Name ______________________________ Date ______________

These Are a Few of My Favorite Things
Modeling Probability

Vocabulary

Match each term to its corresponding definition.

1. event d
2. outcome c
3. probability model b
4. sample space a
5. probability f
6. complement of an event e

a. all of the possible outcomes in a probability experiment
b. a list of the possible outcomes and each outcome's probability
c. one of the possible results of a probability experiment
d. an outcome or set of outcomes in a sample space
e. contains all the outcomes in the sample space that are not outcomes of the event
f. the ratio of the number of desired outcomes to the total number of possible outcomes

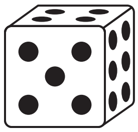
Identify the similarities and differences between the terms.

7. uniform probability model and non-uniform probability model
   Both terms are lists of the possible outcomes of a probability experiment and each outcome's probability. A uniform probability model lists outcomes that have equal probabilities, and a non-uniform probability model lists outcomes with probabilities that are not equal.

Problem Set

Identify the sample space for each situation.

1. A number cube with sides labeled with 1 to 6 dots is rolled once.
   The sample space is 1, 2, 3, 4, 5, 6.



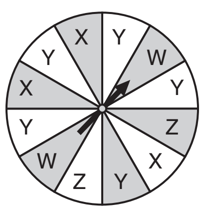
2. An ice cream shop has a sale for its most popular ice cream flavors. Customers can have one scoop of ice cream in a cup or a cone, and the flavors on sale are chocolate, vanilla, and strawberry. It can be served with or without sprinkles.

The sample space is:

cup, chocolate, with sprinkles
cup, vanilla, with sprinkles
cup, strawberry, with sprinkles
cup, chocolate, without sprinkles
cup, vanilla, without sprinkles
cup, strawberry, without sprinkles

cone, chocolate, with sprinkler
cone, vanilla, with sprinkles
cone, strawberry, with sprinkles
cone, chocolate, without sprinkler
cone, vanilla, without sprinkles
cone, strawberry, without sprinkles

3. You spin the spinner one time.



The sample space is W, W, X, X, X, Y, Y, Y, Y, Y, Z, Z.

4. A jar contains 3 red marbles, 4 blue marbles, 2 green marbles, and 1 yellow marble.

The sample space is red, red, red, blue, blue, blue, blue, green, green, yellow

5. An even number between 1 and 15 is chosen at random.

The sample space is 2, 4, 6, 8, 10, 12, 14.

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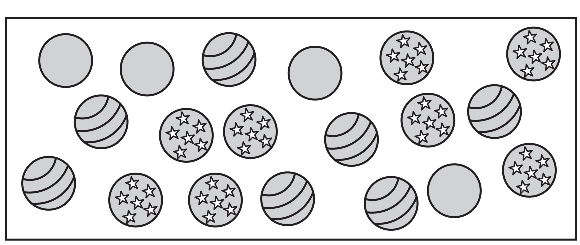
6. A ball is chosen at random from the box.



The sample space is a 5 shaded balls, 7 balls with stripes, and 8 balls with stars.

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Construct a probability model for each situation. Then state whether it is a uniform probability model or a non-uniform probability model.

7. A box contains 4 plain bagels, 2 blueberry bagels, 1 sesame seed bagel, and 2 cheese bagels. A bagel is chosen at random from the box.

Outcomes	Plain Bagel	Blueberry Bagel	Sesame Seed Bagel	Cheese Bagel
Probability	$\frac{1}{3}$, or 0.33	$\frac{1}{6}$, or 0.17	$\frac{1}{12}$, or 0.08	$\frac{5}{12}$, or 0.42

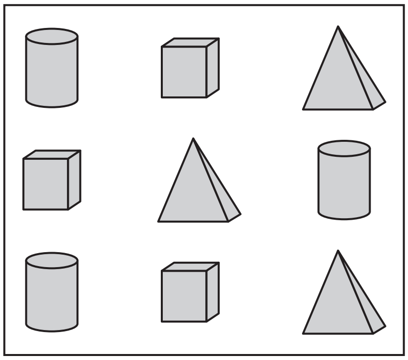
This is a non-uniform probability model.

8. Janet has 3 pairs of blue socks, 2 pairs of white socks, 4 pairs of green socks, and 1 pair of brown socks. She chooses a pair of socks at random from a drawer.

Outcomes	Blue Socks	White Socks	Green Socks	Brown Socks
Probability	$\frac{3}{10}$, or 0.3	$\frac{1}{5}$, or 0.2	$\frac{2}{5}$, or 0.4	$\frac{1}{10}$, or 0.1

This is a non-uniform probability model.

9. A shape is chosen at random from the set.



Outcomes	Cube	Cylinder	Pyramid
Probability	$\frac{1}{3}$, or 0.33	$\frac{1}{3}$, or 0.33	$\frac{1}{3}$, or 0.33

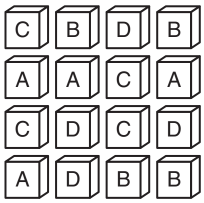
This is a uniform probability model.

10. There are 6 oranges, 4 apples, 3 kiwis, and 9 pears in your refrigerator. You randomly choose a piece of fruit to eat.

Outcomes	Orange	Apple	Kiwi	Pear
Probability	$\frac{3}{11}$, or 0.2	$\frac{2}{11}$, or 0.18	$\frac{3}{22}$, or 0.14	$\frac{9}{22}$, or 0.41

This is a non-uniform probability model.

11. You randomly choose a block from the set.



Outcomes	A Block	B Block	C Block	D Block
Probability	$\frac{1}{4}$, or 0.25	$\frac{1}{4}$, or 0.25	$\frac{1}{4}$, or 0.25	$\frac{1}{4}$, or 0.25

This is a uniform probability model.

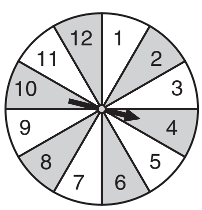
12. A choral group consists of 5 sopranos, 3 altos, 4 tenors, and 3 bases. A group member is chosen at random to sing a solo at a concert.

Outcomes	Soprano	Alto	Tenor	Base
Probability	$\frac{1}{3}$, or 0.33	$\frac{1}{5}$, or 0.2	$\frac{4}{15}$, or 0.27	$\frac{1}{5}$, or 0.2

This is a non-uniform probability model.

Determine the probability of each event, $P(E)$, and its complement, $P(E^c)$.

13. You spin the spinner one time.



$P(\text{greater than } 7) = \frac{5}{12}$

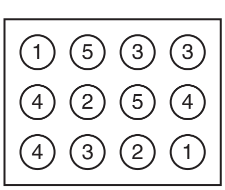
$P(\text{not greater than } 7) = \frac{7}{12}$

14. You write the letters A to K on separate index cards. Then you choose a card at random.

$P(\text{vowel}) = \frac{3}{11}$

$P(\text{not a vowel}) = \frac{8}{11}$

15. You choose a ball at random from the box.



$P(5) = \frac{2}{12}$, or $\frac{1}{6}$

$P(\text{not a } 5) = \frac{10}{12}$, or $\frac{5}{6}$

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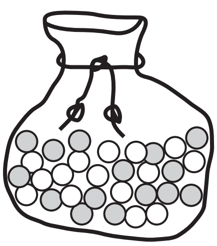
16. You have 5 quarters, 3 nickels, 2 dimes, and 6 pennies. You choose a coin at random.

P(a coin worth more than 5 cents) $= \frac{7}{16}$

P(not a coin worth more than 5 cents) $= \frac{9}{16}$

17. You choose a ball at random from the bag.



P(shaded) $= \frac{15}{30}$

P(not shaded) $= \frac{15}{30}$

18. Among the students in a class, 10 ride the bus, 3 walk, and 5 ride a car to school. A student is chosen at random.

P(walk) $= \frac{3}{18}$, or $\frac{1}{6}$

P(not walk) $= \frac{15}{18}$, or $\frac{5}{6}$

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It's in the Cards

Compound Sample Spaces

Vocabulary

Write the term that best completes each statement.

