Exercise-01   **April 2025**

1. In a batch of 100 final-year engineering students, 54 took Robotics as an optional subject, 69 took Environmental Engineering as an optional subject, and 35 took both Robotics and Environmental Engineering. If one of these students is selected at random, find the probability that:

   (a) the student took Robotics or Environmental Engineering.

   (b) the student did not take either of these subjects.

   (c) the student took Environmental Engineering but not Robotics.

2. From past experience, a stockbroker believes that under present economic conditions a customer will invest in tax-free bonds with a probability of 0.6, will invest in mutual funds with a probability of 0.3, and will invest in both tax-free bonds and mutual funds with a probability of 0.15. At this time, find the probability that a customer will invest

   (a) in either tax-free bonds or mutual funds.

   (b) in neither tax-free bonds nor mutual funds.

   (c) Given that a customer invests in mutual funds, what is the probability that they also invest in tax-free bonds?

3. Interest centers around the life of an electronic component. Suppose it is known that the probability that the component survives for more than 6000 hours is 0.42. Suppose also that the probability that the component survives no longer than 4000 hours is 0.04.

   (a) What is the probability that the life of the component is less than or equal to 6000 hours?

   (b) What is the probability that the life is greater than 4000 hours

4. One bag contains 4 white balls and 3 black balls, and a second bag contains 3 white balls and 5 black balls. One ball is drawn from the first bag and placed unseen in the second bag. What is the probability that a ball now drawn from the second bag is black?

5. A random sample of 200 adults are classified below by sex and their level of education attained.

Education	Male	Female
Elementary	38	45
Secondary	28	50
College	22	17

   (a) Find the probability that the person is a male, given that the person has a secondary education.

   (b) Find the probability that the person does not have a college degree, given that the person is a female.

6. In an office there are two boxes of thumb drives: Box A_1 contains seven 100GB drives and three 500 GB drives, and box A_2 contains two 100 GB drives and eight 500 GB drives. A person is handed a box at random with prior probabilities $P(A_1) = \frac{2}{3}$ and $P(A_2) = \frac{1}{3}$, possibly due to the boxes' respective locations. A drive is then selected at random and the event B occurs if it is a 500 GB drive. Using an equally likely assumption for each drive in the selected box, compute $P(A_1|B)$ and $P(A_2|B)$.

7. A truth serum has the property that 90% of the guilty suspects are properly judged while, of course, 10% of the guilty suspects are improperly found innocent. On the other hand, innocent suspects are misjudged 1% of the time. If the suspect was selected from a group of suspects of which only 5% have ever committed a crime, and the serum indicates that he is guilty, what is the probability that he is innocent?

8. 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, where as 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.