# Chapter 5. Discrete Probability Distributions

**5-2 Probability distributions**

**Random variable:** is a variable whose values are determined by chance.

Variables associated with probability are random variables.

Discrete variables have value that can be counted.

**Discrete probability distribution:** consists of the values a random variable can assume and the corresponding probabilities of the values.

**How to construct a probability distribution:**

**Two requirements for a probability distribution:**

1. The sum of the probabilities of all the events in the sample space must equal 1. That is, ΣP(X) = 1.
2. The probability f for each event in the sample space must be between or equal to 0 and 1.

That is, 0≤ P(X) ≤ 1.

**Mean of a probability distribution:**

The mean of a random variable with a discrete probability distribution is

μ= X1 ⋅P(X1) + X2 ⋅ P(X2) + X3 ⋅ P(X3) + ⋅ ⋅ ⋅ + Xn ⋅ P(Xn)

= ΣX ⋅ P(X)

where X1 , X2, X3, …….,Xn are the outcomes and P(X1), P(X2),………,P(Xn) are the corresponding probabilities.

**Rounding rule for mean and Standard deviation:**

The mean and S.D. should be rounded to one more decimal place than the outcome X. When fractions are used, they should be reduced to the lowest terms.

**Standard Deviation of a probability distribution;**

The S.D.of a random variable with a discrete probability distribution is



**\*** S. D. cannot be negative.

**Expectation:** Expected value is used in various types of games of chance, in insurance etc.

The **expected value** of a discrete random variable of a probability distribution is the theoretical average of the variable**.**

μ = E(X) = ΣX ⋅ P(X)

When expected value problems involve money, the answer is rounded to the nearest cent.

**5-3 & 5-4 The Binomial Distribution**

A **binomial experiment** is a probability experiment that satisfies the following four requirements:

1. Each trial can have only two outcomes or outcomes that can be reduced to two outcomes.
2. There must be a fixed number of trials.
3. The outcomes of each trial must be independent of each other.
4. The probability of a success must remain the same for each trial.

**Binomial Distribution:** The outcomes of a binomial experiment and the corresponding probabilities of these outcomes are called a binomial distribution.

Notations for the Binomial Distribution:

P(S) The symbol for the probability of success

P(F) The symbol for the probability of failure

p The numerical probability of a success

q The numerical probability of a failure

P(S) = p and P(F) = 1− p = q

n The number of trials

X The number of successes in n trials

Remember: 0≤X ≤ n

**Binomial Probability formula:**

In a binomial experiment, the probability of exactly X successes in n trials is



Mean for the Binomial Distribution: μ= n ⋅ p

S.D. for the Binomial Distribution: σ = 