1. A ______set______ is a collection or group of items.

2. Each item in a set is called an ______element______.

3. Sets that do not have common elements are called ______disjoint sets______.

4. Sets that do have common elements are called ______intersecting sets______.

5. ______Tree diagrams______ and ______organized lists______ are two types of visual models that display sample space.

6. Events for which the occurrence of one event has no impact on the occurrence of the other event are ______independent events______.

7. Events for which the occurrence of one event has an impact on the following events are ______dependent events______.

8. The ______Counting Principle______ states that if an action *A* can occur in *m* ways and for each of these *m* ways, an action *B* can occur in *n* ways, then Actions *A* and *B* can occur in $m \cdot n$ ways.

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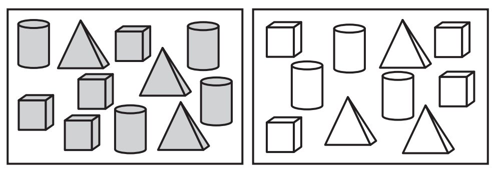
Problem Set

For each situation, identify the following.

- What are the actions?
- What are the outcomes of each action?
- Do the outcomes of each action belong to disjoint sets or intersecting sets?
- What events are described?
- Are the events independent or dependent?

1. You randomly choose one shaded block and one unshaded block.



- The actions are choosing a shaded block from the first set and choosing an unshaded block from the second set.
- The outcomes of choosing a shaded block are cylinder, pyramid, and cube. The outcomes of choosing an unshaded block are cylinder, pyramid, and cube.
- The outcomes of each action form disjoint sets because one set had shaded blocks and the other has unshaded blocks.
- The events are choosing a shaded block and choosing an unshaded block.
- The events are independent because the outcome of the first event does not affect the outcome of the second event.

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2. A teacher randomly chooses 2 students from a class, Matt and Mia, to solve a math problem on the board.

- The actions are choosing one student and choosing another student.
- The outcomes of choosing the first student include all the students in the class. The outcomes of choosing the second student include all the students in the class except for the first student that was chosen.
- The outcomes of each action form intersecting sets because the sets have common elements.
- The events are choosing Matt and then choosing Mia.
- The events are dependent because the outcome of the first event does affect the outcome of the second event.

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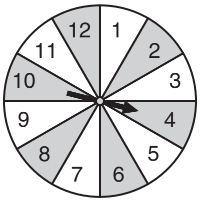
3. You spin the spinner and flip a coin, resulting in a 3 and tails up.



- **The actions are spinning the spinner and flipping the coin.**
- **The outcomes of spinning the spinner are 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12. The outcomes of flipping a coin are heads up and tails up.**
- **The outcomes of each action form disjoint sets because the sets do not have any common elements.**
- **The events are spinning a 3 and a flipping a coin that results in tails up.**
- **The events are independent because the outcome of the first event does not affect the outcome of the second event.**

4. You randomly choose a number between 1 and 50. Your friend chooses a number between 51 and 100. Your choice is 6 and your friend's choice is 77.

- **The actions are you choosing a number between 1 and 50 and your friend choosing a number between 51 and 100.**
- **The outcomes of your choice are the numbers 1 through 50. The outcomes of your friend's choice are the numbers 51 through 100.**
- **The outcomes of each action form disjoint sets because the sets do not have any common elements.**
- **The events are you choosing the number 6 and your friend choosing the number 77.**
- **The events are independent because the outcome of the first event does not affect the outcome of the second event.**

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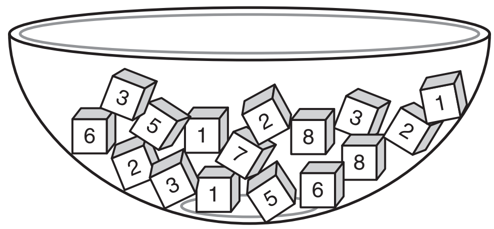
5. A bowl contains numbered cubes. You randomly withdraw a cube from the bowl, and then your friend randomly withdraws a cube from the remaining ones. Your choice is a 3 and your friend's choice is a 5.



- **The actions are you choosing a number cube and your friend choosing a number cube.**
- **The outcomes of your choice are all the number cubes in the bowl. The outcomes of your friend's choice are all the number cubes in the bowl, except for the number cube you choose.**
- **The outcomes of each action form intersecting sets because the sets have common elements.**

- **The events are you choosing a number cube with a 3 and your friend choosing a number cube with a 5.**
- **The events are dependent because the outcome of the first event does affect the outcome of the second event.**

6. The school lunchroom offers a choice of 5 different vegetable wraps. You randomly choose a different one each day. On the first day of the week your choice was a mixed vegetable wrap and on the second day your choice was a spinach and mushroom wrap.

- **The actions are you choosing a different vegetable wrap on each day of the week.**
- **The outcomes of your choices are all 5 vegetable wraps on the first day of the week, 4 vegetable wraps on the second day of the week, 3 vegetable wraps on the third day of the week, and so on.**
- **The outcomes of each action form intersecting sets because the sets have common elements.**

- **The events are you choosing a mixed vegetable wrap on the first day of the week and a spinach and mushroom wrap on the second day.**
- **The events are dependent because the outcome of the first event does affect the outcome of the second event.**

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7. You randomly choose one numbered ping pong ball and then choose another numbered ping pong ball. Your first choice is an even-numbered ping pong ball and your second choice is an odd-numbered ping pong ball.

5	1	8	5
3	2	6	2
4	7	1	6

- **The actions are you choosing one numbered ping pong ball and then choosing another numbered ping pong ball.**
- **The outcomes of your first choice are all of the numbered ping pong balls. The outcomes of your second choice are all of the numbered ping pong balls, except for the one chosen first.**
- **The outcomes of each action form intersecting sets because the sets have common elements.**

- **The events are you choosing an even-numbered ping pong ball first and an odd-numbered ping pong ball second.**
- **The events are dependent because the outcome of the first event does affect the outcome of the second event.**

8. At the local deli, you can have your choice of bread and cheese on every sandwich. Your randomly choose rye bread and Swiss cheese.

- **The actions are you choosing one type of bread and one type of cheese.**
- **The outcomes of your first choice are all of the types of bread. The outcomes of your second choice are all of the types of cheese.**
- **The outcomes of each action form disjoint sets because the sets do not have common elements.**

- **The events are you choosing whole wheat bread and Swiss cheese.**
- **The events are independent because the outcome of the first event does not affect the outcome of the second event.**

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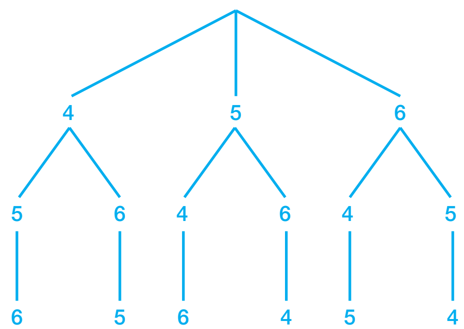
Sketch a tree diagram and write an organized list to represent each sample space.

9. Show all of the different 3-digit numbers using the numbers 4, 5, and 6.

Tree Diagram:

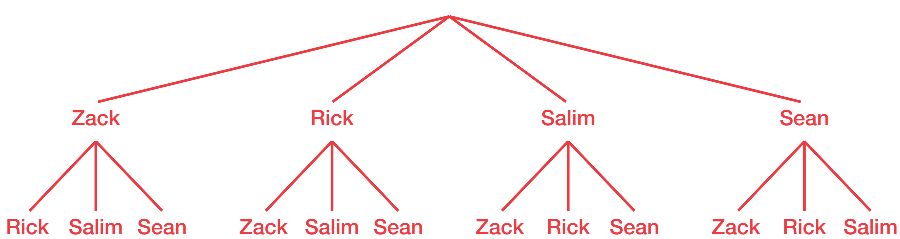


Organized List:

456	546	645
465	564	654

10. Zack, Rick, Salim, and Sean race to the end of the field. Show all of the different ways of finishing in the top two spots.

