

**MT-2005: Probability &  
Statistics (BSCS)**

**Sessional-II Exam**

**A, B, C, D, E, F, G, H, J, K**

**Total Time: 1 Hour  
Total Marks: 60**

Date: 6<sup>th</sup> April, 2024

**Course Instructor(s)**

Dr. M. Usman Ashraf, Dr. Neelam, Ms. Ammara &  
Ms. Kiran

Commented [WU1]:

Student Name Roll No. Course Section Student Signature

**Do not write anything on the question paper except the information required above.**

**Instructions:**

1. Read the question carefully, understand the question, and then attempt your answers in the provided answer booklet.
2. Verify that you have **two (2)** printed page of the question paper including this page. There are **Five (5)** questions.
3. Calculator sharing is strictly prohibited.
4. **One bonus mark** is given to those students who will solve **each question on separate page**.

**Q1: (a): In a certain federal prison, it is known that  $\frac{2}{3}$  of the inmates are under 25 years of age. It is also known that  $\frac{3}{5}$  of the inmates are male and that  $\frac{5}{8}$  of the inmates are female or 25 years of age or older. What is the probability that a prisoner selected at random from this prison is female and at least 25 years old?** [08 marks]

**Q1: (b): A shipment of 12 television sets contains 3 defective sets. In how many ways can a hotel purchase 5 of these sets and receive at least 2 of the defective sets?** [07 marks]

**Q2: (a) How many three-digit numbers can be formed from the digits 0, 1, 2, 3, 4, 5, and 6 if each digit can be used only once?**  
**(b) How many of these are odd numbers?**  
**(c) How many are greater than 330?** [4+4+2=10 marks]

**Q3: In how many ways can 5 starting positions on a basketball team be filled with 8 men who can play any of the positions?** [05 marks]

**Q4: A construction company employs two sales engineers. Engineer 1 does the work of estimating cost for 70% of jobs bid by the company. Engineer 2 does the work for 30% of jobs bid by the company. It is known that the error rate for engineer 1 is such that 0.02 is the probability of an error when he does the work, whereas the probability of an error in the work of engineer 2 is 0.04. Suppose a bid arrives and a serious error occurs in estimating cost. Which engineer would you guess did the work? Explain and show all work.** [10 marks]

**Q5:** Pollution of the rivers in the United States has been a problem for many years. Consider the following events:

**A:** The river is polluted.

**B:** A sample of water tested detects pollution.

**C:** Fishing is permitted.

Where  $c$  represents compliment of the event.

Assume  $P(A) = 0.3$ ,  $P(B|A) = 0.75$ ,  $P(B|A^c) = 0.20$ ,  $P(C|A \cap B) = 0.20$ ,

$P(C|A^c \cap B) = 0.15$ ,  $P(C|A \cap B^c) = 0.80$ ,

$P(C|A^c \cap B^c) = 0.90$ .

a. Find  $P(A \cap B \cap C)$ .

b. Find  $P(B^c \cap C)$ .

c. Find  $P(C)$ .

d. Find the probability that the river is polluted, given that fishing is permitted and the sample tested did not detect pollution. [05\* 04 = 20 marks]

**Good Luck**

Q.1

(a)

let  $M \rightarrow$  represent that prisoner is malelet  $F \rightarrow$  represent that prisoner is femalelet  $C \rightarrow$  represent that prisoner is under 25 years of age~~Required~~ Given,  $P(M) = \frac{3}{5}$ ;  $P(C) = \frac{2}{3}$ ;  $P(F) = \frac{1}{3}$ 

$$P(F \cup C) = \frac{5}{8} = P(M' \cup C')$$

Required,  $P(F \cap C') = ?$ 

$$\begin{aligned} \text{We can write, } P(F \cap C') &= P(M' \cap C') \\ &= P(M \cup C)' = 1 - P(M \cup C) \\ &= 1 - [P(M) + P(C) - P(M \cap C)] \end{aligned}$$

$$\therefore P(F \cup C') = P(M' \cup C') = P(M \cap C)'$$

$$\begin{aligned} \& P(M \cap C) &= 1 - P(M \cap C)' \\ &= 1 - \frac{5}{8} = \frac{3}{8} \end{aligned}$$

