|  |  |  |
| --- | --- | --- |
| Related image | **KONERU LAKSHMAIAH EDUCATION FOUNDATION**  (Deemed to be University estd, u/s, 3 of the UGC Act, 1956) (NAAC Accredited “A++” Grade University)  Green Fields, Guntur District, A.P., India – 522502  **Department of Computer Science and Engineering**  (DST - FIST Sponsored Department) |  |

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

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

**Course Code: 22MT2005**

**PROBABILIRT, STATISTICS AND QUEUING THEORY**

**Course Outcome-1**

**Session 2: INTRODUCTION TO** **PROBABILITY, SAMPLE SPACE AND EVENT**

1. **Course Description (Description about the subject)**

Probability deals with measuring the likelihood of events occurring, and these events are defined using the sample space, which encompasses all possible outcomes of a random experiment.

1. **Aim**

To define the concepts of probability, sample space and events.

1. **Instructional** **Objectives (Course Objectives)**

Identify the relationship between variables using correlation and regression techniques

1. **Learning** **Outcomes (Course Outcome)**

**CO1**: Students will be able to Define the basic concepts of Probability

1. **Module** **Description** **(CO-2 Description)**

Probability, Sample Space and Event.

1. **Session** **Introduction**

Probability is the science of how likely events are to happen. At its simplest, it’s concerned with the roll of 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.

1. **Session description**

**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 space and 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 .

**Probability of event**

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

**Example**: 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.

**Example**: 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.

**Example**: 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.

**Example**: 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 known as probability of success of .

In this experiment  results are favorable to E, and hence the remaining n-s results are not favorable to the event . This set of unfavorable 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



1. **Activities/ Case studies/related to the session.**

* Sample space: The set of all possible outcomes
* Sample Points: Elements of sample space
* Event: A subset of the sample space
* Impossible event: The empty set
* Sure event: The Whole sample space
* Complementary event or ‘not event: The set A’ or S-A
* Event A or B: The set A U B
* Event A and B: The set A Ո B
* Mutually exclusive event: A and B are mutually exclusive if A ՈB = *ϕ.*
* Exhaustive and mutually exclusive events: Events E1, E2,…,En are mutually exclusive and exhaustive if E1 U E2 U…U En = S and Ei Ո Ej = *ϕ* Ɐ ij.

1. **Examples & contemporary extracts of articles/ practices to convey the idea of the Session**

**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

1. **SAQ's-Self Assessment Questions**
2. What is probability?

a) The number of possible outcomes

b) The likelihood of an event occurring

c) The total number of events

d) The number of favorable outcomes

1. What is a sample space in probability theory?

a) The set of all possible outcomes of an experiment

b) The most common outcome of an experiment

c) The average value of all outcomes

d) The range of possible outcomes

1. Events A and B are mutually exclusive. What does this mean?

a) Event A occurs before Event B

b) Events A and B cannot occur at the same time

c) Event A is more likely than Event B

d) Event A is dependent on Event B

1. In a standard deck of 52 playing cards, what is the probability of drawing a heart?

a) 1/13 b) 1/26 c) 1/4 d) 1/52

1. If two fair six-sided dice are rolled, what is the total number of possible outcomes?

a) 6 b) 12 c) 36 d) 72

1. A bag contains 5 red, 3 blue, and 2 green balls. If one ball is drawn at random, what is the probability of getting a blue ball?

a) 1/10 b) 3/10 c) 1/5 d) 3/5

1. The complement of an event A is:

a) The set of all outcomes in A

b) The set of all outcomes not in A

c) The intersection of events A and B

d) The union of events A and B

1. If two events are independent, what is the probability of both events occurring?

a) The sum of their probabilities

b) The product of their probabilities

c) The difference of their probabilities

d) None of the above

**Answers**: 1. b, 2. a, 3. B, 4. c, 5. c, 6. b, 7. b, 8. b

1. **Summary**

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

1. **Terminal Questions**
2. 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?
3. One card is drawn at random from the pack of 52 cards. Find the Probability that (i) it is an honor card. (ii) 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 at least one child in a family of three children is a boy. What is the probability that all three are boys?
6. 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?
7. A coin is tossed 5 times in a row. What is the size of the sample space of this experiment?
8. If 3 books are picked at random from a shelf containing 5 novels, 3 books of poems, and a dictionary what is the probability that

(a) the dictionary is selected

(b) 2 novels and 1 book of poems are selected

(c) a novel, a book of poems and the dictionary is selected

(d) all three books are novels

1. Summarize the different type of events with examples.
2. **Case Studies (CO Wise)**

**NA**

1. **Answer Key**

**NA**

1. **Glossary**

**NA**

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

**Reference books:**

1. Chapter 1 of TP1: William Feller, An Introduction to Probability Theory and Its Applications: Volume 1, Third Edition, 1968 by John Wiley & Sons,Inc.

2. Richard A Johnson, Miller& Freund’s Probability and statistics for Engineers, PHI, New Delhi, 11th Edition (2011).

**Web Resources**

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

2. Notes: sections 1 to 1.3 of http://www.statslab.cam.ac.uk/~rrw1/prob/prob-weber.pdf

3. https://ocw.mit.edu/courses/res - 6 -012 -introduction -to -probability - spring - 2018/91864c7642a58e216e8baa8fcb4a5cb5\_MITRES\_6\_012S18\_L01.pd f 9

1. **Keywords**

Probability, Sample Spaces, Events