TEACHING STATISTICS IN MANAGEMENT COURSES IN INDIA ®

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Statistics is taught as a core course in the Management programmes leading to the degree of Master of Business Administration (MBA) or an equivalent degree in various Universities and Management Institutes in India. As a part of this course, Probability Theory, and Probability distributions are covered. The students who are admitted to this course are drawn from various disciplines; their level of understanding of mathematical concepts is not uniform, and hence, introducing concepts of the above topics need very careful planning and execution. In this paper, we outline some approaches generally used in teaching these courses, and compare the effectiveness of these approaches. We propose the use of case-based approach to teach some of the basic concepts in Statistics. We also discuss a specific case problem and discuss how this case problem can be effectively used to introduce the concept of Probability and Probability distributions. This method has been found to be quite useful in teaching Statistics in Executive Development Programmes also.

1. INTRODUCTION

In the recent years, Master of Business Administration (M. B. A.) is one of the most sought after courses in India. This course is offered in more than 500 business schools spread over the entire country. This is generally offered as a two-year full-time course. The Post-Graduate Diploma in Management (PGDM) offered by the Indian Institutes of Management (IIM's) is the most popular ones amongst all, and is recognized as equivalent to the M. B. A. course. Students who have graduated in any discipline are eligible to be considered for admission to the MBA (or equivalently PGDM) course. Admission to these courses is very competitive; the students seeking admission to these programmes are screened through a Common Admissions Test (conducted nationwide, and is common to all IIM's and other management schools), personal interview and Group Discussions. Students of this course are drawn from various disciplines such as Arts, Commerce and Science, and professional stream such as Engineering. Profile of the students admitted to Indian Institute of Management Kozhikode in the last 5 batches are given in Table 1.1:

Table 1.1
Academic Background of Students in PGDM at IIMK

Year \ Discipline	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002
Engineering	79 %	61 %	68 %	55 %	80 %
Commerce	8 %	11 %	13 %	18 %	9 %
Arts	5 %	11 %	10 %	10 %	8 %
Science	8 %	17 %	9 %	17 %	3 %

It is believed that work experience would be of great help in learning Management principles. Hence the programme admits students with some work experience. About 60-70% of all students admitted to MBA (PGDM) programme have worked in an organization for about 2-5 years.

During the first year of MBA (PGDM) course, a course on Statistics is offered as a compulsory course. As a part of this course, Probability Theory, Probability distributions, Sampling techniques and Sampling distributions, Statistical Inference (which includes Point and interval estimation and testing of hypothesis), Regression Analysis and Time series Analysis are included. As a result of the varied background of the students, their level of understanding of mathematical concepts is not uniform, and hence, introducing concepts of the above topics need very careful planning and execution.

Most of the books in Statistics (e.g., Levin & Rubin, 1997; Hildebrand & Lyman, 1998; Berenson & Levine, 1996) introduce the concepts of probability, random variables and probability distributions through class room examples such as coin-tossing experiments, or throwing of a die or playing cards etc. However, the students do not find the relevance of these examples with reference to management. Hence, they loose interest in learning these concepts, and this kind of a lack of interest continues till the end of the course, even though, a lot of examples related to management are discussed at a later stage. As a result, the students become less motivated, and they go through the course so as to get a grade in the programme, implying that no learning takes place.

It is, therefore, suggested in this paper to introduce a motivating example which involves a real life problem of a decision maker, and through this problem, motivate and define the various concepts such as random variables, mutually exclusive events, probability and probability distributions, etc. To this end, it is suggested that a good case (a problem well stated along with the decision environment) be presented to the students so that they appreciate the need for studying these concepts and realize the importance of the statistics methodologies in solving complex problems in decision making.

In this paper, we introduce a case problem and outline the objective of the case, and explain how the case can be effectively used to make the students realize the importance of these concepts. In Section 2 of the paper, we give the description of the case, which can be used as a motivating problem to introduce the concepts of probability and distributions. In Section 3, we present how to introduce the concepts using this case, and in Section 4, we give concluding remarks on the use of this method for introducing other concepts in Statistics, and compare the effectiveness of the above method.

