33) = 0.9082 \quad \boxed{90.82\%}$$

Javascript

$$P(X<4) = P\left(\frac{X-\mu}{\sigma} < \frac{4-2.8}{0.5}\right) = P(Z<2.4) = 0.9918 \quad \boxed{99.18\%}$$

Javascript is more efficient with 99.18% runs under 4 sec. (2)

8 Identifying slowest code submission



Python

$P(Z>z) = 10\%$

$P(Z<z) = 90\%$

$z = 1.28$ (from table)

$X = \mu + \sigma z$

$= 3.2 + (0.6)(1.28) = \boxed{3.97\ sec}$

Javascript

$P(Z>z) = 10\%$

$P(Z<z) = 90\%$

$z = 1.28$

$X = \mu + \sigma z$

$= 2.8 + 0.5(1.28)$

$= \boxed{3.44}\ sec.$

Javascript is more consistent as its slowest 10% runs starts at 3.44 sec; while Python's start at 3.97 second. (2)

$\therefore$ binomial is also applicable.

P. Q2:

7

Given $P = 0.01$, $n = 200$

as $P \to 0$ & $n \to \infty$, here we use Poisson approximation to find the Probability that at most 3 errors will be observed.

$P(X \leq 3) = P(X=0) + P(X=1) + P(X=2) + P(X=3)$

Probability function of Poisson dist is:

$$P(X=x) = \frac{e^{-\lambda} \lambda^{x}}{x!} \quad 1$$

$\lambda = np = 200 \times 0.01 = 2$ 1

$$P(X=0) = \frac{e^{-2} (2)^{0}}{0!} = 0.1353 \quad 1$$

$$P(X=1) = \frac{e^{-2} (2)^{1}}{1!} = 0.2707 \quad 1$$

$$P(X=2) = \frac{e^{-2} (2)^{2}}{2!} = 0.2707 \quad 1$$

$$P(X=3) = \frac{e^{-2} (2)^{3}}{3!} = 0.1805 \quad 1$$

$$P(X \leq 3) = \boxed{0.8572} \quad 1$$

CS CamScanner

Q3: 8

Given Sample:

8, 6, 8, 5, 9, 10, 14, 15, 13, 8, 11, 13, 11, 10, 7.

To find 95% CI:

$$\bar{x} \pm t_{\alpha/2(\nu)} \frac{s}{\sqrt{n}}$$ 1

$n = 15$, $\nu = 15-1 = 14$ 2

$$\bar{x} = \frac{\Sigma x}{n} = \frac{148}{15} = \boxed{9.8667}$$

$$s = \sqrt{\frac{1}{n-1}\left[\Sigma x^2 - \frac{(\Sigma x)^2}{n}\right]}$$

$$= \sqrt{\frac{1}{14}\left[1584 - \frac{(148)^2}{15}\right]}$$ 2

$$= \boxed{2.9729}$$

$$9.8667 \pm t_{0.025(14)} \frac{2.9729}{\sqrt{15}}$$

1

$$9.8667 \pm (2.145)(0.7676)$$

11.5132, 8.2202.

1 1

The 95% CI for μ is

$$8.2202 < \mu < 11.5132$$

which shows true mean assembling time.