



National University

of Computer & Emerging Sciences Peshawar Campus



Program: BS (CS & SE)
Semester: Spring-2022
Time Allowed: **03 hours**
Course: Probability & Statistics (MT2005)

Examination: **FINAL**
Total Marks: 100, Weightage: **50**
Date: 24/06/2022
Instructors: Osama Sohrab & Askar Ali

NOTE: ATTEMPT ALL PROBLEMS.

Problem # 01

[7]

(Diagnostics of computer codes): A new computer program consists of two modules. The first module contains an error with probability 0.2. The second module is more complex; it has a probability of 0.4 to contain an error, independently of the first module. An error in the first module alone causes the program to crash with probability 0.5. For the second module, this probability is 0.8. If there are errors in both modules, the program crashes with probability 0.9. Suppose the program crashed. What is the probability of errors in both modules?

Problem # 02

[8]

Sketch a stem and leaf plot of the following data and find Interquartile range (IQR) of the data.

82, 89, 94, 110, 74, 122, 112, 95, 100, 78, 65, 60, 90, 83, 87, 75, 114, 85
69, 94, 124, 115, 107, 88, 97, 74, 72, 68, 83, 91, 90, 102, 77, 125, 108, 65

Problem # 03

[10]

An internet service provider charges its customers for the time of the internet use rounding it up to the nearest hour. The joint distribution of the used time (X , hours) and the charge per hour (Y , cents) is given in the table below.

$p(x, y)$		x			
		1	2	3	4
y	1	0	0.06	0.06	0.10
	2	0.10	0.10	0.04	0.04
	3	0.40	0.10	0	0

Each customer is charged $Z = X \cdot Y$ cents, which is the number of hours multiplied by the price of each hour. Find the distribution of Z . (i.e. PMF of Z).

Problem # 04**[10*2=20]**

(a) In a certain population, 85% of the people have Rh-positive blood. Suppose that two people from this population marry. What is the probability that they are both Rh-negative, thus making it inevitable that their children will be Rh-negative?

(b) The lifetime in hours of electronic tubes is a random variable having a probability density function given by $f(x) = a^2 x e^{-ax}$, $x \geq 0$. Compute the expected lifetime of such a tube.

Problem # 05**[15]**

The life span, in hours, of an electrical component is a random variable with commulative distribution function

$$F(x) = \begin{cases} 1 - e^{-x/75}, & x > 0, \\ 0, & \text{elsewhere.} \end{cases}$$

(a) Determine its probability density function.

(b) Calculate the probability that the life span of such a component will exceed 70 hours.

Problem # 06**[10]**

A randomly chosen IQ test taker obtains a score that is approximately a normal random variable with mean 100 and standard deviation 15. What is the probability that the score of such a person is (a) more than 125; (b) between 90 and 110?

Problem # 07**[15]**

The joint probability density function of X and Y is given by

$$f(x, y) = \begin{cases} 2e^{-x}e^{-2y} & 0 < x < \infty, 0 < y < \infty \\ 0 & \text{elsewhere} \end{cases}$$

Compute (a) $P\{X > 1, Y < 1\}$ (b) $P\{X < Y\}$

Problem # 08**[15]**

A product is classified according to the number of defects it contains and the factory that produces it. Let X_1 and X_2 be the random variables that represent the number of defects per unit (taking on possible values of 0, 1, 2, or 3) and the factory number (taking on possible values 1 or 2), respectively. The entries in the table represent the joint possibility mass function of a randomly chosen product. Find $E[X_1]$, $\text{Var}(X_2)$, and $\text{Cov}(X_1, X_2)$.

$X_1 \backslash X_2$	X_2	
	1	2
0	$\frac{1}{8}$	$\frac{1}{16}$
1	$\frac{1}{16}$	$\frac{1}{16}$
2	$\frac{3}{16}$	$\frac{1}{8}$
3	$\frac{1}{8}$	$\frac{1}{4}$