Tree Diagram:



Organized List:

Zack, Rick	Rick, Zack	Salim, Zack	Sean, Zack
Zack, Salim	Rick, Salim	Salim, Rick	Sean, Rick
Zack, Sean	Rick, Sean	Salim, Sean	Sean, Salim

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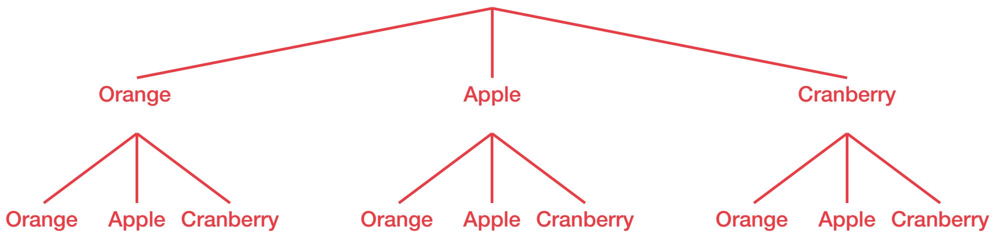
11. Lunch includes a drink of your choice. The options are orange juice, apple juice, or cranberry juice. What are the possible outcomes for your choice of drink on two days?

Tree Diagram:



Organized List:

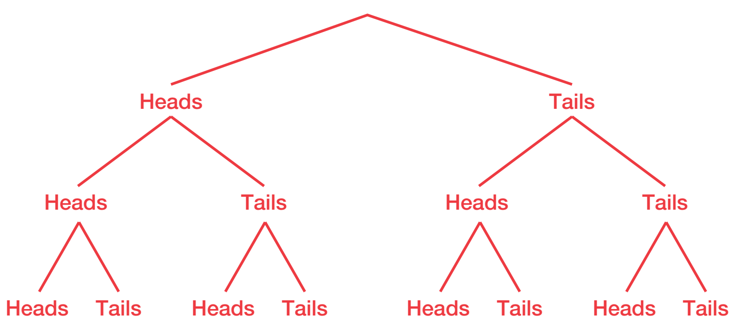
orange, orange
orange apple
orange, cranberry

apple, orange
apple, apple
apple, cranberry

cranberry, orange
cranberry, apple
cranberry, cranberry

12. What are the possible outcomes for flipping a coin 3 times?

Tree Diagram:



Organized List:

heads, heads, heads
heads, heads, tails
heads, tails, heads
heads, tails, tails

tails, tails, tails
tails, tails, heads
tails, heads, tails
tails, heads, heads

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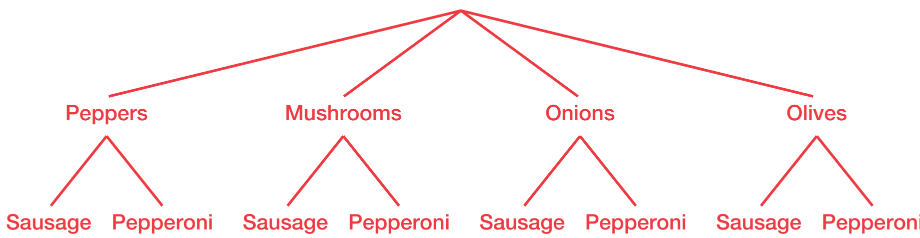
13. The pizza shop offers a weekly special that includes one free vegetable topping and one free meat topping with every large pizza. The vegetable toppings are peppers, mushrooms, onions, and olives. The meat toppings are sausage and pepperoni.

Tree Diagram:

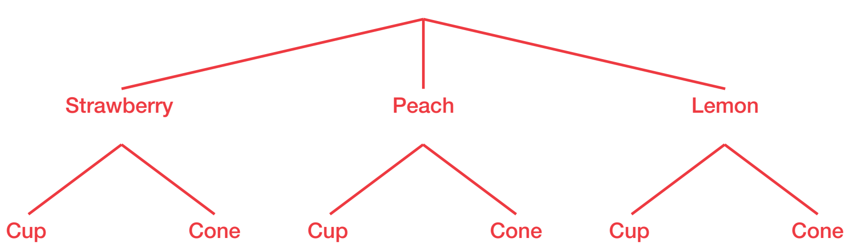


Organized List:

peppers, sausage	mushrooms, sausage
peppers, pepperoni	mushrooms, pepperoni
onions, sausage	olives, sausage
onions, pepperoni	olives, pepperoni

14. You just made it to the ice cream store before closing. The only remaining frozen yogurt flavors are strawberry, peach, and lemon. You can choose one scoop in a cup or one scoop in a cone.

Tree Diagram:



Organized List:

strawberry, cup	peach, cup	lemon, cup
strawberry, cone	peach, cone	lemon, cone

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Use the Counting Principle to determine the number of possible outcomes for each situation. Show your calculations.

15. There are 5 students scheduled to read their essays aloud in an English class one day. The teacher will randomly choose the order of the students. In how many different orders can the students read their essays?

There are 120 different orders of the students possible.

$5 \cdot 4 \cdot 3 \cdot 2 \cdot 1 = 120$

16. A restaurant offers a special price for customers who order a sandwich, soup, and a drink for lunch. The diagram shows the restaurant's menu. How many different lunches are possible?

Lunch Menu

Sandwiches	Soup	Drinks
Cheese	Minestrone	Cola
Chicken	Chicken Noodle	Tea
Ham and Egg	Vegetable	Coffee
Turkey Club		

There are 36 possible lunches.

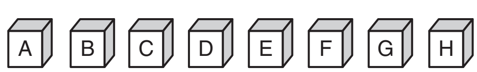
$4 \cdot 3 \cdot 3 = 36$

17. A website requires users to make up a password that consists of three letters (A to Z) followed by three numbers (0 to 9). Neither letters nor digits can be repeated. How many different passwords are possible?

There are 11,232,000 different passwords possible.

$26 \cdot 25 \cdot 24 \cdot 10 \cdot 9 \cdot 8 = 11{,}232{,}000$

18. Letter blocks are arranged in a row from A to H, as shown.



How many different arrangements in a row could you make with blocks?

There are 40,320 different arrangements for the blocks.

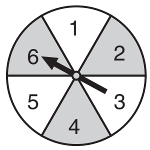
$8 \cdot 7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 = 40{,}320$

19. Gina has 12 favorite songs. She sets her audio player to continuously play songs, randomly selecting a song each time. How many different ways can Gina listen to 5 of her 12 favorite songs?

There are 248,832 different ways for Gina to listen to 5 of her 12 favorite songs.

$12 \cdot 12 \cdot 12 \cdot 12 \cdot 12 = 248{,}832$

20. You spin the spinner shown in the diagram 5 times. How many different outcomes are possible?



There are 7,776 possible outcomes.

$6 \cdot 6 \cdot 6 \cdot 6 \cdot 6 = 7{,}776$

21. A photographer arranges 12 members of a soccer team in a row to take a group picture. How many different arrangements are possible?

There are 479,001,600 ways to arrange the team members in a row.

$12 \cdot 11 \cdot 10 \cdot 9 \cdot 8 \cdot 7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1 = 479{,}001{,}600$

22. The travel lock shown in the figure requires users to move the spinners to a 4-digit code that will open the lock. Each spinner includes the digits 0 to 9. How many different codes are possible with the lock?

The lock has 10,000 possible codes.

