Dilemma of a Sales Executive

Prerequisite Conceptual Understanding

- Basics of Probability
- Probability Distribution.

Synopsis of the Case Study

The case details a decision problem of a sales executive, Jaffer. While he has to meet his targets, he was given a chance to his professional boost in his career by giving presentation for his fellow executives. As Jaffer would not like to miss the target, he would go to Bangalore, only if he is confident of completing the target, which means that he should be working for at least 27 days. This, in turn, means that the number of days that could be lost due to flood or bandh or hartal or Trade Exhibition and conference should not exceed 1, as he needs one day to visit Bangaluru. Therefore, Jaffer needs to compute the probability that no more than one day is lost in the remaining 29 days due to any of the reasons, and if this probability is sufficiently large, he may decide to accept the invitation. The case ends with a question – what should he do?

Pedagogical Objectives

- To introduce the method of structuring a problem in terms of identifying the decision problem(s), the alternatives, the uncertainties that affect the results accruing from each of the alternatives, measuring the consequences and choosing an alternative with the help of a well defined criterion
- To introduce the basic concepts of Probability Theory
- To demonstrate the use of Binomial distribution in resolving complex problems under uncertainty.

This teaching note was written by R. Muthukumar, IBSCDC. It is only an illustrative orchestration of the case study ‘Dilemma of a Sales Executive’. It is never meant to limit the learning outcomes.

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Assignment Questions

I. What decision can Jaffer arrive at? How did he arrive at the decision?

Case Analysis

Basic Concepts of Probability

In order to solve the problem described above, we need to define the following variable: X: Total Number of days lost out of the remaining 27 days. At this point, we may introduce random variables, and also indicate the distinction between continuous and discrete random variables. We can bring to the notice of the students that X is a discrete random variable and that X may take any of the values 0, 1, 2, ..., 29. Now the problem of our interest can be restated using this random variable X as computing the Probability that \( X = 1 \), i.e., the Probability that \( X = 0 \) or 1.

At this stage, we may introduce the events, their probabilities, the basic properties of a probability function, etc. Next, we may define random variables, which are needed in computation of the above probabilities. First, define \( X_i \), \( i = 1, 2, ..., 29 \), where \( X_i = 1 \) or 0, to mention whether \( i \)-th day is lost or not lost. Then, notice that \( X = \sum X_i \), and, \( P(X_i = 1) = P(A_i \cup B_i \cup C_i) \), \( i = 1, 2, ..., 29 \), where \( A_i \) is the event that movement on the \( i \)-th day is restricted due to flood in the city, and \( B_i \) is the event that movement on the \( i \)-th day is restricted due to bandh or hartal in the city and \( C_i \) is the event that restricts movement due to Trade Exhibition. At this stage, we may introduce the probabilities of complements of events, probabilities of union of two events, etc. Using the definition of probabilities of complements of events, we may compute \( P(X_i = 0) \) as \( 1 - P(X_i = 1) \).

We may introduce the independence of events, and justify the independence of \( A_i, B_i \), and \( C_i \) in this case. Hence, we can derive that,

\[
P \left( A_i \cup B_i \cup C_i \right) = P(A_i) + P(B_i) + P(C_i) - P(A_i \cap B_i \cap C_i)
\]

Where \( i = 1, 2, ..., 29 \).

We may, then, compute the corresponding probabilities using the given facts of the case, namely the frequencies of the basic events. At this stage, we can introduce the basic types of Probability, namely, Classical Probability, Relative Frequency of Occurrence and Subjective Probabilities. Using the given case facts, we get the probabilities of \( A_i, B_i \), and \( C_i \) to be \( P(A_i) = 1/30 = 0.03333 \), \( P(B_i) = 14/730 = 0.01918 \) and \( P(C_i) = 15/1095 = 0.013699 \). These probabilities are derived using Relative Frequency approach. Hence, \( P(A_i \cup B_i \cup C_i) = 0.05187 \), \( i = 1, 2, ..., 29 \). Hence, \( P(X_i = 1) = 0.064859 \). As we are interested in \( P(X = 1) \), and since \( X = \sum X_i \), we may introduce the binomial experiments and binomial probabilities.

Introduction of the Concept of Binomial Distribution

Properties of a Binomial Experiment:

a) There are \( n \) Bernoulli trials; each one results in one of two outcomes, say, success (S) and Failure (F)

b) The probability of a success remains constant over trails
c) The trials are independent

d) The random variable of interest is Y i.e., the number of successes in trials. The ordering of successes is not important.

As can be seen in this case, we need to verify the following:

1) Each $X_i$ takes only two values
2) $P(X_i = 1)$ is the same for all $i = 1, 2, ... 29$
3) The events $X_i = 0$ and $X_i = 1$ are statistically independent of $X_j = 0$ and $X_j = 1$, for $i \neq j$. In this case, it can be seen that it is easily verified, while it is reasonable to assume that $P(X_i = 1)$ remains the same on all the days, and that the events of different days are independent. We can now derive the probabilities of a Binomial random variable, and we can emphasise the use of each of the postulates (a)–(c) in deriving these probabilities. Now, we can use this formula of the Binomial Probability to compute the desired probability, and it is given that $P(X = 1) = P(X = 0) + P(X = 1) = 0.430$. Here, again, we can emphasise the use of mutually exclusive events. At this stage, we may also introduce the Poisson distribution and the Poisson approximation to Binomial Probability.

**Recommendations for Decision Dilemma**

As there is a probability of 0.570 of more than one day being problematic during the next 29 days, it may be recommended that Jaffer may drop the programme of going to Bangalore to address his fellow workers. At this stage, we may also point out that the level of confidence desired by the user needs to be clearly defined so as to arrive at a proper conclusion. For example, if Jaffer desires to be 90% (any value above 43%) confident of meeting the target, the recommendation remains the same.