📘 Assignment: Probability & Bayes’ Theorem

Objective: Strengthen the understanding of classical probability and conditional reasoning through Bayes’ Theorem.

Total Questions: 10

Chapters Covered:

Classical & Conditional Probability

Independent Events

Total Probability

Bayes’ Theorem with real-life use cases

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✅ Instructions:

Attempt all questions showing all steps and formulas used.

Round off answers to 2 decimal places where needed.

Diagrams/Venn may be used wherever necessary.

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🔢 PART A: PROBABILITY (Q1–Q6)

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Q1. Coin and Dice

A fair coin is tossed and a fair 6-sided die is rolled.

👉 Find the probability:

a) Getting a head and an even number

b) Getting a tail or a number greater than 4

c) Not getting head and number less than 4

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Q2. Deck of Cards

From a well-shuffled standard deck of 52 cards, one card is drawn at random.

👉 Find the probability of:

a) Drawing a black face card

b) Drawing a card that is a diamond or a king

c) Drawing a non-ace card

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Q3. Conditional Probability

In a group of 100 people:

60 like tea

30 like both tea and coffee

20 like only coffee

👉 Find the probability that a person:

a) Likes coffee given they like tea

b) Likes tea or coffee

c) Likes neither

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Q4. Probability from Table

A bag contains 5 red balls, 4 green balls, and 3 blue balls. One ball is drawn at random.

👉 Find:

a) The probability it is not green

b) The probability it is either red or blue

c) If two balls are drawn without replacement, what's the probability both are red?

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Q5. Checking for Independence

Events A and B have the following probabilities:

P(A) = 0.6, P(B) = 0.5, P(A ∩ B) = 0.3

👉 Are events A and B independent? Show the formula and reasoning.

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Q6. Total Probability Theorem

A school has 40% students from City A, 35% from City B, and 25% from City C. The probabilities of attending class on a rainy day are:

City A: 0.7

City B: 0.6

City C: 0.9

👉 What is the probability that a randomly selected student attends class on a rainy day?

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🔢 PART B: BAYES’ THEOREM (Q7–Q10)

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Q7. Basic Bayes' Application

A factory has two machines:

Machine A produces 60% of the products and has 2% defect rate.

Machine B produces 40% of the products and has 3% defect rate.

👉 If a product is defective, what is the probability it came from Machine B?

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Q8. Medical Diagnosis Problem

In a population, 1% of people have a disease.

A test detects it correctly 99% of the time (true positive rate). It also gives a false positive 5% of the time.

👉 If a person tests positive, calculate the probability that they actually have the disease. Use Bayes’ Theorem.

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Q9. Email Classification

A spam filter is tested on a batch of emails:

30% of emails are spam

The word “offer” appears in 80% of spam and 10% of non-spam emails

👉 If an email contains “offer”, what is the probability it is actually spam?

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Q10. Student Major Identification

At a university:

40% of students are Engineering majors

30% are Business majors

30% are Arts majors

The probability that a student knows Python is:

0.8 if Engineering

0.3 if Business

0.2 if Arts

👉 If a student is selected at random and they know Python, what is the probability they are from Engineering?