$10 \cdot 10 \cdot 10 \cdot 10 = 10{,}000$

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And?
Compound Probability with "And"

Vocabulary

Define each term in your own words.

1. compound event

   A compound event is an event that consists of two or more events.

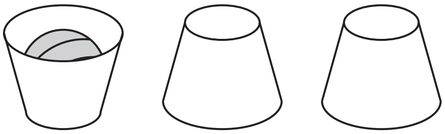
2. Rule of Compound Probability involving "and"

   If two events are independent, the probability that both events happen is the product of the probability that the first event happens and the probability that the second event happens, given that the first event has happened.

Problem Set

Determine the probability of each individual event. Then, determine the probability of each compound event. Show your calculations.

1. The "shell game" consists of placing three opaque cups, representing shells, upside down on a table and hiding a ball under one of the cups, as shown in the diagram. A player, who has not seen where the ball is hidden, has to choose one of the cups. If the ball is hidden under it, the player wins. What is the probability that a player will win 5 times in a row?



The probability that a player wins 5 times in a row is $\frac{1}{243}$.

I calculated the answer by using the Rule of Compound Probability involving "and."

The probability of winning the shell game 1 time is $\frac{1}{3}$.

Let W represent the probability of winning the shell game 1 time.

$P(W) = \frac{1}{3}$

$$P(W, W, W, W, \text{and } W) = P(W) \cdot P(W) \cdot P(W) \cdot P(W) \cdot P(W)$$
$$= \frac{1}{3} \cdot \frac{1}{3} \cdot \frac{1}{3} \cdot \frac{1}{3} \cdot \frac{1}{3}$$
$$= \frac{1}{243}$$

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2. There are 24 students in a math class. Each day, the teacher randomly chooses 1 students to show a homework problem solution on the board. What is the probability that the same student will be chosen 5 days in a row?

The probability of choosing the same student 5 days in a row is $\frac{1}{7{,}962{,}624}$.

I calculated the answer by using the Rule of Compound Probability involving "and."

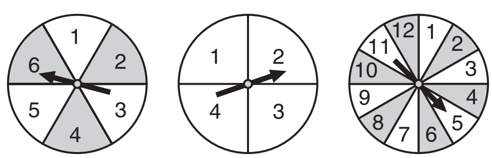
The probability of choosing the one particular student is $\frac{1}{24}$.

Let S represent the probability of choosing one particular student.

$P(S) = \frac{1}{4}$

$$P(S, S, S, S, \text{and } S) = P(S) \cdot P(S) \cdot P(S) \cdot P(S) \cdot \text{P(S)}$$
$$= \frac{1}{24} \cdot \frac{1}{24} \cdot \frac{1}{24} \cdot \frac{1}{24} \cdot \frac{1}{24}$$
$$= \frac{1}{7{,}962{,}624}$$

3. You spin each spinner in the diagram one time. What is the probability that the first two spinners land on a 1?



The probability that the first two spinners land on 1 is $\frac{1}{24}$.

I calculated the answer by using the Rule of Compound Probability involving "and."

The probability of the 1st spinner landing on 1 is $\frac{1}{6}$.

$P(1 \text{ on 1st spinner}) = \frac{1}{6}$

The probability of the 2nd spinner landing on 1 is $\frac{1}{4}$.

$P(1 \text{ on 2nd spinner}) = \frac{1}{4}$

The probability of the 3rd spinner landing on any number is $\frac{12}{12}$, or 1.

$P(\text{any number on 3rd spinner}) = 1$

I don't have to include the probability of the 3rd spin in my calculation because multiplying by 1 will not affect the final answer.

$$P(1 \text{ on 1st spinner and 1 on 2nd spinner}) = P(1 \text{ on 1st spinner}) \cdot P(1 \text{ on 2nd spinner})$$
$$= \frac{1}{6} \cdot \frac{1}{4}$$
$$= \frac{1}{24}$$

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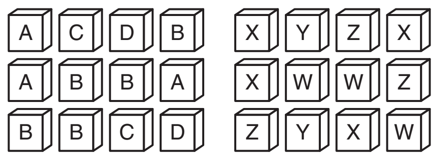
4. You randomly choose a block from each set below. What is the probability of choosing a block labeled *W* from the second set?



The probability of choosing a block labeled *W* from the second set is $\frac{1}{4}$.

I calculated the answer by using the Rule of Compound Probability involving "and."

The probability of choosing any block from the first set is $\frac{12}{12}$, or 1.

$P(\text{any block 1st}) = 1$

The probability of choosing a block labeled *W* from the second set is $\frac{3}{12}$, or $\frac{1}{4}$.

$P(W \text{ 2nd}) = \frac{1}{4}$

I don't have to include the probability of any block 1st in my calculation because multiplying by 1 will not affect the final answer. So, the final answer is $P(W \text{ 2nd}) = \frac{1}{4}$.

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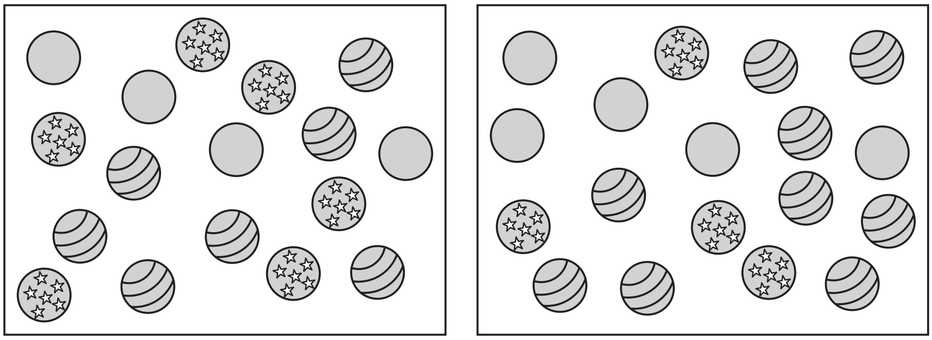
5. You randomly choose a marble from each set. What is the probability that both marbles with have stripes on it?



The probability of choosing two marbles with stripes is $\frac{7}{34}$.

I calculated the answer by using the Rule of Compound Probability involving "and."

The probability of choosing a marble with stripes from the 1st set is $\frac{7}{17}$.

Let A represent the probability of choosing a marble with stripes from the 1st set.

$P(A) = \frac{7}{17}$

The probability of choosing a marble with stripes from the 2nd set is $\frac{9}{18}$, or $\frac{1}{2}$.

Let B represent the probability of choosing a marble with stripes from the 2nd set.

$P(B) = \frac{1}{2}$

$$\begin{aligned} P(A \text{ and } B) &= P(A) \cdot P(B) \\ &= \frac{7}{17} \cdot \frac{1}{2} \\ &= \frac{7}{34} \end{aligned}$$

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Name ____________________ Date ____________

6. A store is having a grand opening sale. To attract customers, the manager plans to randomly choose one of the first 50 customers each day for a prize. The prize giveaway will occur each day for 5 days. If you and a friend are among the first 50 customers each day, what is the probability that one of you will win the prize every day?

The probability that a player wins 5 times in a row is $\frac{1}{9,765,625}$.

I calculated the answer by using the Rule of Compound Probability involving "and."

The probability of me or my friend winning the prize 1 time is $\frac{2}{50}$, or $\frac{1}{25}$.

Let W represent the probability of me or my friend winning the prize 1 time.

$P(W) = \frac{1}{25}$

$$P(W, W, W, W, \text{and } W) = P(W) \cdot P(W) \cdot P(W) \cdot P(W) \cdot P(W)$$

$$= \frac{1}{25} \cdot \frac{1}{25} \cdot \frac{1}{5} \cdot \frac{1}{25} \cdot \frac{1}{25}$$

$$= \frac{1}{9,765,625}$$

Determine the probability that each event will occur. Then determine the probability that both or all of the dependent events will occur. Show your calculations.

