

Permutations and Combinations

Objectives:

- Calculate a permutation.
- Calculate a combination.
- Determine whether you should use a combination or permutation to calculate the number of outcomes

Suggested Problems:

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problems 1, 3, 5, 7, 11, 13,
14, 17, 18, 20, 24, 25, 27,
28, 29, 31, 35

Vocabulary:

- combination ${}_n C_r =$
- permutation
- with replacement
- without replacement ${}_n P_r =$

Which Counting Technique?

1. What is being selected?
2. If the selected items can be repeated, use the **Fundamental Principle of Counting** and multiply the number of choices for each category.
3. If there is only one category, use:
 - **combinations** if the order of selections does not matter - that is, r items can be selected from a pool of n items in ${}_n C_r = \frac{n!}{(n-r)!r!}$ ways.
 - **permutation** if the order of selection does matter - that is r items can be selected from a pool of n items in ${}_n P_r = \frac{n!}{(n-r)!}$ ways.
4. If there is more than one category, use the **Fundamental Principle of Counting** with one box per category.
 - a. If you are selecting one item per category, the number in the box for that category is the number of choices for that category.
 - b. If you are selecting more than one item per category, the number in the box for that category is found by using step 3.

Possible Classroom Examples:

Find ${}_3C_2$.

List all the combinations of {a, b, c} when the elements are taken two at a time.

A group of ten seniors, eight juniors, five sophomores, and five freshmen must select a committee of four. How many committees are possible if the committee must contain the following?

- a. one person from each class
- b. any mixture of the classes
- c. exactly two seniors

How many five-card poker hands consisting of three kings and two queens are possible?

How many five-card poker hands consisting of three of a kind and a pair (a full house) are possible?

A 7/39 lottery requires choosing seven of the numbers 1 through 39. How many different lottery tickets can you choose? (Order is not important, and the numbers do not repeat.)