



Math Virtual Learning

Probability and Statistics

May 20, 2020



Probability and Statistics

Lesson: May 20, 2020

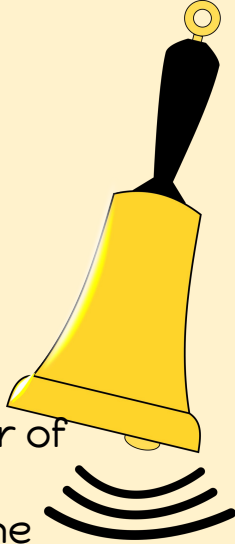
Objective/Learning Target:

Students will be able to distinguish between and solve various probability situations.

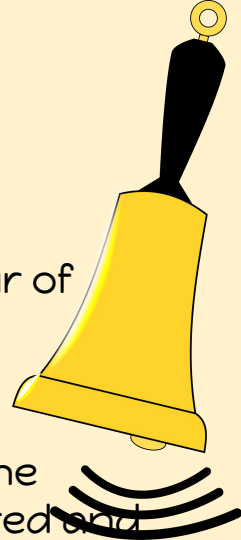
Let's Get Started!

Below is one Combination, one Permutation and one Counting Principle situation. Identify which one is which.

1. There are 8 different marbles all of different colors in a bag. If you draw four of them, how many different ways can your pile of colors look?
2. The daily double prize at the race track is a bonus prize to whoever picks the correct winning in two consecutive races. The first race has 7 horses entered and the second race has 5. How many different tickets would you have to buy in order to guarantee that you have a winning ticket?
3. Social Security numbers have 9 digits. Assume that digits are not repeated (which is not true), how many SSNs can be created?



Let's Get Started! ANSWERS



1. There are 8 different marbles all of different colors in a bag. If you draw four of them, how many different ways can your pile of colors look?

This is a COMBINATION because the order the marbles are drawn in is NOT important. The question was about the final group of marbles.
2. The daily double prize at the race track is a bonus prize to whoever picks the correct winning in two consecutive races. The first race has 7 horses entered and the second race has 5. How many different tickets would you have to buy in order to guarantee that you have a winning ticket?

This is a COUNTING PRINCIPLE because you have two separate groups of choices. You have 7 horses in the first race to make a choice from and 5 horses in the second race to make a choice from.
3. Social Security numbers have 9 digits. How many unique SSNs can be created?

This is a permutation because the order will matter. A SSN of 123456789 is different than an SSN of 987654321.

Probability Recap

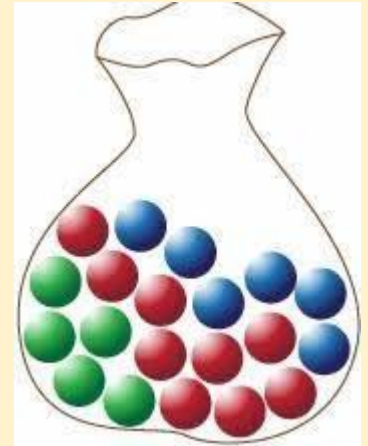
We've learned five main ideas in the Probability Unit!

- Simple Probability & Odds
- Compound Probability
- Counting Principle
- Permutations
- Combinations

Today we are going to do a quick review on the highlights of each one and some mixed practice.

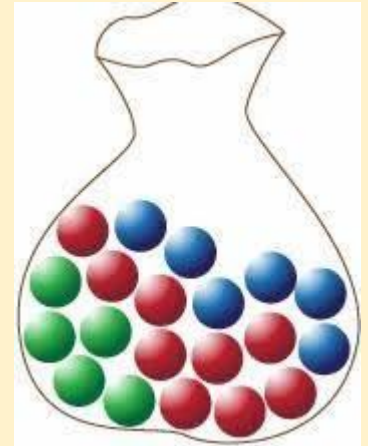
Simple Probability & Odds

- Chances for one event happening as you desire
- Probability = $\frac{\text{what you "want" to happen}}{\text{what "could" happen}} = \frac{\text{favorable}}{\text{total}}$
- Odds = $\frac{\text{what you "want" to happen}}{\text{what you "don't want" to happen}} = \frac{\text{favorable}}{\text{not favorable}}$
- Examples: For the bag of marbles to the right, find...
 - $P(\text{Green}) = 5/20$ or 25%
 - $O(\text{Blue}) = 6:14 = 3:7$
 - $P(\text{Not Red}) = 11/20$ or 55%



Compound Probability

- Chances of multiple events happening as you desire
- Union (“or”) Probability
 - Symbolized with \cup
 - Add the probabilities from the individual events
- Intersection (“and”) Probability
 - Symbolized with \cap
 - Multiple the probabilities from the individual events
- Examples: Given the bag of marbles to the right...
 - $P(B \cup R) = 6/20 + 9/20 = 15/20$ or $3/4$
 - $P(B \cap R) = 6/20 * 9/20 = 27/200$ (remember to reduce fractions)



Counting Principle

- Find the total possibilities of having to make a SERIES of choices from DIFFERENT categories
- Multiply the total options for each choice together
- Example: A boxed lunch as 3 options of sandwiches, 2 side options and 3 drink options. How many total lunch combinations would be made?
 - This has three different choices to make (sandwich, side, drink)
 - $3 \cdot 2 \cdot 3 = 18$ different lunch combinations

Combinations

- Total number of possibilities from having to make a SERIES of choices from ONE category
- The order of the selection is not important - just the final group of selections

- We used the formula

$$C(n, r) = \frac{n!}{r!(n - r)!}$$

- Example: There are 8 different marbles all of different colors in a bag. If you draw four of them, how many different ways can your pile of colors look?