7. A common deck of playing cards includes 4 aces. Altogether there are 52 cards. If you randomly choose 4 cards from the deck, what is the probability of choosing 4 aces?

The probability of choosing all 4 aces is $\frac{1}{270,725}$.

I calculated the answer by using the Rule of Compound Probability involving "and."

The probability of choosing an ace first is $\frac{4}{52}$, or $\frac{1}{13}$.

The probability of choosing an ace second is $\frac{3}{51}$, or $\frac{1}{17}$.

The probability of choosing an ace third is $\frac{2}{50}$, or $\frac{1}{25}$.

The probability of choosing an ace fourth is $\frac{1}{49}$.

$$P(\text{ace 1st, ace 2nd, ace 3rd, and ace 4th}) = P(\text{ace 1st}) \cdot P(\text{ace 2nd}) \cdot P(\text{ace 3rd}) \cdot P(\text{ace 4th})$$

$$= \frac{1}{13} \cdot \frac{1}{17} \cdot \frac{1}{25} \cdot \frac{1}{49}$$

$$= \frac{1}{270,725}$$

19

8. A bag contains 8 red ribbons, 7 green ribbons, and 3 yellow ribbons. If you randomly remove 3 of the ribbons from the bag, what is the probability that the first two ribbons will be yellow?

The probability that the first two ribbons will be yellow is $\frac{1}{51}$.

I calculated the answer by using the Rule of Compound Probability involving "and."

The probability of choosing a yellow ribbon 1st is $\frac{3}{18}$, or $\frac{1}{6}$.

The probability of choosing a yellow ribbon 2nd is $\frac{2}{17}$.

The probability of choosing any ribbon 3rd is $\frac{16}{16}$, or 1.

I don't have to include the probability of choosing any ribbon 3rd in my calculation because multiplying by 1 will not affect the final answer

$$\begin{aligned} P(\text{yellow 1st and yellow 2nd}) &= P(\text{yellow 1st}) \cdot P(\text{yellow 2nd}) \\ &= \frac{1}{6} \cdot \frac{2}{17} \\ &= \frac{1}{51} \end{aligned}$$

19

Name ____ Date ______________

9. A box contains discs with letters on them, as shown in the diagram. You randomly remove four of the discs, one at a time, and set them in a row on a table. What is the probability that the discs you remove will be, in order, A B C D?

C	A	B	A
D	C	C	A
A	D	A	B
A	B	D	D

The probability of choosing 4 discs in alphabetical order is $\frac{9}{1820}$.

I calculated the answer by using the Rule of Compound Probability involving "and."

The probability of choosing a disc with an A 1st is $\frac{6}{16}$, or $\frac{3}{8}$.

The probability of choosing a disc with an B 2nd is $\frac{3}{15}$, or $\frac{1}{5}$.

The probability of choosing a disc with an D 3rd is $\frac{3}{14}$.

The probability of choosing a disc with an D 4th is $\frac{4}{13}$.

$$P(A \text{ 1st}, B \text{ 2nd}, C \text{ 3rd, and } D \text{ 4th}) = P(A \text{ 1st}) \cdot P(B \text{ 2nd}) \cdot P(C \text{ 3rd}) \cdot P(D \text{ 4th})$$

$$= \frac{3}{8} \cdot \frac{1}{5} \cdot \frac{3}{14} \cdot \frac{4}{13}$$

$$= \frac{36}{7280}$$

$$= \frac{9}{1820}$$

10. Evan has 6 quarters, 4 dimes, 3 nickels, and 8 pennies in his pocket. If he randomly removes 3 coins from his pocket, what is the probability of choosing a quarter first?

The probability of Evan choosing a quarter 1st is $\frac{2}{7}$.

I calculated the answer by using the Rule of Compound Probability involving "and."

The probability of choosing a quarter 1st is $\frac{6}{21}$, or $\frac{2}{7}$.

The probability of choosing any coin 2nd is $\frac{20}{20}$, or 1.

The probability of choosing any coin 3rd is $\frac{19}{19}$, or 1.

I don't have to include the probability of choosing any coin 2nd or the probability of choosing any coin 3rd in my calculation because multiplying by 1 will not affect the final answer. So, the probability of Evan choosing a quarter 1st is $\frac{2}{7}$.

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Name ______________________________ Date ____________

11. The table shows the birth months of students in a class. If 4 students in the class are chosen at random, what is the probability that they will all have birthdays in June, July, or August?

Month	January	February	March	April	May	June
Number of Students	2	3	1	0	3	2

Month	July	August	September	October	November	December
Number of Students	6	1	3	5	2	0

The probability of choosing 4 students with birthdays in June, July, or August is $\frac{2}{325}$.

I calculated the answer by using the Rule of Compound Probability involving "and."

The probability of the 1st student having a birthday in June, July, or August is $\frac{9}{28}$.

The probability of the 2nd student having a birthday in June, July, or August is $\frac{8}{27}$.

The probability of the 3rd student having a birthday in June, July, or August is $\frac{7}{26}$.

The probability of the 4th student having a birthday in June, July, or August is $\frac{6}{25}$.

Let *B* represent choosing a student with a birthday in June, July, or August.

$$P(B\text{ 1st}, B\text{ 2nd}, B\text{ 3rd, and }B\text{ 4th}) = P(A\text{ 1st}) \cdot P(B\text{ 2nd}) \cdot P(C\text{ 3rd}) \cdot P(D\text{ 4th})$$

$$= \frac{9}{28} \cdot \frac{8}{27} \cdot \frac{7}{26} \cdot \frac{6}{25}$$

$$= \frac{3024}{491{,}400}$$

$$= \frac{2}{325}$$

19

12. Alicia writes the numbers 1 to 45 on separate cards. She then randomly chooses three of the cards. What is the probability that the 2nd and 3rd cards will include the digit 9 in the number?

The probability of the 2nd and 3rd cards having a 9 as one of their digits is $\frac{3}{946}$.

I calculated the answer by using the Rule of Compound Probability involving "and."

The probability that any number is chosen 1st is $\frac{45}{45}$, or 1.

The probability that the 2nd number has a 9 as one of its digits is $\frac{3}{44}$.

The probability that the 3rd number has a 9 as one of its digits is $\frac{2}{43}$.

Let *N* represent choosing a card that has a 9 as one of its digits.

I don't have to include the probability of choosing any number 1st because multiplying by 1 will not affect the final answer

$$\begin{aligned} P(N \text{ 2nd and } N \text{ 3rd}) &= P(N \text{ 2nd}) \cdot P(N \text{ 3rd}) \\ &= \frac{3}{44} \cdot \frac{2}{43} \\ &= \frac{6}{1892} \\ &= \frac{3}{946} \end{aligned}$$

19

Name ____ Date ____________

Or?
Compound Probability with "Or"

Vocabulary

Answer each question.

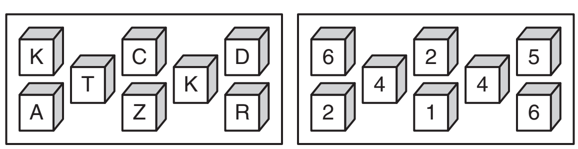
1. In symbols, what is the Addition Rule for Probability?
   $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$

2. When should you use the Addition Rule for Probability?
   You use the Addition Rule for Probability when you want to know the probability that one event or another event will occur.

Problem Set

Use the Addition Rule for Probability to determine the probability that one or the other of the independent events described will occur.

1. You randomly choose a block from each set in the diagram. What is the probability that you will choose a block labeled with a T or a block labeled with a 6?



The probability of choosing a block labeled with a *T* or a block labeled with a 6 is $\frac{11}{32}$.

