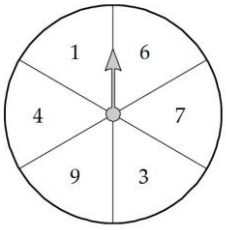
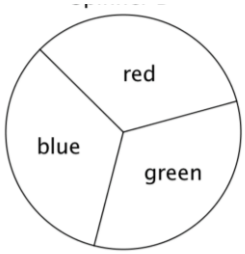
Sets and Set Notation

- **Set – a set is a collection of objects**
- **Subset – part of a larger set** $\boldsymbol{A \sqsubset B}$
- **Element – any object of a set**
- **Empty set – the set that has no elements**
- **Union – elements that are in both sets** $\boldsymbol{A \cup B}$
- **Intersection – what sets share.** $\boldsymbol{A \cap B}$
- **Complement – is the set of elements that are not in the set**.

1. List the sample space for the spinners below using set notation.





$M = \{1,2,3,4,5,6,7\}$
$N = \{1,3,5,7\}$

2. What is $M \cap N$?

3. What is $M \cup N$?

4. Is $N \sqsubset M$?

$R = \{0,1,4,9,16,25\}$
$P = \{1,2,3,4,5\}$

5. What is $R \cap P$?

6. What is $R \cup P$?

7. Is $P \sqsubset R$?

The Fundamental Counting Principal

If you have (a) ways of doing event 1, (b) ways of doing event 2, and (c) ways of doing event 3, then you can find the total number of outcomes by multiplying.

$$a \cdot b \cdot c$$

8. Flipping a coin 3 times.

9. Flipping a coin and rolling a dice.

10. Three choices of sandwiches, three choices of sides, and 2 choices of drinks.

11. A jewelry store sells gold and platinum rings. Each ring is fitted with a ruby, sapphire, emerald, or diamond gemstone

12. How many different outfits can be made with 3 different jackets, 6 different shirts, and 4 different pairs of pants.

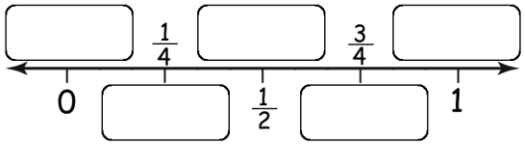
13. I license plate containing 2 digits followed by 5 letters.

Introduction to Probability

- **Probability is a number (0 to 1) that measures the chance that an event will occur.**
- **Outcome is the result of an experiment.**
- **Even – an outcome or collection of outcomes.**
- **Sample space – the set of all possible outcomes.**

P(event) = _____

Describing Probabilities Can be written as a _____, _____ or _____.



1. Determine the probability for one roll of a fair number cube (1-6).

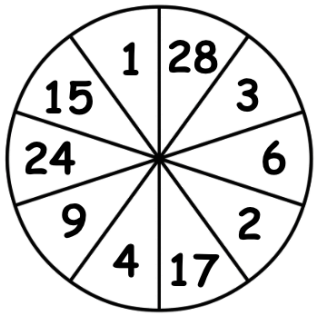
P(rolling a 2)	P(rolling an odd number)	P(rolling at least a 5)	P(rolling a negative number)

2. Consider the letters in the state of NORTH CAROLINA. Suppose you took each letter of the word and put them into a bag. Find the probability of picking out the following at random.

P(choosing an A)	P(choosing a vowel)	P(choosing an O or R)	P(choosing a letter)

3. Use the spinner on the left to answer questions 12 – 20.
Write your answer as a fraction, decimal and a percent.

P(even number)	P(negative number)	P(odd number)
P(multiple of 3)	P(factor of 24)	P(prime number)



Find the probability of the missing outcome.

4. There are three choices of soda – Coke, Sprite and Dr. Pepper. The probability of getting a Coke is 3/10 and the probability of getting Sprite is 1/5. Find the probability of getting a Dr. Pepper.

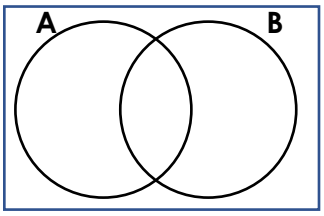
5. You sold the most for your school's fundraiser so you get to enter the cash vault. There are $1, $5, $10 and $20 bills. The probability of picking a $1 bill is 48%, a $5 bill is 26%, a $20 bill is 10%. What is the probability of picking a $10 bill?

