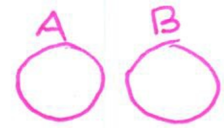
Definition of Probability:
the likelihood of something happening over time "ODDS"

Experiment	Theoretical Probability (what SHOULD happen)			Experimental Probability (what DOES happen)		
	Fraction	Decimal	Percent	Fraction	Decimal	Percent
Percentage of heads when you flip a coin 20 times.	$\frac{1}{2}$	0.5	50%	$\frac{8}{20}$	0.4	40%
Percentage of 5's when you roll a die 20 times.	$\frac{1}{6}$	$0.1\overline{6}$	$16.\overline{6}\%$	$\frac{2}{20}$	0.1	10%

Mutually Exclusive Events:

Definition: Two events are mutually exclusive if they cannot happen at the same time.



Mutually Exclusive	NOT Mutually Exclusive
A magazine opens to a random page. It lands on page 4 or page 17.	You pick a random student from our class. The student is a boy or the student has brown hair.

Decide whether each of the following events are mutually exclusive or not.

a) A spinner has an equal chance of landing on each of its eight numbered regions. After spinning, it lands in region three or six.

Mutually exclusive {can't land on both at the same time

b) A bag contains six yellow jerseys numbered one to six. The bag also contains four purple jerseys numbered one to four. You randomly pick a jersey. It is purple or has a number greater than 5.

Mutually exclusive {no purple jersey w/ # > 5

c) A basket contains three apples, three peaches, and four pears. You randomly select a piece of fruit. It is an apple or a peach.

Mutually exclusive {cannot pick apple and peach at same time

d) You roll a

fair six-sided die. The die shows an even number or a number greater than three.

2, (4), (6)

(4), 5, (6)

NOT mutually exclusive.

e) A card is drawn from a deck of standard playing cards. Event A: A heart is drawn. Event B: A king is drawn.

♥ A, 2, 3, 4, 5, 6, 7, 8, 9, 10, J, Q, (K)

K♠ K♣ (K♥) K♦

NOT mutually exclusive

f) A bag contains cards numbered from 1 to 14. One card is drawn at random. Event A: Selecting a multiple of 2. Event B: Selecting a multiple of 3.

2, 4, (6), 8, 10, (12), 14 3, (6), 9, (12)

NOT mutually exclusive

The Probability of Two Events

The Addition Rule Formula:	When do I use this formula?
$P(A \text{ OR } B) = P(A) + P(B) - P(A \text{ and } B)$ (overlap)	OR

Use the addition rule to calculate the probability of some of the situations on the front.

a) A basket contains three apples, three peaches, and four pears. You randomly select a piece of fruit. It is an apple or a peach. (10 Total)

$P(A \text{ or } P) = \frac{3}{10} + \frac{3}{10} - \frac{0}{10} = \boxed{\frac{6}{10}}$ 60%

b) A bag contains cards numbered from 1 to 14. One card is drawn at random. Event A: Selecting a multiple of 2. Event B: Selecting a multiple of 3. 3,6,9,12 2,4,6,8,10,12,14

$P(\text{mult 2 OR 3}) = \frac{7}{14} + \frac{4}{14} - \frac{2}{14} = \boxed{\frac{9}{14}}$ 64%

c) A bag contains six yellow jerseys numbered one to six. The bag also contains four purple jerseys numbered one to four. You randomly pick a jersey. It is purple or has a number greater than 5. (10 Total)

$P(\text{purple or } \#>5) = \frac{4}{10} + \frac{1}{10} - 0 = \boxed{\frac{5}{10}}$ 50%

d) You roll a fair six-sided die. The die shows an even number or a number greater than three. 2,4,6 — 4,5,6

$P(\text{even or } \#>3) = \frac{3}{6} + \frac{3}{6} - \frac{2}{6} = \boxed{\frac{4}{6}}$ 67%

The Multiplication Rule Formula:	When do I use this formula?
$P(A \text{ and } B) = P(A) \cdot P(B)$	AND, THEN, BOTH

Use the multiplication rule to calculate the probabilities.

a) You roll a die. What is the probability that you roll a 6 and then a 3?