I used the Addition Rule for Probability to determine the answer.
Let *T* represent choosing a block labeled with a *T*.
Let 6 represent choosing a block labeled with a 6.

$$\begin{aligned} P(T \text{ or } 6) &= P(T) + P(6) - P(T \text{ and } 6) \\ &= \frac{1}{8} + \frac{2}{8} - \left(\frac{1}{8}\right)\left(\frac{2}{8}\right) \\ &= \frac{1}{8} + \frac{2}{8} - \frac{2}{64} \\ &= \frac{8}{64} + \frac{16}{64} - \frac{2}{64} \\ &= \frac{22}{64} \\ &= \frac{11}{32} \end{aligned}$$

19

2. The vegetable display at a market has exactly 48 apples and 36 oranges. Of these, 2 of the apples are rotten and 2 of the oranges are rotten. You randomly choose an apple and an orange from the display. What is the probability that the apple or the orange is rotten?

The probability of choosing a rotten apple or a rotten orange is $\frac{41}{432}$.

I used the Addition Rule for Probability to determine the answer.

Let A represent choosing a rotten apple.

Let O represent choosing a rotten orange.

$$P(A \text{ or } O) = P(A) + P(O) - P(A \text{ and } O)$$

$$= \frac{2}{48} + \frac{2}{36} - \left(\frac{2}{48}\right)\left(\frac{2}{36}\right)$$

$$= \frac{2}{48} + \frac{2}{36} - \frac{4}{1728}$$

$$= \frac{72}{1728} + \frac{96}{1728} - \frac{4}{1728}$$

$$= \frac{164}{1728}$$

$$= \frac{41}{432}$$

3. The sides of a 6-sided number cube are labeled from 1 to 6. You roll the cube 2 times. What is the probability that it will land with a 1 facing up the first roll or the second roll?

The probability of a one on the 1st roll or a one on the 2nd roll is $\frac{11}{36}$.

I used the Addition Rule for Probability to determine the answer.

Let O represent rolling a one.

$$P(O \text{ 1st or } O \text{ 2nd}) = P(O \text{ 1st}) + P(O \text{ 2nd}) - P(O \text{ 1st and } O \text{ 2nd})$$

$$= \frac{1}{6} + \frac{1}{6} - \left(\frac{1}{6}\right)\left(\frac{1}{6}\right)$$

$$= \frac{1}{6} + \frac{1}{6} - \frac{1}{36}$$

$$= \frac{6}{36} + \frac{6}{36} - \frac{1}{36}$$

$$= \frac{11}{36}$$

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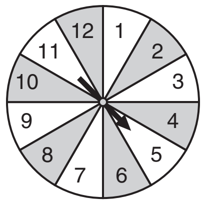
Name ____________________ Date __________

4. You spin the spinner 2 times. What is the probability that it will land on a number greater than 9 the first spin or a number less than 6 the second spin?



The probability of landing on a number greater than 9 on the 1st spin or a number less than 6 on the 2nd spin is $\frac{9}{16}$.

I used the Addition Rule for Probability to determine the answer.

Let ">9" represent landing on a number greater than 9.

Let "<6" represent landing on a number less than 6.

$$P(>9 \text{ 1st or } <6 \text{ 2nd}) = P(>9 \text{ 1st}) + P(<6 \text{ 2nd}) - P(>9 \text{ 1st and } <6 \text{ 2nd})$$

$$= \frac{3}{12} + \frac{5}{12} - \left(\frac{3}{12}\right)\left(\frac{5}{12}\right)$$

$$= \frac{3}{12} + \frac{5}{12} - \frac{15}{144}$$

$$= \frac{36}{144} + \frac{60}{144} - \frac{15}{144}$$

$$= \frac{81}{144}$$

$$= \frac{9}{16}$$

19

5. There are 28 students in a math class and 24 students in a history class. In each of the classes, 7 of the students are members of the school band. A student is chosen at random from each class. What is the probability that the student chosen in the math class or the student chosen in the history class is in the band?

The probability that the student chosen from the math class or the student chosen from the history class is in the band is $\frac{15}{32}$.

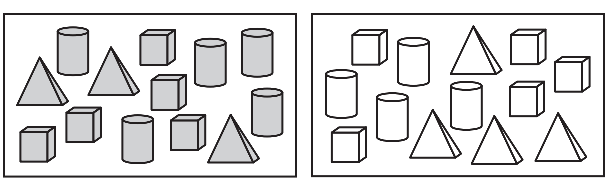
I used the Addition Rule for Probability to determine the answer.

Let M represent choosing a student from the math class who is in the band.

Let H represent choosing a student from the history class who is in the band.

$$
\begin{aligned}
P(M \text{ and } H) &= P(M) + P(H) - P(M \text{ and } H)\\
&= \frac{7}{28} + \frac{7}{24} - \left(\frac{7}{28}\right)\left(\frac{7}{24}\right)\\
&= \frac{7}{28} + \frac{7}{24} - \frac{49}{672}\\
&= \frac{168}{672} + \frac{196}{672} - \frac{49}{672}\\
&= \frac{315}{672}\\
&= \frac{15}{32}
\end{aligned}
$$

6. You randomly choose a block from each set of shapes. What is the probability of choosing a pyramid from the shaded set or a cylinder from the unshaded set?



The probability of choosing a pyramid from the shaded set or a cylinder from the unshaded set is $\frac{79}{169}$.

I used the Addition Rule for Probability to determine the answer.

Let pyramid represent choosing a pyramid from the shaded set.

Let cylinder represent choosing a pyramid from the shaded set.

$$
\begin{aligned}
P(\text{pyramid and cylinder}) &= P(\text{pyramid}) + P(\text{cylinder}) - P(\text{pyramid and cylinder})\\
&= \frac{3}{13} + \frac{4}{13} - \left(\frac{3}{13}\right)\left(\frac{4}{13}\right)\\
&= \frac{3}{13} + \frac{4}{13} + \frac{12}{169}\\
&= \frac{39}{169} + \frac{52}{169} - \frac{12}{169}\\
&= \frac{79}{169}
\end{aligned}
$$

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Name ____ Date ______________

Use the Addition Rule for Probability to determine the probability that one or the other of the dependent events will occur.

7. You decide to randomly choose two days this week to go jogging. What is the probability that the first day you choose will be Monday or the second day you choose will be Tuesday?

The probability of choosing Monday or Tuesday is $\frac{11}{42}$.

I used the Addition Rule for Probability to determine the answer.

$$
\begin{aligned}
P(\text{Monday or Tuesday}) &= P(\text{Monday}) \cdot P(\text{Tuesday}) - P(\text{Monday and Tuesday}) \\
&= \frac{1}{7} + \frac{1}{7} - \left(\frac{1}{7}\right)\left(\frac{1}{6}\right) \\
&= \frac{1}{7} + \frac{1}{7} - \frac{1}{42} \\
&= \frac{6}{42} + \frac{6}{42} - \frac{1}{42} \\
&= \frac{11}{42}
\end{aligned}
$$

8. You have 6 blue socks, 8 white socks, 4 green socks, and 2 brown socks in a drawer. You randomly remove 2 socks from the drawer. What is the probability that the first sock will be blue or the second sock will be green?

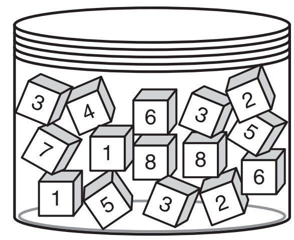
The probability of choosing a blue sock first or a green sock second is $\frac{83}{190}$.

I used the Addition Rule for Probability to determine the answer.

$$
\begin{aligned}
P(\text{blue 1st or green 2nd}) &= P(\text{blue 1st}) + P(\text{green 2nd}) - P(\text{blue 1st and green 2nd}) \\
&= \frac{6}{20} + \frac{4}{20} - \left(\frac{6}{20}\right)\left(\frac{4}{19}\right) \\
&= \frac{6}{20} + \frac{4}{20} - \frac{24}{380} \\
&= \frac{114}{380} + \frac{76}{380} - \frac{24}{380} \\
&= \frac{166}{380} \\
&= \frac{83}{190}
\end{aligned}
$$

19

9. The figure shows number cubes in a jar. Without looking, you randomly remove two cubes from the jar. What is the probability that the first cube you remove will have a 2 on it or the second cube you remove will have a 3 on it?



