

Name: _____

Algebra 2 – Prob & Stats Unit, Permutations

Warm-up: If 7 students stand in a lunch line, in how many different ways can they line up?

The Fundamental Counting Principle provides us with a tool that allows us to calculate the number of outcomes possible in many situations. What if the situation is a bit more complex? For many situations, the order that we complete a task does not matter. Ordering milk, bacon, and scrambled eggs in that order is the same as ordering bacon, scrambled eggs, and milk. In this case the order that we make our choices wouldn't matter, but there are many situations in which the order that we do things does make a difference.

A permutation is a specific order or arrangement of a set of objects or items. What if you wish to call someone on the phone? If I make the call, the order that I punch in the numbers matters so this is an example of a permutation. A good question to ask when deciding if your arrangement is a permutation is "DOES ORDER MATTER?" If yes, then you are dealing with a permutation. For example, if you ordered an ice cream sundae and they put the cherry in first, then the chocolate sauce, then the whip cream, and then the ice cream, you would probably not be happy with that particular ice cream sundae. You would likely prefer that they put the ice cream in first, then the chocolate sauce, then the whip cream, and then put the cherry on top. Clearly each sundae had the same four ingredients, but they were quite different from one another. Each order that we can make the ice cream sundae is called a permutation.

Example 1

Suppose you are going to order an ice cream cone with two different flavored scoops. You are going to take a picture of your ice cream cone for use in the school newspaper. The ice cream shop has 3 flavors to choose from; chocolate, vanilla, strawberry. How many different ice cream cone photos are possible?

Solution

Example 2

Give the value of ${}_6P_4$ by hand and then by using your calculator.

Example 3

In a class of 32 students, in how many ways could you choose a valedictorian, president, and secretary?

Example 4

If 12 cars compete in a race, in how many ways can any four cars finish 1st, 2nd, 3rd, and 4th?

Example 5

How many possible anagrams are there using the word "math"?

Problem Set 1.3

Exercises

- 1) Use the formula for Permutations, $nPr = n! / (n-r)!$ to find the value for each expression. Confirm each result by using your calculator. (do part a & b by hand—all others by calculator is OK 😊)
 - a) ${}_8P_3$
 - b) ${}_4P_4$
 - c) ${}_5P_3$
 - d) ${}_5P_0$
- 2) How many 4 letter permutations can be formed from the letters in word *rhombus*?
- 3) For a board of directors composed of eight people, in how many ways can a president, vice president, and treasurer be selected?
- 4) How many different ID cards can be made if there are six digits on a card and no digit can be used more than once?
- 5) In how many ways can seven different brands of laundry soap be displayed on a shelf in a store?
- 6) A child has four different stickers that can be placed on a model car in a vertical stack. In how many ways can this be done if each sticker is to be used only one time?
- 7) An inspector must select three tests to perform in a certain order on a manufactured part. He has a choice of seven tests. How many different ways can he perform three tests?
- 8) In how many different ways can 4 raffle tickets be selected from 50 tickets if each of the 4 ticket holders wins a different prize?
- 9) A researcher has 5 different antibiotics to test on 5 different rats. Each rat will receive exactly one antibiotic and no rat will receive the same antibiotic as any other rat. In how many different ways can the researcher administer the antibiotics?
- 10) There are five violinists in an orchestra. Three of them will be selected to play in a trio with a different part for each musician. In how many ways can the trio be selected?
- 11) There are five violinists in an orchestra. Four of them will be selected to play in a quartet with a different part for each musician. In how many ways can the quartet be selected?
- 12) There are five violinists in an orchestra. All five of them will be selected to play in a quintet with a different part for each musician. In how many ways can the quintet be selected?
- 13) There are five violinists in an orchestra. A piece of music is written so that it can be played with either 3, 4, or 5 violinists. Each musician selected to play this piece will play a different part. In how many ways can a group of at least three musicians be selected? Hint: Use your answers from problems 10), 11) and 12).