

# Random Variable and Probability Distribution

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# Outline

- ① Random Variable
- ② Probability Distribution

# Random Variable

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# Introduction

A variable which takes numerical values resulting from random experiments, is called a random variable (RV).

- There is a probability associated with each possible values
- Random variables are denoted by capital letters such as  $X, Y, Z$  etc.
- Possible values are denoted by small letters such as  $x, y, z$  etc.
- Example:
  - Height of students
  - Number of heads when tossing a coin three times

# Types of Random Variable

- **Discrete random variable:** A random variable defined over a discrete sample space
  - Number of students in a class, sample space,  $S = 0, 1, 2, \dots, \infty$
  - Number of correct answers in among 50 questions,  $S = 0, 1, 2, \dots, 50$
- **Continuous random variable:** A random variable defined over a continuous sample space
  - Monthly income,  $S = X : 0 \leq x < \infty$
  - Monthly profit,  $S = X : -\infty < x < \infty$

# Probability Distribution

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# Probability Distribution

- Probability distribution means the distribution of the probabilities among the different values of a random variable
- For example, when tossing a coin twice, the sample space,  $S = \{HH, HT, TH, TT\}$
- Let an RV,  $X$  = number of heads in two coin tosses, then  $X$  can take the values: 0, 1, 2
- Then the probability of each value of  $X$ :

$x$	$P(X = x)$
0	1/4
1	2/4
2	1/4

# Types of Probability Distributions

Depending on the type of variable, distributions are of two types:

- **Discrete probability distribution:** probability distribution of a discrete random variable
- **Continuous probability distribution:** probability distribution of a continuous random variable



# Discrete probability distribution

- The probability distribution of a discrete random variable is a table, graph, formula, or other device used to specify all possible values of a discrete random variable along with their respective probabilities
- If we let the discrete probability distribution be represented by the function  $p(x)$ , then  $p(x) = P(X = x)$  is the probability of the discrete random variable  $X$  to assume a value  $x$
- $p(x)$  is called a probability mass function (PMF)

# Probability Mass Function (PMF)

A function,  $p(x)$ , of a discrete random variable  $X$  will be called a PMF, if and only if all the following conditions are satisfied:

- ①  $p(x) \geq 0; \forall x$
- ②  $\sum_x p(x) = 1$
- ③  $P(X = a) = p(a)$

**Thank you.**

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