The probability of choosing a cube with a 2 first or a cube with a 3 second is $\frac{32}{105}$.

I used the Addition Rule for Probability to determine the answer.

$$\begin{aligned}
P(2\text{ 1st or 3 2nd}) &= P(2\text{ 1st}) \cdot P(3\text{ 2nd}) - P(2\text{ 1st and 3 2nd}) \\
&= \frac{2}{15} + \frac{3}{15} - \left(\frac{2}{15}\right)\left(\frac{3}{14}\right) \\
&= \frac{2}{15} + \frac{3}{15} - \frac{6}{210} \\
&= \frac{28}{210} + \frac{42}{210} - \frac{6}{210} \\
&= \frac{64}{210} \\
&= \frac{32}{105}
\end{aligned}$$

10. You and a friend decide to sign up for soccer tryouts. Altogether, there are 42 people trying out. What is the probability that you will be chosen to try out first or your friend will be chosen to try out second?

The probability that I will be chosen first or my friend will be chosen second is $\frac{27}{574}$.

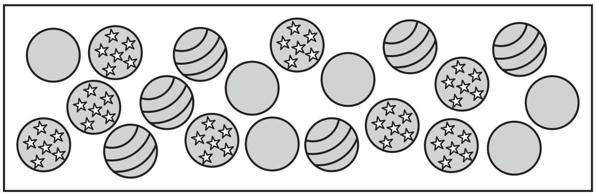
I used the Addition Rule for Probability to determine the answer.

$$\begin{aligned}
P(\text{me 1st or friend 2nd}) &= P(\text{me 1st}) \cdot P(\text{friend 2nd}) - P(\text{me 1st and friend 2nd}) \\
&= \frac{1}{42} + \frac{1}{42} - \left(\frac{1}{42}\right)\left(\frac{1}{41}\right) \\
&= \frac{1}{42} + \frac{1}{42} - \frac{1}{1722} \\
&= \frac{41}{1722} + \frac{41}{1722} - \frac{1}{1722} \\
&= \frac{81}{1722} \\
&= \frac{27}{574}
\end{aligned}$$

19

Name ____ Date ______________

11. You choose two balls from the set in the figure and place both balls on a table. What is the probability that the first ball you choose will have stars on it or the second ball you choose will have stripes on it?



The probability that the first ball has stars or the second ball has stripes is $\frac{9}{190}$.

I used the Addition Rule for Probability to determine the answer.

P(stars 1st or stripes 2nd) = P(stars 1st) + P(stripes 2nd) − P(stars 1st and stripes 2nd)

$$= \frac{8}{20} + \frac{6}{20} - \left(\frac{8}{20}\right)\left(\frac{6}{19}\right)$$

$$= \frac{8}{20} + \frac{6}{20} - \frac{48}{380}$$

$$= \frac{152}{380} + \frac{114}{380} - \frac{48}{380}$$

$$= \frac{218}{380}$$

$$= \frac{9}{190}$$

12. A standard deck of cards has 4 aces, 4 Kings, and 4 Queens. There are 52 cards altogether in the deck. One at a time, you randomly choose 2 cards from the deck and lay them on a table. What is the probability that the first card you choose is an ace or the second card you choose is a King?

The probability of choosing an ace first or a King second is $\frac{98}{663}$.

I used the Addition Rule for Probability to determine the answer.

P(ace 1st or King 2nd) = P(ace 1st) + P(King 2nd) − P(ace 1st and King 2nd)

$$= \frac{4}{52} + \frac{4}{52} - \left(\frac{4}{52}\right)\left(\frac{4}{51}\right)$$

$$= \frac{4}{52} + \frac{4}{52} - \frac{16}{2652}$$

$$= \frac{204}{2652} + \frac{204}{2652} - \frac{16}{2652}$$

$$= \frac{392}{2652}$$

$$= \frac{98}{663}$$

19

13. You randomly choose two different numbers in the box below. What is the probability that the first number you choose will be in a shaded box or the second number you choose will be in a shaded box?

1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36

The probability of shaded box first or an shaded box second is $\frac{2}{5}$.

I used the Addition Rule for Probability to determine the answer.

$$\begin{aligned} P(\text{shaded 1st or shaded 2nd}) &= P(\text{shaded 1st}) + P(\text{shaded 2nd}) - P(\text{shaded 1st and shaded 2nd}) \\ &= \frac{8}{36} + \frac{8}{36} - \left(\frac{8}{36}\right)\left(\frac{7}{35}\right) \\ &= \frac{8}{36} + \frac{8}{36} - \frac{56}{1260} \\ &= \frac{280}{1260} + \frac{280}{1260} - \frac{56}{1260} \\ &= \frac{504}{1260} \\ &= \frac{2}{5} \end{aligned}$$

14. You have 26 songs on your music player. Of these, 4 are your favorite songs. Your player is set to randomly play different songs until all 26 are played. If you listen to 2 songs, what is the probability that the first song played or the second song played will be one of your favorites?

The probability of a favorite song first or a favorite song second is $\frac{94}{325}$.

I used the Addition Rule for Probability to determine the answer.

Let F represent choosing a favorite song.

$$\begin{aligned} P(F\text{ 1st or }F\text{ 2nd}) &= P(F\text{ 1st}) + P(F\text{ 2nd}) - P(F\text{ 1st and }F\text{ 2nd}) \\ &= \frac{4}{26} + \frac{4}{26} - \left(\frac{4}{26}\right)\left(\frac{3}{25}\right) \\ &= \frac{4}{26} + \frac{4}{26} - \frac{12}{650} \\ &= \frac{100}{650} + \frac{100}{650} - \frac{12}{650} \\ &= \frac{188}{650} \\ &= \frac{94}{325} \end{aligned}$$

19

Name ____ Date ____________

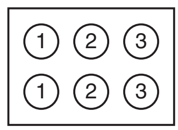
And, Or, and More!

Calculating Compound Probability

Problem Set

Determine the probability that each compound event will occur with replacement.

1. You randomly choose a number from the set, replace it, and then randomly choose another number. What is the probability of choosing a 2 first and a 3 second?



The probability of choosing a 2 first and a 3 second is $\frac{1}{9}$.

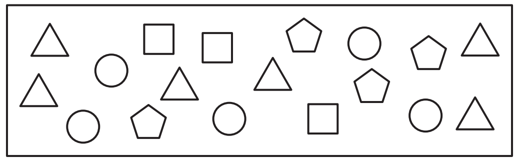
$$\begin{aligned} P(\text{2 1st and 3 2nd}) &= P(\text{2 1st}) \cdot P(\text{3 2nd}) \\ &= \frac{1}{3} \cdot \frac{1}{3} \\ &= \frac{1}{9} \end{aligned}$$

2. A box contains 25 marbles. There are 6 blue, 2 green, 8 red, 1 yellow, and 3 orange marbles. You randomly choose 3 marbles, one after the other. Each time, you replace the marble back in the box before choosing the next one. What is the probability that the first marble is green, the second marble is red, and the third marble is blue?

The probability of choosing a green marble first, a red marble second, and a blue marble third is $\frac{96}{15,625}$.

$$\begin{aligned} P(\text{green 1st, red 2nd, and blue 3rd}) &= P(\text{green 1st}) \cdot P(\text{red 2nd}) \cdot P(\text{blue 3rd}) \\ &= \frac{2}{25} \cdot \frac{8}{25} \cdot \frac{6}{25} \\ &= \frac{96}{15,625} \end{aligned}$$

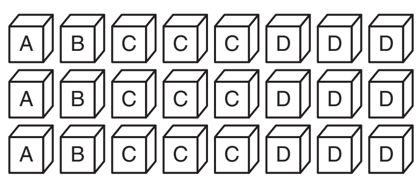
3. You choose a shape at random from the box, replace it, and then choose another shape at random. What is the probability that the first shape is a triangle or the second is a square?



