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**B.Tech. II CSE(H) PROGRAM**

**A.Y. 2023-24 ODD, Semester-II**

**Course Code: 22MT2005**

**PROBABILITY, STATISTICS AND QUEUING THEORY**

**Course Outcome-1**

**SESSION-1 Introduction to Probability, Sample space and event**

## 1.Instructional Objective:

* Explain the concept of probability.
* Calculate the probability of simple events.
* Calculate the probability of compound events.
* Calculate the probability of complementary events

2. **Learning Outcomes:**

* Explain the concept of a random event.
* Express the probability definitions
* Define the sample space.
* Formulate theorems about the concept of probability.

3. Topic1- Introduction to Probability

Probability is the science of how likely events are to happen. At its simplest, it’s concerned with the roll of a dice, or the fall of the cards in a game. But probability is also vital to science and life more generally.

Probability is used, for example, in such diverse areas as weather forecasting and to work out the cost of your insurance premiums.

**A basic understanding of probability is an essential skill in life, even if you are not a professional gambler or weather forecaster.**

**4. Explanation**

**Random experiment:** An experiment is called a **random experiment** if, when repeated under the same conditions, it is such that the outcome cannot be predicated with certainty but all possible outcomes can be determined prior to the performance of the experiment.

Ex: Throwing of a die, Tossing of a coin, Drawing two playing cards from a pack of cards.

**Sample space:** The set of all possible outcomes of a Random experiment is called the Sample spaceand is represented by the symbol **S.**

**Ex: 1)** When a coin is tossed the sample space is .

2) When a six faced die is rolled the sample space is .

5. Review

1. **A spinner has 4 equal sectors that are colored yellow, blue, green, and red. What will be the probability of their landing on each color after we spin this spinner?**

#### 2. A coin is tossed 5 times in a row. What is the size of the sample space of this experiment?

#### 3. What do you mean by the cardinality of a sample space?

6. Topic-2 Probability of event

7. Explanation of Topic-2

**Event:**  An event is subset of a sample space.

Ex: When a six faced die is rolled  is a event and represent the occurrence of an even numbers of dots.

Events are denoted by  or 

An event may be a subset that includes the entire sample space S called entire event, or a subset of S called the null set and denoted by the symbol , which contains no elements at all called null event.

For instance, if we let be the event of detecting a Microscopic organism by the naked eye in a Biological experiment, then **.

Also, if , then  must be the null set.

**Complement of an event:**  The complement of an event  with respect to  is the sub set of all elements of  which are not in. We denote the complement of  by the symbol  or or.

Ex: Let  be an event that an even number of dots occurred when a die is rolled then  is an event that an odd number of dots occurred.

**Intersection of two events:**  the intersection of two events A and B denoted by the symbol is the event containing all elements that are common to A and B.

Ex: Let C be the event that a student selected at random is a second year student and M be the event that student is a boy then is the event of all second year boys.

**Mutually exclusive events:**  Two events A and B are mutually exclusive, or disjoint if , i.e., if A and B have no elements in common.

Ex: In the die tossing experiment, if  and then the events A and B are mutually exclusive.

**Union of two events:**  The union of two events A and B, denoted by the symbol, is the event containing all the elements that belong to A or B or both.

Ex: In die tossing experiment, if  and  then  and it represent the event of getting an even number or a multiple of 3 dots.

The following results can be observed:

1)

2) 

3) 

4) 

5) 

6) 

7) 

8) 

9) 

**Classical definition of Probability:**

If there are outcomes mutually exclusive and equally likely outcomes of a random experiment, out of which,  outcomes are favourable for a particular  , then we define the probability of , as 

This probability is also know as probability of success of .

In this experiment  results are favourable to E, and hence the remaining n-s results are not favourable to the event . This set of unfavourable events denoted by  or or.

 Then probability of 

**The relative frequency interpretation of probability or Statistical definition of probability:**

Let m be the frequency of occurrence of the event associated with the independent trails of the random experiment. Then probability of the event, denoted by the symbol) is given by

 We may note that  is the relative frequency of the event A in n-trails. If n is very large then the relative frequency  is very close to actual probability.

**Axiomatic definition of probability:**

Probability is a number that is assigned to each member of a collection of events from a random experiment that satisfies the following properties.

If S is the sample space and E is any event in a random experiment,

1.  for each event e in S.

2. 

3. If  and  are any mutually exclusive events in S, then 

**Example 1**A coin is thrown 3 times .what is the probability that atleast one head is obtained?

Solution :Sample space = [HHH, HHT, HTH, THH, TTH, THT, HTT, TTT]  
Total number of ways = 2 × 2 × 2 = 8.  Fav. Cases = 7  
P (A) = 7/8  
OR  
P (of getting at least one head) = 1 – P (no head)⇒ 1 – (1/8) = 7/8

**Example 2**

Find the probability of getting a numbered card when a card is drawn from the pack of 52 cards.

Solution: Total Cards = 52.

Numbered Cards = (2, 3, 4, 5, 6, 7, 8, 9, 10) 9 from each suit 4 × 9 = 36  
P (E) = 36/52 = 9/13

8. Review

1. **One card is drawn at random from the pack of 52 cards.**
2. **Find the Probability that it is an honor card.**
3. **It is a face card.**
4. **A problem is given to three persons P, Q, R whose respective chances of solving it are 2/7, 4/7, 4/9 respectively. What is the probability that the problem is solved?**
5. If atleast one child in a family of three children is a boy. What is the probability that all three are boys?

9. Summary

Students can able to solve the problems based on probability of events

10. Assessment

##### 1. **A bag contains 14 blue, 6 red, 12 green, and 8 purple buttons. 25 buttons are removed from the bag randomly. How many of the removed buttons were red if the chance of drawing a red button from the bag is now 1/3?**

Activity

Probability fair online game

Gallery walk

**References of books, sites, links**

1. William Feller, An Introduction to Probability Theory and Its Applications: Volime 1, Third Edition, 1968 by John Wiley & Sons,Inc.
2. Alex Tsun, Probability & Statistics with Applications to Computing (Available at: http://www.alextsun.com/files/Prob\_Stat\_for\_CS\_Book.pdf)

**13.Case Studies (CO Wise)**

**NA**

**14.Answer Key**

**NA**

**15.Glossary**

**NA**

**16.References of books, sites, links Text Books:**

**Textbooks:**

1. Probability and Statistics Rukmangad Achari E. and E. Keshava Reddy
2. Probability and Statistics for Engineers and Scientists” Ronald E. Walpole, Sharon L. Myers and Keying Ye 8th Edition Pearson pub
3. Probability & Statistics for Engineers Dr. J. Ravichandran first Edition Wiley-India

**Reference books:**

1. Hossein Pishro-Nik, Introduction to Probability, Statistics, and Random Processes, 2014, by Kappa Research LLC; ISBN-13: 978-0990637202

**Web Resources**

1. https://ncert.nic.in/textbook.php?kemh1=0- 16
2. https://ncert.nic.in/textbook.php?jemh1=ps-15

**17.Keywords**

Mean, median, mode, central tendency, Interval, continuous data, discrete data.