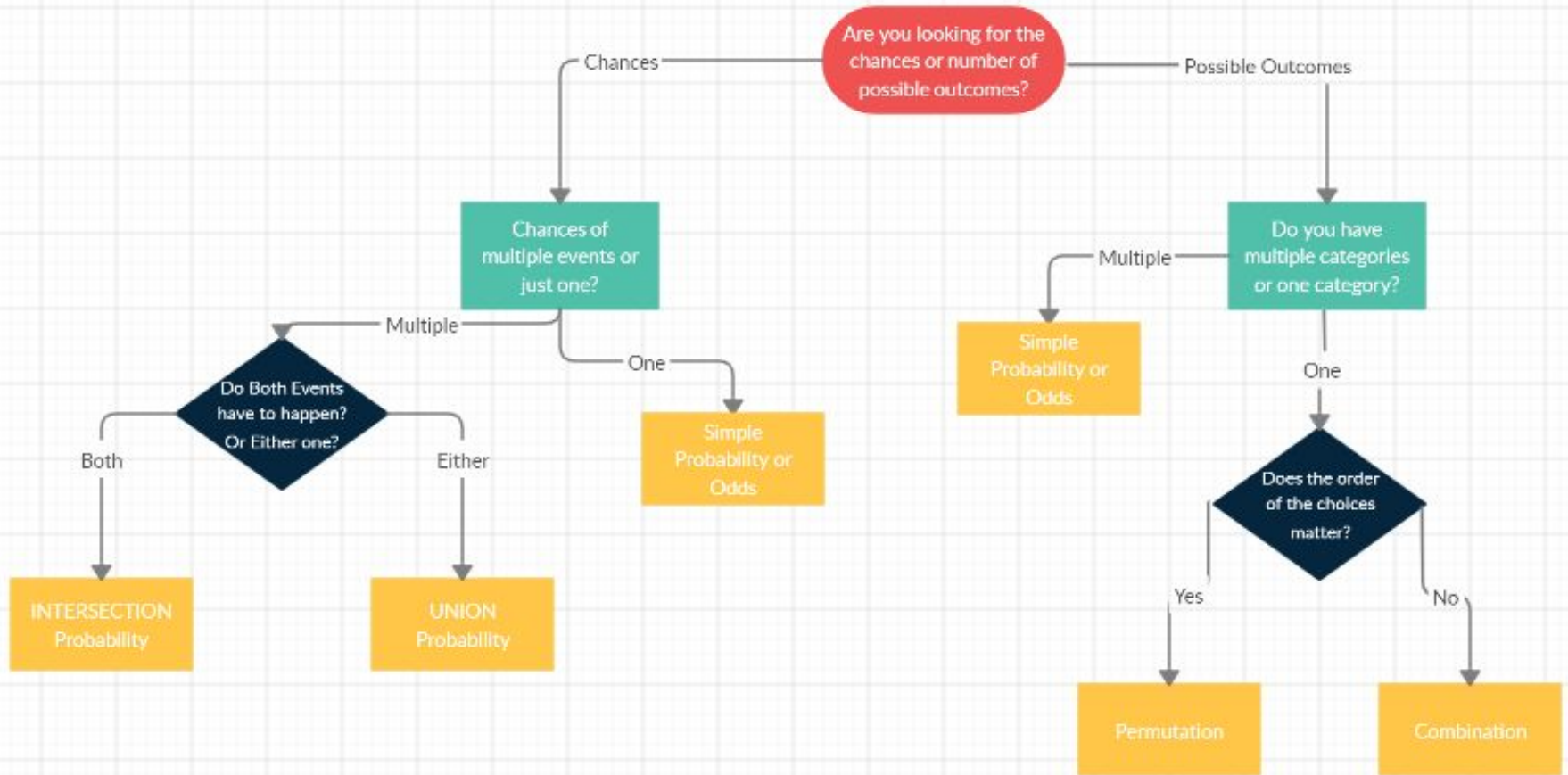
$C(8, 4) = 70$ different combinations of marbles

Permutations

- Total number of possibilities from having to make a SERIES of choices from ONE category
- The order of the selection is important - switching the order of the selections will be important
- We used the formula
$$P(n, r) = \frac{n!}{(n - r)!}$$
- Example: There are 8 raffle tickets a bag. You are going to draw three of them as winners. Each winner gets a different prize. How many ways can the 8 raffle tickets win?