$$\therefore P(F \cap C') = 1 - \left[ \frac{3}{5} + \frac{2}{3} - \frac{3}{8} \right]$$

$$= \frac{13}{120} = 0.108$$

(b)

$$\text{Possible Ways} = \frac{\binom{3}{2} \binom{9}{1}}{\binom{12}{3}} + \frac{\binom{3}{3} \binom{9}{0}}{\binom{12}{3}}$$

$$= \frac{7}{55} \text{ ways}$$



### Question 5

$$\begin{aligned} \textcircled{a} P(A \cap B \cap C) &= P(A) P(B/A) P(C/A \cap B) \\ &= (0.3)(0.75)(0.20) = 0.045 \end{aligned}$$

5

$$\textcircled{b} P(B' \cap C) = R_1 + R_2 = P(R_1) + P(R_2)$$

$$R_2 = P(A \cap B) - P(A \cap B \cap C)$$

$$\begin{aligned} P(R_2) &= P(A \cap B' \cap C) = P(A) P(B'/A) P(C/A \cap B') = (0.30)(0.25)(0.80) \\ &= 0.06 \end{aligned}$$

$$R_1 = P(A' \cap B' \cap C)$$

$$P(R_1) = P(A' \cap B' \cap C)$$

$$P(R_1) = P(A') P(B'/A') P(C/A' \cap B')$$

$$= (0.70)(0.80)(0.90) = 0.504$$

$$P(B' \cap C) = 0.564$$

5

$$\begin{aligned} \textcircled{c} P(C) &= P(R_1) + P(R_2) + P(A \cap B \cap C) + P(A' \cap B \cap C) \\ &= 0.564 + 0.06 + 0.045 + P(A') P(B/A') P(C/A' \cap B) \\ &= 0.564 + 0.06 + 0.045 + (0.70)(0.20)(0.15) \end{aligned}$$

$$P(C) = 0.630$$

5

$$\textcircled{d} P(A/C \cap B') = \frac{P(A \cap B' \cap C)}{P(B' \cap C)} = \frac{0.06}{0.564} = 0.1063$$

### Question 4

$$P(E_1) = 0.70$$

$E_1$  = Engineer I

$$P(E_2) = 0.30$$

$E_2$  = Engineer 2

$E \rightarrow$  error rate

$$P(E/E_1) = 0.02$$

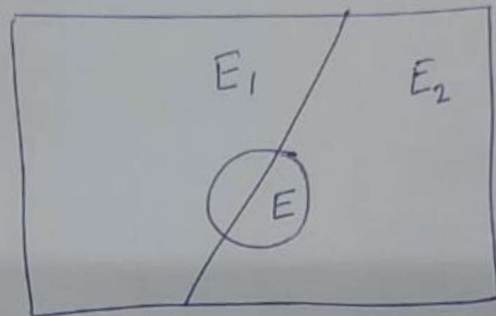
$$P(E/E_2) = 0.04$$

2

$$P(E) = P(E_1 \cap E) + P(E_2 \cap E)$$

$$= P(E_1)P(E/E_1) +$$

$$P(E_2)P(E/E_2)$$



$$P(E) = (0.70)(0.02) + (0.30)(0.04) = 0.026$$

3

$$P(E_1/E) = \frac{P(E_1 \cap E)}{P(E)} = \frac{(0.70)(0.02)}{0.026} = 0.5384$$

2

$$P(E_2/E) = \frac{P(E_2 \cap E)}{P(E)} = \frac{(0.04)(0.30)}{0.026} = 0.461538$$

2

So more likely Engineer 1 did the job.

01

d. Find the probability that the car tested did not detect pollution.

[05-04-20 marks]

### Question # 3

$${}^8P_5 = \frac{8!}{3!} = \frac{8 \times 7 \times 6 \times 5 \times 4 \times \cancel{3!}}{\cancel{3!}} =$$

Good Luck

### Question No. 2

(a)  $5 \times \cancel{6} \times 6 = 180 \rightarrow (4)$

(b)  $5 \times 5 \times 3 = 75 \rightarrow (4)$

(c)  $3 \times 6 \times 5 = 90$  (4, 5, 6)  
 $1 \times 3 \times 5 = 15$   
 $90 + 15 = 105$

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