11.3 Combinations

A **combination** is a collection of items taken from a group without regard to their order. As with permutations, no item from the group is used more than once, but if there are two or more identical items in the group they can all be used.

# Objective 1: Distinguish between permutation and combination problems

**Permutation** problems involve situations in which order matters. **Combination** problems involve situations where the order does not matter. Real world situations usually determine which is appropriate. Awarding first, second, and third place in a race is a case where order matters. Selecting a protein, a vegetable, and a drink to put on a dinner tray is a case where order does not matter.

**PERMUTATIONS AND COMBINATIONS OF THREE LETTERS CHOSEN FROM {A,B,C,D}**

| **Combination** | ABC | ABD | ACD | BCD |
| --- | --- | --- | --- | --- |
| **Permutations** | ABC  ACB  BAC  BCA  CAB  CBA | ABD  ADB  BAD  BDA  DAB  DBA | ACD  ADC  CAD  CDA  DAC  DCA | BCD  BDC  CBD  CDB  DBC  DCB |

Note that each combination has 6 unique permutations.

# Objective 2: Solve problems involving combinations using the combinations formula

Because order matters for permutations, but not combinations, a single combination can be rearranged into  permutations, where *r* is the number of elements in each combination or permutation. For this reason, the formula for combinations is the formula for permutations, divided by .

**COMBINATIONS OF *n* THINGS TAKEN *r* AT A TIME**

The number of possible combinations if *r* items are taken from *n* items is

.

To choose a combination of combinations, for example a mixed group with a fixed number each of men and women, find the number of possible combinations of men and the number of possible combinations of women using the formula for combinations. Apply the fundamental counting principle and multiply these two results to get all possible combinations.