$P(6 \text{ and } 3) = \frac{1}{6} \cdot \frac{1}{6} = \boxed{\frac{1}{36}}$ 2.8%

d) I roll a die, then toss a coin. What is the probability that I get a 2 and a tails?

$P(2 \text{ and } T) = \frac{1}{6} \cdot \frac{1}{2} = \boxed{\frac{1}{12}}$ 8.3%

c) A jar contains colored stones. There are 4 pink, 9 orange, and 5 green stones. Ryan picks one stone, records its color and puts it back in the jar. Then he draws another stone. What is the probability of picking both pink stones? (18 Total)

$P(\text{pink and pink}) = \frac{4}{18} \cdot \frac{4}{18} = \boxed{\frac{16}{324}}$ 5%

b) You spin this spinner 3 times. What is the probability that you spin a 5 and then a 2 and then a 1?

12 Total

$P(5 \text{ and } 2 \text{ and } 1) = \frac{4}{12} \cdot \frac{2}{12} \cdot \frac{1}{12} = \boxed{\frac{8}{1728}}$ 0.5%

Pass these off for your homework!

a) There are 10 white, 17 black, 8 red, 12 blue, and 3 green marbles in a jar. I pick two marbles with replacement. Find P(white then green) (50 Total)

$P(W) \cdot P(G) = \frac{10}{50} \cdot \frac{3}{50} = \boxed{\frac{30}{2500}}$ 1.2%

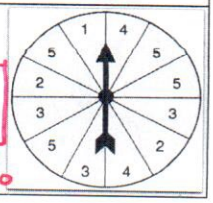
b) There are 10 white, 17 black, 8 red, 12 blue, and 3 green marbles in a jar. I pick two marbles with replacement. Find P(white or green)

$P(W) + P(G) = \frac{10}{50} + \frac{3}{50} = \boxed{\frac{13}{50}}$ 26%

c) A spinner has an equal chance of landing on each of its nine numbered regions (numbered 1 through 9). Find P(even number or ≥ 6) (6 2 7 4 8 6 9 8)

$= \frac{4}{9} + \frac{4}{9} - \frac{2}{9} = \boxed{\frac{6}{9}}$ 67%

d) You spin this spinner 2 times. Find P(3 then 4).



$P(3) \cdot P(4) = \frac{3}{12} \cdot \frac{2}{12} = \boxed{\frac{6}{144}}$ 4.2%

I have a funny pair of dice. They both have six sides, but one of them has the numbers 2,3, 4, 5, 6, 7 and the other one has the numbers 2, 4, 6, 8, 10, 12.

Find the probabilities of each of the following sums:

	2	3	4	5	6	7
2	4	5	6	7	8	9
4	6	7	8	9	10	11
6	8	9	10	11	12	13
8	10	11	12	13	14	15
10	12	13	14	15	16	17
12	14	15	16	17	18	19

36 Total sums

a) P(*10*) $= \frac{3}{36}$

b) P(*odd*) $= \frac{18}{36}$

b) P(*greater than 12* **and** *less than 18*) $P(>12) \cdot P(<18) = \frac{15}{36} \cdot \frac{34}{36} = \frac{510}{1296}$

d) P(*prime* **or** *4*) $P(\text{prime}) + P(4) = \frac{12}{36} + \frac{1}{36} = \frac{13}{36}$

I have a bookshelf with 20 mystery books, 13 children books, 10 fantasy books, and 7 classic books. You randomly pick books off of my bookshelf. Find the following probabilities.

Pay careful attention to words!

a) Picking one book: P(*mystery* **or** *fantasy*)=
b)Picking two books with replacement: P(*mystery* **then** *fantasy*)=
c) Picking one book: P(*mystery* **and** *fantasy*)=

Try a few more:

d) P(*children* **then** *mystery*)	P(*not a fantasy* **then** *not a classic*)	P(*children or classic* **then** *fantasy*)

Independence:

If two events are independent, then _____

Examples: Decide whether the two events are independent

1) $P(A) = .45, P(B) = .8$, and $P(A \cap B) = .36$

2) $P(A) = .5, P(B) = .75$, and $P(A \cap B) = .2$

Addition Rule: _____