

Random Variable and Probabiilty Distribution

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Outline

- ① Random Variable
- ② Probability Distribution

Random Variable

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

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 $P(X = a) = p(a)$

Example: PMF

In page 3, the probability mass function of the variable X representing the number of heads when a coin is tossed twice is given. It is an example of a PMF.

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

Thank you.
