

Example 5.6.8

Finding the Number of Distinguishable Permutations

How many distinguishable permutations can be made from the word *Mississippi*?

SOLUTION

There are 11 letters in the word *Mississippi*, one M, four I's, four S's, and two P's. So, there are

$$\frac{11!}{(1!)(4!)(4!)(2!)} = 34,650$$

distinguishable permutations of the letters in *Mississippi*.

It is important to remember that combinations are used when order is not important, and permutations are used when order is important.

Concept		Formula
Fundamental Counting Principle	If one event has n_1 outcomes and another event has n_2 outcomes, the number of ways the event can occur in sequence is the product of n_1 and n_2 .	$n_1 \cdot n_2$
Factorial	$n!$ is the product of each of the positive whole numbers from 1 to n .	$n! = (n-1)(n-2) \cdots (3)(2)(1)$
Combination	A collection or grouping of objects where order is not important.	The number of combinations of n unique objects taken k at a time is given by the following formula. ${}_n C_k = \frac{n!}{(n-k)!k!}$
Permutation	A specific order or arrangement of objects.	The number of arrangements for n objects when order is important is given by n factorial. $n!$
	The number of permutations of n unique objects taken k at a time.	${}_n P_k = \frac{n!}{(n-k)!}$
	Given n objects with n_1 alike, n_2 alike, ..., n_k alike, then the number of distinguishable permutations is given by the formula to the right.	$\frac{n!}{(n_1!)(n_2!)(n_3!) \cdots (n_k!)}$

 **5.6 Exercises**

Basic Concepts

1. What is the fundamental counting principle?
2. What is a factorial?
3. Describe the difference between permutations and combinations.
4. Give an example of a situation in which you would need to calculate the number of distinguishable permutations.

Exercises

5. The blue plate lunch at a local cafeteria consists of an entrée, a side item, and a desert. If there are 6 choices for an entrée, 5 choices for a side item, and 4 choices for a dessert, how many different lunches are available?
6. You are interested in buying a home in a new subdivision. The builder offers 3 basic floor plans, each with 4 possible arrangements for the garage, and siding in 6 different colors. How many different homes can be built?

7. Compute each of the following.
 - a. $1!$
 - b. $3!$
 - c. $5!$
 - d. $7!$
8. Compute each of the following.
 - a. $2!$
 - b. $4!$
 - c. $6!$
 - d. $8!$
9. A DJ needs to select 6 songs from a CD containing 12 songs to compose an event's musical lineup. How many different lineups are possible?
10. In how many ways can 11 kids be picked for the 9 positions on a baseball team?
11. How many distinguishable permutations can be made from the word STATISTICS?
12. How many distinguishable permutations can be made from the word SASSAFRAS?
13. A person tosses a coin 11 times. In how many ways can he get 9 heads?
14. How many 5 card hands can be dealt from a deck of 52 cards?