# Multiplication Or Fundamental Rule of counting

If an operation can be performed in $n_1$ ways, and if for each of these a second operation can be performed in $n_2$ ways, and for each of the first two a third operation can be performed in $n_3$ ways, and so forth, then the sequence of $k$ operations can be performed in $n_1 n_2 \cdots n_k$ ways.

i.   How many sample points are there in the sample space when a pair of dice is thrown once?

ii.  How many there digit numbers can be formed from the digits 2, 4, 6, and 8 if: (i) repetitions are not allowed    (ii) repetitions allowed

# Set of Example (iii - viii)

(iii)    A developer of a new subdivision offers prospective home buyers a choice of Tudor, rustic, colonial, and traditional exterior styling in ranch, two-story,   and split-level floor plans. In how many different ways can a buyer order one    of  these homes?

(iv)    If a 22-member club needs to elect a chair and a treasurer, how many different ways can these two to be elected?

(v) Sam is going to assemble a computer by himself. He has the choice of chips from   two brands, a hard drive from four, memory from three, and an   accessory bundle from five local stores. How many different ways can    Sam order the parts?

(vi)    How many even four-digit numbers can be formed from the digits 0, 1, 2, 5, 6, and 9 if each digit can be used only once?

(vii)    How many new arrangements can be made from the letters of the word **FAVOUR** so that vowel occupy even place.

# Permutation

- A **permutation** is an arrangement of all or part of a set of objects.

- The number of permutations of n objects is n!.

- Suppose you have to arrange 3 books: **Statistics**, **Maths**, **Physics** on a shelf. How many arrangements are  possible?

# Permutations of "n" objects taken "r" at a time

$$_nP_r = \frac{n!}{(n-r)!}.$$

- In one year, three awards (research, teaching, and service) will be given to a class of 25 graduate students in a statistics department. If each student can receive at most one award, how many possible selections are there?

# Example # 10:

- A president and a treasurer are to be chosen from a student club consisting of 50 people. How many different choices of officers are possible if

(a) there are no restrictions;

(b) *A* will serve only if he is president;

(c) *B* and *C* will serve together or not at all;

(d) *D* and *E* will not serve together?

# Circular Permutations

- The number of permutations of n objects arrange in a circle is (n −1 )!.

**2.43** In how many ways can 5 different trees be planted in a circle?

# Permutations of n objects when they are not all different.

The number of distinct permutations of $n$ things of which $n_1$ are of one kind, $n_2$ of a second kind, ..., $n_k$ of a $k$th kind is

$$\frac{n!}{n_1! n_2! \cdots n_k!}.$$

- Find the number of permutations of 9995

- In how many ways can the letters of the word STATISTICS be arranged?

- In how many ways can 2 red, 3 blue, and 4 green chips be arranged in a row, if the chips of same color are not distinguishable from each other?

- In a college football training session, the defensive coordinator needs to have 10 players standing in a row. Among these 10 players, there are 1 freshman, 2 sophomores, 4 juniors, and 3 seniors. How many different ways can they be arranged in a row if only their class level will be distinguished?

# Combinations

- Selection of "r" objects from "n" different objects and when the order is not important.

$$\binom{n}{r} = \frac{n!}{r!(n-r)!}.$$

- In how many ways a committee of 3 students can be selected from 4 students.

- From a group of 10 boys and 6 girls a committee of 3 boys and 2 girls are to be selected. In how many ways can this done?

# Exercises

**2.22** In a medical study, patients are classified in 8 ways according to whether they have blood type $AB^+$, $AB^-$, $A^+$, $A^-$, $B^+$, $B^-$, $O^+$, or $O^-$, and also according to whether their blood pressure is low, normal, or high. Find the number of ways in which a patient can be classified.

**2.33** If a multiple-choice test consists of 5 questions, each with 4 possible answers of which only 1 is correct,

(a) in how many different ways can a student check off one answer to each question?

(b) in how many ways can a student check off one answer to each question and get all the answers wrong?

**2.37** In how many ways can 4 boys and 5 girls sit in a row if the boys and girls must alternate?

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**2.45** How many distinct permutations can be made from the letters of the word *INFINITY*?

**2.47** How many ways are there to select 3 candidates from 8 equally qualified recent graduates for openings in an accounting firm?

**2.48** How many ways are there that no two students will have the same birth date in a class of size 60?