2. INTRODUCTION OF PROBABILITY CONCEPTS THROUGH A CASE

A case is a short description, in numbers and words, of an actual management situation. Most cases stop short of presenting all of the actions taken by the manager in the real-world situation. They thus leave open to the student the selection of an action or a set of actions that should be taken. It is expected that students will study cases, come to their own conclusions about what should be done, and then discuss the cases in class and/or write papers describing and defending their suggested courses of action. A good case almost puts the student into the position of the real-world manager, facing the challenge to make a decision and prepare a plan of action. Since the students are interested in solving the problems given in the case, if we introduce the basic concepts required to solve this problem, they would show a lot of interest in learning these concepts. This method has been found to be quite effective in teaching the concepts of Management to the students as well as to executives (see Reynolds, 1980). In this section, we introduce a case "The Problem of a Medical Representative". This case is based on a problem encountered by a professional associate of the author, and the author's advice was sought on the issue. The objective of the case is to introduce to the students the need to study the concept of probability and learn to use them in decision making.

2.1 THE PROBLEM OF A MEDICAL REPRESENTATIVE

Mr. Muralidharan Nair, a sales representative of WKPIL (Well known Pharmaceuticals India limited) is one of the promising representatives located in Kozhikode City in South India. He has won several awards for his excellent job of meeting the targets. Last year, he has also won the National award of BEST REPRESENTATIVE of the year.

One of the most important jobs of the medical representatives is to meet the practicing doctors and introduce to them some of their new products, and discuss with them about their advantages over the other existing products. As the awareness of the doctors about the products of WKPIL has a direct relation to the sales, the company fixes targets on the number of doctors to be visited over a period of time. WKPIL has a policy of finalizing the annual as well as quarterly targets in consultation with the concerned officials. The company believes that this is the best way of involving the entire organization in the decision making process, and it is observed that the officials become more accountable and are generally bound by the decision as they were part of the decision making process. To meet the current target, considering the number of visits that can

be made per day, Mr. Nair needs to meet 100 more doctors in Kozhikode in the 27 days that is remaining in the quarter.

The regional manager of Western Region, Mr. Saurav Deshpande, has extended an invitation to Mr. Nair to address and interact with his fellow representatives, in the current term, highlighting the factors that helped in his achievements. The company feels that this will be a motivating factor for other representatives. The venue for this meeting is identified as Pune, which is about 800 k.m.'s away from Kozhikode. Mr. Nair needs a day exclusively for this purpose. Mr. Nair knows that he requires at least 25 days to complete his target. As such, it looks it is possible to take a day off required to go to Pune. However, he is also aware that he cannot walk on a tight rope like this, because there are some of the days during which he cannot travel to meet the doctors due to the following exhaustive reasons.

a) In this region, some political or social organizations announce bandh or hartal, as a mark of protest against some policy of the Government or to highlight a specific problem facing the society. During these days, there is a total restriction on movement of the public. And, therefore, during the days when a bandh or hartal is declared, Mr. Nair will not be able to meet the doctors.
b) And also during the current season (viz. monsoon season) when it rains quite heavily some parts of the city gets flooded with water. As a result of this, some of the roads get blocked, and, hence, on these days again Mr. Nair will not be able to meet the doctors.

Since Mr. Nair is not willing to miss the target, he wants to make sure that he works for at least 25 days to meet the target. At the same time, he is very keen to go to Pune to address his fellow workers in Western region, as this will be a professional boost to his career, and in the process, he may help his fellow workers also to excel. In order to ensure that he gets enough working days, he wishes to find out the frequency of the happenings of these two events. After scanning through the newspapers of the last two years, Mr. Nair observed that during the monsoon there is a one in 30 chance that, on any day in this season, the roads are blocked due to flood in the city. He also observed from the records of the civic administration that the movement in the city was restricted due to bandh or hartal, etc. for 14 days in the last 2 years viz., about 730 days. What conclusion did Mr. Nair arrive at? What are the methods Mr. Nair used to arrive at this conclusion?

3. TEACHING NOTE TO THE CASE

Teaching objectives of the case are:

i) 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.
ii) To introduce the basic concepts of Probability Theory
iii) To demonstrate the use of Binomial distribution in resolving complex problems under uncertainty.

3.1 STATEMENT OF THE PROBLEM

As Mr. Nair would not like to miss the target, he would undertake going to Pune, only if he is confident of completing the target, which means that he should be working for at least 25 days. This, in turn, means that the number of days that could be lost due to flood or bandh or hartal should not exceed 1, as he needs one day to visit Pune. Therefore, Mr. Nair needs to compute the probability that no more than one day is lost in the remaining 27 days due to flood or bandh or hartal, and if this probability is sufficiently large, he may decide to accept the invitation.