$P(8, 3) = 336$ different winning combinations

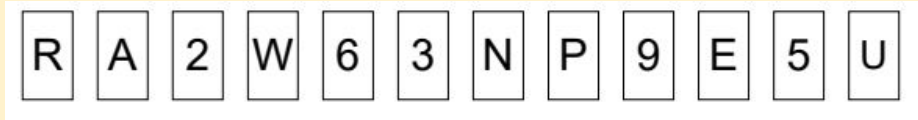
Probability Flow Chart



You Try: Mixed Practice #1

1. Andrea is a very good student. The probability that she passes her math test is $\frac{68}{75}$. If the probability that Andrea studies is $\frac{15}{16}$, find the probability that Andrea passes her mathematics test and she has studied.
2. In a contest, 4 winners will get equal prizes. If 20 people enter the contest, how many different groups of 4 winners can be chosen?

3.



The above cards are placed in a bag and a card is drawn. Find the probability of selecting a prime number or a multiple of 3.

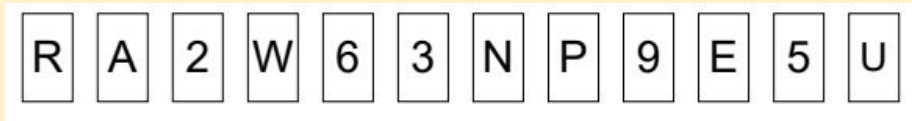
4. A single die is rolled multiple times and the outcomes are recorded here:
Find the experimental probability of rolling a 5.
Find the experimental odds of rolling a 2.

Number	1	2	3	4	5	6
Total	12	16	21	23	18	10

You Try: Mixed Practice #1 ANSWERS

1. Andrea is a very good student. The probability that she passes her math test is $68/75$. If the probability that Andrea studies is $15/16$, find the probability that Andrea passes her mathematics test and she has studied. **COMPOUND (\cap)** $17/20 * 15/16 = .85$
2. In a contest, 4 winners will get equal prizes. If 20 people enter the contest, how many different groups of 4 winners can be chosen? **COMBINATION because order doesn't matter if they are equal prizes.** $C(20,4) = 4845$

3.



The above cards are placed in a bag and a card is drawn. Find the probability of selecting a prime number or a multiple of 3. **COMPOUND (U)** $P(\text{prime}) = 2/12 + P(\text{mult of } 3) = 3/12$ $2/12+3/12= 5/12$

4. A single die is rolled and the outcome are recorded here:
Find the experimental probability of rolling a 5.
Find the experimental odds of rolling a 2.

Number	1	2	3	4	5	6
Total	12	16	21	23	18	10

SIMPLE PROBABILITY AND ODDS:

Total rolls: 100 $P(5) = 18/100 = 9/50$ $O(2) = 16/84 = 4/21$

You Try: Mixed Practice #2

1. 30 Artists enter an Art Show Contest. How many ways can you award 1st, 2nd, 3rd, and Honorable Mention ribbons?
2. A class ring has four stone options (emerald, diamond, ruby and sapphire), three metal options (platinum, gold and silver) and 3 size options (small, medium large).
 - a. How many different rings can be made?
 - b. What is the probability that, if all rings were made and placed in a box, that you would randomly draw the exact ring that you would like?
3. In a graduating class of 260, 40 students had perfect attendance and 100 students had a GPA of 3.5 or above. What is the probability that a randomly chosen student would have perfect attendance and a GPA of 3.5 or above?
4. The ACT Prep kids in Mrs. Hendrick's room always stack their ACT books on a shelf when they leave each day. There are 8 kids in the class. How many different ways can the books be stacked on her shelf?

You Try: Mixed Practice #2 ANSWERS

1. 30 Artists enter an Art Show Contest. How many ways can you award 1st, 2nd, 3rd, and Honorable Mention ribbons? **PERMUTATION (order matters) $P(30,4) = 657,720$**
2. A class ring has four stone options (emerald, diamond, ruby and sapphire), three metal options (platinum, gold and silver) and 3 size options (small, medium large).
 - a. How many different rings can be made? **COUNTING PRINCIPLE $4*3*3 = 36$ different rings**
 - b. What is the probability that, if all rings were made and placed in a box, that you would randomly draw the exact ring that you would like? **$1/36 = 3\%$**
3. In a graduating class of 260, 40 students had perfect attendance and 100 students had a GPA of 3.5 or above. What is the probability that a randomly chosen student would have perfect attendance and a GPA of 3.5 or above? **COMPOUND (\cap) $P(\text{perf atten}) = 40/260$ $P(\text{GPA}>3.5) = 100/260$ $40/260*100/260 = 10/169$**
4. The ACT Prep kids in Mrs. Hendrick's room always stack their ACT books on a shelf when they leave each day. There are 8 kids in the class. How many different ways can the books be stacked on her shelf? **PERMUTATION (order matters because if Susie put her book in the 1st spot she cannot put it in another spot) but we need to use all 8 of the books. $P(8,8)$ or $8! = 40,320$**