Using Venn Diagrams

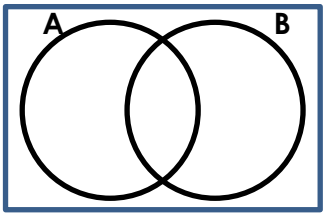
- A Venn diagram is **an illustration of the relationships between and among sets, groups of objects that share something in commo**n.

Shade in the appropriate area of the Venn Diagram.

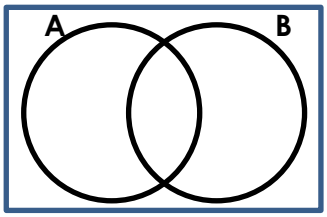
1. $A \cap B$



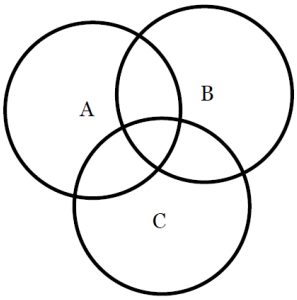
2. $A \cap B'$



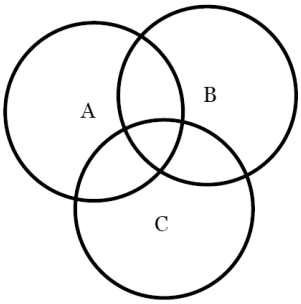
3. A'



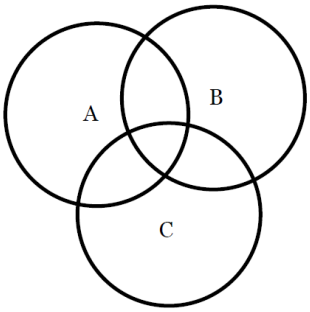
4. $B \cup C$



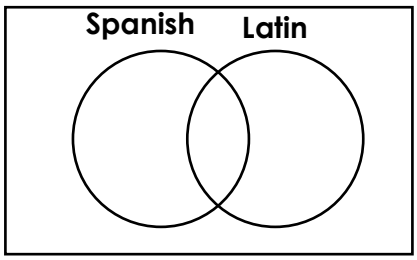
5. $A \cap B \cap C$



6. $A \cap B'$



A guidance counselor is planning schedules for 30 students. 16 want to take Spanish and 11 want to take Latin. 5 Say they want to take both. Display this information on the Venn Diagram below.



_____1. Find P(S ∩ L)

_____2. Find P(L)

_____3. What is the probability that a student studies at least one subject? P(S ∪ L)

_____4. What is the probability that a student studies exactly one subject?

_____5. What is the probability that a student studies neither subject? P(S ∪ L)'

Compound Probability: Mutually Exclusive vs. Overlapping

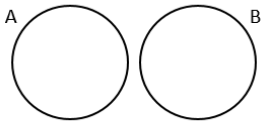
- **Compound Event – when two or more events occur**
- **Mutually Exclusive – no common outcomes**
- **Overlapping – common outcomes**

Mutually Exclusive

The probability that one or the other of several events will occur
is found by summing the individual probabilities of the events:

$$P(A \text{ or } B) = P(A) + P(B)$$

Mutually Exclusive Events



P(A or B) = P(A) + P(B)

1. Find the probability that a girl's favorite department store is Macy's or Nordstrom.

2. Find the probability that a girl's favorite store is not JC Penny's.

Macy's	0.25
Saks Fifth Ave.	0.20
Nordstrom	0.20
JC Penny's	0.10
Bloomingdale's	0.25

