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MC 3020: Probability and Statistics

Tutorial: 01 **April 2023**

1. In a certain region of the country, it is known from past experience that the probability of selecting an adult over 40 years of age with cancer is 0.05. If the probability of a doctor correctly diagnosing a person with cancer as having the disease is 0.78, and the probability of incorrectly diagnosing a person with cancer as having the disease is 0.06,
   (a) what is the probability that an adult over 40 years of age is diagnosed as having cancer?
   (b) What are the chances that a person has no cancer but is still diagnosed otherwise?

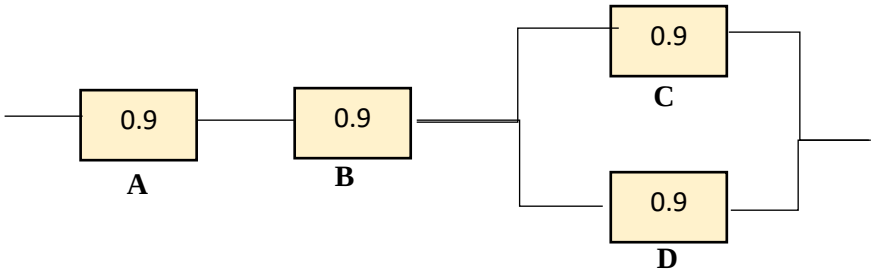
2. A certain federal agency employs three consulting firms (A, B, and C) with probabilities 0.40, 0.35 and 0.25, respectively. From past experience, it is known that the probability of cost overruns for the firms are 0.05, 0.03 and 0.15, respectively. Suppose a cost overrun is experienced by the agency.
   (a) What is the probability that the consulting firm involved is company C?
   (b) What is the probability that it is company A?

3. Suppose we are given three boxes, Box A contains 10 light bulbs, of which 4 are defective; Box B contains 6 light bulbs, of which 1 is defective; and Box C contains 8 light bulbs, of which 3 are defective. We select a box randomly and then draw a bulb from that box at random. What is the probability that the bulb is defective?

4. Machines A and B turn, respectively 10% and 90% of the total production of a certain type of article. The probability that machine A turns out a defective item is 0.01, and the probability that machine B turns out a defective item is 0.05.

   (a) What is the probability that an article taken randomly from the production line is defective?
   (b) What is the probability that an article taken at random from the production line was made by machine A, given that it is defective?

5. An electrical system consists of four components, as illustrated in Figure. The system works if components A and B work and either components C or D work. The reliability (probability of working) of each component is also shown in Figure. Find the probability that the entire system works.



6. Three bags, A, B and C, each contains coloured balls. Bag A contains 4 red balls and 2 yellow balls only. Bag B contains 4 red balls and 1 yellow ball only. Bag C contains 6 red balls only. In a game, Mike randomly takes a ball from bag A, records the colour, and places it in bag C. He then takes a ball at random from bag B, records the colour and places it in bag C. Finally, Mike takes a ball at random from bag C and records the colour.
   (a) Draw the tree diagram to illustrate the game with all probabilities.
   (b) Show that the probability that Mike records a yellow ball exactly twice is 1/10.
   (c) Given that Mike records exactly 2 yellow balls, find the probability that the ball is drawn from bag A is red.

7. Use the following data from the 100 senators from the 108th Congress of the United States:

	Republican	**Democrat**	**Independent**
Male	46	39	1
Female	5	9	0

   (a) If we randomly select one senator, what is the probability of getting a Republican, given that a male was selected?
   (b) If we randomly select one senator, what is the probability of getting a male, given that a Republican was selected? Is this the same result found in (a)?
   (c) If we randomly select one senator, what is the probability of getting a female, given that an Independent was selected?
   (d) If we randomly select one Senator, let A be the event that the selected Senator is a female and B be the event that the selected Senator is a Republican. Are events A and B mutually exclusive?

8. The Engineering student union (ESU) has Seven members: 4 women and 3 men. Three are selected to attend a workshop seminar related ragging awareness program, which is held in Colombo. Find these probabilities.
   (a) All 3 selected will be women.
   (b) All 3 selected will be men.
   (c) 2 men and 1 woman will be selected.
   (d) 1 man and 2 women will be selected.

9. At a large factory, the employees were surveyed and classified according to their level of education and whether they smoked. The data are shown in the table.

	Educational level		
Smoking habit	**Not a high school graduate**	**High school graduate**	**College graduate**
Smoke	6	14	19
Do not smoke	18	7	25

   If an employee is selected at random, find these probabilities.

   (a) The employee smokes, given that he or she graduated from college.
   (b) Given that the employee did not graduate from high school, he or she is a smoker.