3.2 INTRODUCTION OF 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 attention of the students that X is a discrete random

variable and that X may take any of the values 0, 1, 2, … 27. Now the problem of our interest can be re-stated 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, and their probabilities, the basic properties of a probability function etc. Next, we may define further random variables, which are needed in computation of the above probabilities. First, define X_i , i = 1, 2, … 27, where X_i = 1 or 0, according as whether i-th day is lost or not lost. Then, notice that $X=\sum X_i$, and, $Pr(X_i=1) = Pr(A_i \cup B_i)$, i = 1, 2, … 27, 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. At this stage, we may introduce the probabilities of complements of events, and probabilities of union of two events etc. Using the definition of probabilities of complements of events, we may compute the $Pr(X_i=0)$ as $1-Pr(X_i=1)$. We may introduce the independence of events, and justify the independence of A_i and B_i in this case, and hence derive,

$$Pr(A_i \cup B_i) = Pr(A_i) + Pr(B_i) - Pr(A_i).\ Pr(B_i),\ i = 1, 2, \ldots 27. \qquad (3.1)$$

We may, then, compute the corresponding probabilities using the given facts of the case, viz., the frequencies of the basic events. At this stage we can introduce the basic types of Probability, viz., Classical Probability, Relative Frequency of Occurrence, and Subjective Probabilities. Using the given case facts, we get the probabilities of A_i and B_i to be $Pr(A_i) = 1/30 = 0.03333$, and $Pr(B_i) = 14/730 = 0.01918$. These probabilities are derived using Relative Frequency approach. Hence, using (3.1), $Pr(A_i \cup B_i) = 0.05187$, i = 1, 2, … 27. Hence, $Pr(X_i=1)=0.05187$. As we are interested in $Pr(X\leq 1)$, and since $X=\sum X_i$, we may introduce the binomial experiments, and binomial probabilities.

3.3 INTRODUCTION 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 trials.
c) The trials are independent.
d) The random variable of interest is Y, 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) $Pr(X_i=1)$ is the same for all i = 1, 2,…27.
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 1) is easily verified, while it is reasonable to assume that $Pr(X_i=1)$ 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 emphasize 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 is given by $Pr(X\leq 1) = Pr(X=0)+Pr(X=1) = 0.588$. Here, again, we can emphasize the use of mutually exclusive events.

At this stage, we may also introduce the Poisson distribution, and the Poisson approximation to Binomial Probability.

3.4 RECOMMENDATIONS FOR THE CASE

As there is a probability of 0.412 of more than one day being washed out during the next 27 days due to Flood or bandh or hartal, it may be recommended that Mr. Nair may drop the programme of going to Pune 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 Mr. Nair desires to be 90% (any value above 58.8%) confident of meeting the target, the recommendation remains the same.

4 CONCLUDING REMARKS

In this paper we introduced a case and demonstrated the use of the case method in introducing the concepts of Probability and Probability distributions. This method has been found quite useful and effective, and the students do really appreciate the necessity of these concepts in solving management problems.

The author tried the proposed method viz., introducing the probability through case, in the current batch (2001-2002) while the method of Levin-Rubin viz., introduce the definitions of probability and probability distributions, and then discuss examples, was followed in the previous years. In a test, for the current batch (2001-2002) and for the batch (1999-2000), the case "Special Probability Distributions", given in page 216 of Hildebrand and Lymen (1998), was given, and the students were asked to analyze the case. The students were evaluated out of 30 marks, their understanding of the concepts with reference to the case, and their analytical ability to link the concepts with the problem. The summary statistics of the scores of the two batches are given in Table 4.1.

Table 4.1
Summary Statistics of Scores of Two Batches

Batch	Number of students	Mean score	Standard deviation of scores
2001-2002	65	17.80	5.64
1999-2000	61	15.33	5.60

We performed a two-sample t-test (assuming common variance) to test H_0: $\mu_1 = \mu_2$ vs. H_1: $\mu_1 > \mu_2$, and the test rejects H_0 with a p-value of 0.0075. Thus, it follows that the effect of the case method has increased the students' analytical ability, and also the students have a better understanding of the concepts of Probability and probability distributions. We recommend here that this approach may be used to introduce various statistical concepts and procedures. This will motivate the students to learn some of the concepts of Statistics.

REFERENCES:

Berenson, M.L., & Levine, D.M. (1996). *Basic business statistics: Concepts and applications* (6th edn.). New Jersey: Prentice-Hall International.

Hildebrand, D.K., & Lyman, O. (1998). *Statistical thinking for managers* (4th edn.). California: Duxbury Press.

Levin, R.I., & Rubin, D.S. (1997). *Statistics for management*, (7th edn.). New Jersey: Prentice-Hall International.

Reynolds, J.I. (1980). *Case method in management development: Guide for effective use.* ILO publication.