3. When rolling two dice, what is probability you roll a double?

4. When rolling two dice, what is probability that your sum will be 4 or 5?

5. When rolling two dice, what is probability that your sum will be even or a sum of 9?

+	1	2	3	4	5	6
1						
2						
3						
4						
5						
6						

6. What is the probability of picking a spade?

7. What is the probability of picking a queen or an ace from a deck of cards?

Standard Deck of 52 Playing Cards

Clubs	Spades	Hearts	Diamonds
A♣	A♠	A♥	A♦
2♣	2♠	2♥	2♦
3♣	3♠	3♥	3♦
4♣	4♠	4♥	4♦
5♣	5♠	5♥	5♦
6♣	6♠	6♥	6♦
7♣	7♠	7♥	7♦
8♣	8♠	8♥	8♦
9♣	9♠	9♥	9♦
10♣	10♠	10♥	10♦
Jack♣	Jack♠	Jack♥	Jack♦
Queen♣	Queen♠	Queen♥	Queen♦
King♣	King♠	King♥	King♦

Compound Probability: Mutually Exclusive vs. Overlapping

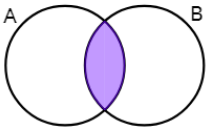
Overlapping Events

Probability that non-mutually exclusive events A and B or both will occur expressed as:

P(A or B)

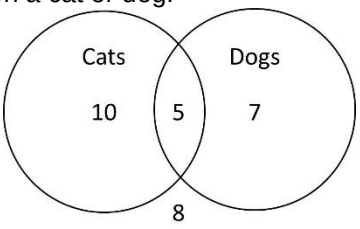
$P(A \cup B) = P(A) + P(B) - P(A \cap B)$

Non-Mutually Exclusive Events

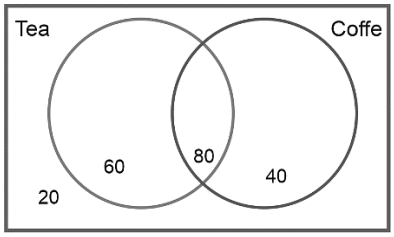


P(A or B) = P(A) + P(B) – P(A and B)

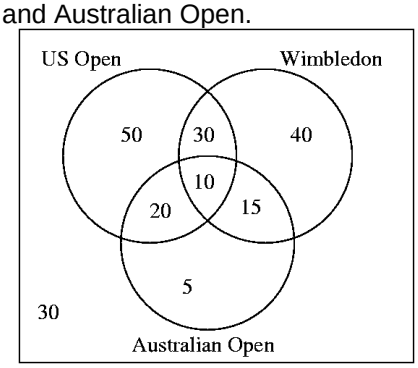
1. Find the probability that a person own a cat or dog.



2. Find the probability that a person drinks tea and coffee.



3. Find the probability that person watches the US Open, Wimbledon, and Australian Open.



4. Find the probability of picking a female or a person from Florida out of the committee members.

	Female	Male
Florida	8	4
Alabama	6	3
Georgia	7	3

5. Find the probability of picking a king or a club in a deck of cards.

Standard Deck of 52 Playing Cards

Clubs	Spades	Hearts	Diamonds
A♣	A♠	A♥	A♦
2♣	2♠	2♥	2♦
3♣	3♠	3♥	3♦
4♣	4♠	4♥	4♦
5♣	5♠	5♥	5♦
6♣	6♠	6♥	6♦
7♣	7♠	7♥	7♦
8♣	8♠	8♥	8♦
9♣	9♠	9♥	9♦
10♣	10♠	10♥	10♦
Jack♣	Jack♠	Jack♥	Jack♦
Queen♣	Queen♠	Queen♥	Queen♦
King♣	King♠	King♥	King♦

6. When rolling 2 dice, what is the probability of getting an even sum or a number greater than 10

7. When rolling 2 dice, what is the probability of getting double or a sum of 6?

+	1	2	3	4	5	6
1						
2						
3						
4						
5						
6						

Determine if the scenario is mutually exclusive or overlapping.

1. A spinner has an equal chance of landing on each of its eight numbered regions. After spinning, it lands in region three or six.	2. 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 five
3. A magazine contains twelve pages. You open to a random page. The page number is eight or ten.	4. A box of chocolates contains six milk chocolates and four dark chocolates. Two of the milk chocolates and three of the dark chocolates have peanuts inside. You randomly select and eat a chocolate. It is a milk chocolate or has no peanuts inside.

