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MC3020 : Probability and statistics

Tutorial-01 **April 2025**

1. A game involves drawing cards from three decks. Deck A has 3 blue cards and 2 green cards. Deck B contains 4 blue and 1 green cards. Deck C comprises 5 blue cards. A card is drawn from Deck A and placed in Deck C. A card from Deck B is drawn and placed in Deck C. Finally, a card is drawn from Deck C.

   (a) Draw a tree diagram to illustrate this game with all probabilities.

   (b) Calculate the probability that exactly two green cards are drawn.

   (c) Given that two green cards are drawn, find the probability that the card from Deck A is blue.

2. In an organization of 300 staff, they are divided among departments like this:

	$Design$	$Production$	$QualityControl$
$Male$	60	80	40
$Female$	50	40	30

   (a) What is the probability of selecting a Production employee given that a male was selected?

   (b) What is the probability of selecting a male given that a Design employee was selected?

   (c) If we randomly select one employee, let X be the event that the selected employee is a female and Y be the event that the selected employee is from the Quality control. Are events X and Y mutually exclusive?

3. A group of 10 people consists of 3 managers and 7 employees. A team of 4 people to be selected randomly. What is the probability that:

   (a) The team includes exactly 1 manager.

   (b) The team has at least 1 manager.

   (c) The team has 3 managers and 1 employee.

4. At a certain assembly plant, three machines make 30%, 45% and 25% respectively of the products. It is known from past experience that 2%, 3% and 4% of the products made by each machine, respectively, are defective. Now, suppose that a finished product is randomly selected. What is the probability that it is defective? And if a product was chosen randomly and found to be defective, what is the probability that it was made by machine 3?

5. At a statistical computing laboratory 35% of all programs submitted are written in 'R'; the remaining 65% are in Matlab. Suppose that 10% of the 'R' programs and 15% of the Matlab programs compile on their first run. What is the probability that the next program submitted will compile on its first run?

6. In a mechanical service center, statistical analysis shows the following probabilities: the probability that a vehicle needs a tire rotation is 0.35; the probability that it needs a brake inspection is 0.50; and the probability that both tire rotation and brake inspection are needed is 0.20.

   (a) If a vehicle needs a tire rotation, what is the probability that it also needs a brake inspection?

   (b) If a vehicle needs a brake inspection, what is the probability that it also needs a tire rotation?

7. Three political parties A, B, and C contested in a province during the recently held election. 30%, 40%, and 20% of the eligible voters were known as supporters of A,B, and C respectively. Records show that only a fraction of supporters actually voted during the election. Only 80% of supporters of A voted and the balance did not vote. Similarly, only 60% of supporters of B and 90% of supporters of C voted. Those who did not support any party did not vote.

   (a) If an eligible voter is chosen at random and it is found that he did not vote in the election, find the probability that he is a supporter of B.

   (b) A second eligible voter is chosen at random and it is found that he also did not vote, what is the probability that both persons are supporters of B?

8. Three plants C_1, C_2 and C_3 produce respectively, 15%, 50% and 35% of a company's output. Although plant C_1 is a small plant, its manager believes in high quality and only 1% of its products are defective. The other two C_2 and C_3 are worse and produce items that are 4% and 5% defective, respectively. All products are sent to a central warehouse. One item is selected at random and observed to be defective, then (we define event D as defective).

   (a) What is the conditional probability that it comes from plant C_1.

   (b) What is the conditional probability that it comes from plant C_2.

9. A survey shows that 56% of all Srilankan workers have a workplace retirement plan, 68% have health insurance, and 49% have both benefits. We select a worker at random.

   (a) What is the probability that he has neither health insurance nor a retirement plan?

   (b) What is the probability that he has health insurance, if he has a retirement plan?

   (c) Are having health insurance and a retirement plan independent events? Are these two benefits mutually exclusive?