

# What you NEED to know about COUNTING:

**Permutations** = when the order matters

Total number  
of choices = (ways to choose) × (ways to choose) × (ways to choose) × ... × (ways to choose)  
1st item                      2nd item                      3rd item                      last item

**Combinations** = when the order doesn't matter

Number of  
combinations = (total number of choices, figured as above) ÷ (how many ways to arrange each set)

**Think of it as a fraction:**

$$\text{Number of combinations} = \frac{\text{(total number of choices, figured as above)}}{\text{(how many ways to arrange each set)}}$$

**How many ways can you arrange a set?**

Let  $n$  = the number of items in the set,  
Then the ways to arrange them are:  $(n) \times (n - 1) \times (n - 2) \times \dots \times 3 \times 2 \times 1 = n!$

# What you NEED to know about PROBABILITY:

$$\text{Probability}(\text{event happens}) = \frac{\text{(how many ways the event can happen)}}{\text{(total number of possible things that could happen)}}$$

**The “AND” probability**, when several things must ALL happen together:

$$\text{Prob}(\text{this AND that AND that all happen}) = \text{Prob}(\text{this}) \times \text{Prob}(\text{that}) \times \text{Prob}(\text{the 3rd thing}) \times \dots$$

**Example:** What is the probability of throwing double sixes when rolling two dice?

**The “EITHER/OR” probability**, when only one of several things can happen:

$$\text{Prob}(\text{this OR that OR that happens}) = \text{Prob}(\text{this}) + \text{Prob}(\text{that}) + \text{Prob}(\text{the 3rd thing}) + \dots$$

**Example:** What is the probability of rolling an even number (2 or 4 or 6) with a 6-sided die?

$$\text{The “odds” for something to happen} = \frac{\text{Prob}(\text{event happens})}{\text{Prob}(\text{event doesn't happen})} = \frac{\text{(how many ways it can happen)}}{\text{(how many ways it won't happen)}}$$

**Note:** Math Counts generally uses the above definition of odds. But in everyday common usage, the “odds” usually means the “odds *against*” something =  $\frac{\text{Prob}(\text{event doesn't happen})}{\text{Prob}(\text{event happens})}$

In normal conversation (odds against), odds of 100-to-1 means the event is not likely to happen.