Conditional Probability

- **Contains a condition that limits the sample space of an event.**
- **Written as P(A|B) the probability of event A, given event B.**
- $\boldsymbol{P(A|B) = \frac{P(A \cap B)}{P(B)}}$

EYE COLOR	Black	Brown	Blue	Green	Gray	Total
Female	20	30	10	15	10	85
Male	25	15	12	20	10	82
Total	45	45	22	35	20	167

1. P(Blue eyes)

2. P(Female)

3. P(Green and Male)

4. P(Brown and Female)

5. P(Gray or Female)

6. P(Male or Black)

7. (Male | Blue)

8. (Gray | Female)

Independent and Dependent Events

Independent Events

- Event A occurring does NOT affect the probability of Event B occurring.
- $P(A \text{ and } B) = P(A \cap B) = P(A) \bullet P(B)$

P(A)=0.8 P(B)=0.25 P(C)=0.6

1. Find P(A and C)

2. Find P(A and B and C)

3. A coin is tossed and a 6-sided die is rolled. Find the probability of landing on the head side of the coin and rolling a 3 on the die.

4. A card is chosen at random from a deck of 52 cards. It is then replaced and a second card is chosen. What is the probability of choosing a jack and an eight?

Standard Deck of 52 Playing Cards

Clubs	Spades	Hearts	Diamonds
A♣	A♠	A♥	A♦
2♣	2♠	2♥	2♦
3♣	3♠	3♥	3♦
4♣	4♠	4♥	4♦
5♣	5♠	5♥	5♦
6♣	6♠	6♥	6♦
7♣	7♠	7♥	7♦
8♣	8♠	8♥	8♦
9♣	9♠	9♥	9♦
10♣	10♠	10♥	10♦
Jack♣	Jack♠	Jack♥	Jack♦
Queen♣	Queen♠	Queen♥	Queen♦
King♣	King♠	King♥	King♦

5. A jar contains 3 red, 5 green, 2 blue and 6 yellow marbles. A marble is chosen at random from the jar. After replacing it, a second marble is chosen. What is the probability of choosing a green and a yellow marble?

6. A school survey found that 9 out of 10 students like pizza. If three students are chosen at random with replacement, what is the probability that all three students like pizza?

Dependent Events

- Event A occurring AFFECTS the probability of Event B occurring.
- Usually you will see the words “WITHOUT REPLACING.”
- $P(A \text{ and } B) = P(A \cap B) = P(A) \bullet P(B|A)$

7. A jar contains 3 red, 5 green, 2 blue and 6 yellow marbles. A marble is chosen at random from the jar. A second marble is chosen without replacing the first one. What is the probability of choosing a green and a yellow marble?

8. An aquarium contains 6 male goldfish and 4 female goldfish. You randomly select a fish from the tank, do not replace it, and then randomly select a second fish. What is the probability that both fish are male?

9. James has 3 dimes, 4 pennies, and 2 quarters in his pocket. If each coin is equally likely to be pulled out of his pocket in order without replacement quarters in a row first?

10. In a cookie jar there are 10 chocolate chip cookies and 8 peanut butter cookies left. The cookies are randomly mixed in the jar. What is the probability of pulling two of the same types of cookies out of the cookie jar in a row

How to Determine If 2 Events Are Independent:

- Substitute in what you know in to **P(A ∩ B) = P(A) ● P(B)** and check to see if left side equals right side.
  - If it's equal, then it's independent.
  - If it's not equal, then it's not independent (or dependent).

$P(M) = 0.8 \quad P(N) = 0.25 \quad P(R) = 0.6$

11. If the probability $of\ P(M\ and\ N) = 0.2$, are M and N independent?

12. If the probability of $P(N\ and\ R) = 0.3$, are N and R independent?

13. Let event M = taking a math class. Let event S = taking a science class. Then, M and S = taking a math class and a science class. Suppose $P(M) = 0.6, P(S) = 0.5$, and $P(M\ and\ S) = 0.3$. Are M and S independent?

14. In a class, 60% of the students are female. 50% of all students in the class have long hair. 45% of the students are female and have long hair. Of the female students, 75% have long hair. Let F be the event that the student is female. Let L be the event that the student has long hair. One student is picked randomly. Are the events of being female and having long hair independent?