The probability of choosing a triangle first or a square second is $\frac{4}{9}$.

$$
\begin{aligned}
P(\text{triangle 1st or square 2nd}) &= P(\text{triangle 1st}) + P(\text{square 2nd}) - P(\text{triangle 1st and square 2nd}) \\
&= \frac{6}{18} + \frac{3}{18} - \left(\frac{6}{18}\right)\left(\frac{3}{18}\right) \\
&= \frac{6}{18} + \frac{3}{18} - \frac{18}{324} \\
&= \frac{108}{324} + \frac{54}{324} - \frac{18}{324} \\
&= \frac{144}{324} \\
&= \frac{4}{9}
\end{aligned}
$$

4. You choose a blocks at random from the set, replace it, and then choose another block. What is the probability that you will choose an A block the first time or a D block the second time?



The probability of choosing an *A* block first or a *D* block second is $\frac{29}{64}$.

$$
\begin{aligned}
P(A\text{ block 1st or }D\text{ block 2nd}) &= P(A\text{ block 1st}) + P(D\text{ block 2nd}) - P(A\text{ block 1st and }D\text{ block 2nd}) \\
&= \frac{3}{24} + \frac{9}{24} - \left(\frac{3}{24}\right)\left(\frac{9}{24}\right) \\
&= \frac{3}{24} + \frac{9}{24} - \frac{27}{576} \\
&= \frac{72}{576} + \frac{216}{576} - \frac{27}{576} \\
&= \frac{261}{576} \\
&= \frac{29}{64}
\end{aligned}
$$

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5. You have 4 quarters, 6 dimes, 3 nickels, and 9 pennies in your pocket. You randomly draw a coin out of your pocket, replace it, and then draw out another coin. What is the probability that the first coin is a quarter or the second coin is a dime?

The probability of choosing a quarter first or a dime second is $\frac{49}{121}$.

$$\begin{aligned} P(\text{quarter 1st or dime 2nd}) &= P(\text{quarter 1st}) + P(\text{dime 2nd}) - P(\text{quarter 1st and dime 2nd}) \\ &= \frac{4}{22} + \frac{6}{22} - \left(\frac{4}{22}\right)\left(\frac{6}{22}\right) \\ &= \frac{4}{22} + \frac{6}{22} - \frac{24}{484} \\ &= \frac{88}{484} + \frac{132}{484} - \frac{24}{484} \\ &= \frac{196}{484} \\ &= \frac{49}{121} \end{aligned}$$

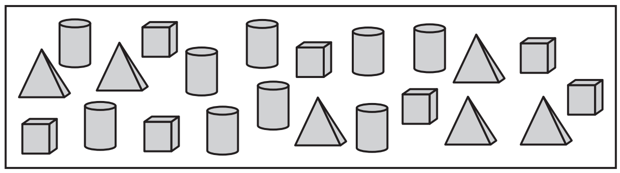
6. A box contains 6 blue blocks, 4 green blocks, 8 orange blocks, 12 yellow blocks, and 14 red blocks. You randomly choose 3 blocks from the box. Each time you choose a block, you replace it before choosing the next one. What is the probability of choosing a green block first, a yellow block second, and a blue block third?

The probability of choosing a green block first, a yellow block second, and a blue block third is $\frac{9}{2662}$.

$$\begin{aligned} P(\text{green 1st , yellow 2nd, and blue 3rd}) &= P(\text{green 1st}) \cdot P(\text{yellow 2nd}) \cdot P(\text{blue 3rd}) \\ &= \frac{4}{44} \cdot \frac{12}{44} \cdot \frac{6}{44} \\ &= \frac{1}{11} \cdot \frac{3}{11} \cdot \frac{3}{22} \\ &= \frac{9}{2662} \end{aligned}$$

Determine the probability that each compound event will occur without replacement.

7. You randomly choose three shapes from the set, one after the other, without replacement. What is the probability that the first shape is a triangle, the second shape is a cube, and the third shape is a cylinder?



The probability of choosing a triangle first, a cube second, and a cylinder third is $\frac{9}{220}$.

$$\begin{aligned} P(\text{triangle 1st , cube 2nd, or cylinder 3rd}) &= P(\text{triangle 1st}) \cdot P(\text{cube 2nd}) \cdot P(\text{cylinder 3rd}) \\ &= \frac{6}{22} \cdot \frac{7}{21} \cdot \frac{9}{20} \\ &= \frac{3}{11} \cdot \frac{1}{3} \cdot \frac{9}{20} \\ &= \frac{27}{660} \\ &= \frac{9}{220} \end{aligned}$$

8. A fruit bowl contains 6 apples, 2 pears, and 4 oranges. You randomly choose one fruit, and then without replacement, you choose another fruit. What is the probability that you choose a pear first or an orange second?

The probability of choosing a pear first or an orange second is $\frac{29}{66}$.

$$\begin{aligned} P(\text{pear 1st or orange 2nd}) &= P(\text{pear 1st}) + P(\text{orange 2nd}) - P(\text{pear 1st and orange 2nd}) \\ &= \frac{2}{12} + \frac{4}{12} - \left(\frac{2}{12}\right)\left(\frac{4}{11}\right) \\ &= \frac{2}{12} + \frac{4}{12} - \frac{8}{132} \\ &= \frac{22}{132} + \frac{44}{132} - \frac{8}{132} \\ &= \frac{58}{132} \\ &= \frac{29}{66} \end{aligned}$$

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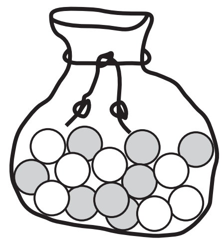
9. You randomly choose one ball from the bag without replacement, and then choose another ball. What is the probability that you will choose a white ball first or a shaded ball second?



The probability of choosing a white ball first or a shaded ball second is $\frac{11}{15}$.

$$\begin{aligned} P(\text{white 1st or shaded 2nd}) &= P(\text{white 1st}) + P(\text{shaded 2nd}) - P(\text{white 1st and shaded 2nd}) \\ &= \frac{7}{15} + \frac{8}{15} + \left(\frac{7}{15}\right)\left(\frac{8}{14}\right) \\ &= \frac{7}{15} + \frac{8}{15} - \frac{56}{210} \\ &= \frac{98}{210} + \frac{112}{210} - \frac{56}{210} \\ &= \frac{154}{210} \\ &= \frac{11}{15} \end{aligned}$$

10. A teacher is dividing the 24 members of a class into groups to work on different projects. The letter A, B, or C is written on each of 24 cards, and the cards are placed in a box. There are eight A cards, six B cards, and ten C cards. Each student randomly draws a card from the box, without replacement, to determine the student's group assignment. What is the probability that the first student will draw out an A or the second student will draw out a B?

The probability of choosing an *A* first or a *B* second is $\frac{35}{69}$.

$$\begin{aligned} P(A\text{ 1st or }B\text{ 2nd}) &= P(\text{A 1st}) + P(B\text{ 2nd}) - P(A\text{ 1st and }B\text{ 2nd}) \\ &= \frac{8}{24} + \frac{6}{23} - \left(\frac{8}{24}\right)\left(\frac{6}{23}\right) \\ &= \frac{8}{24} + \frac{6}{23} - \frac{48}{552} \\ &= \frac{184}{552} + \frac{144}{552} - \frac{48}{552} \\ &= \frac{280}{552} \\ &= \frac{35}{69} \end{aligned}$$

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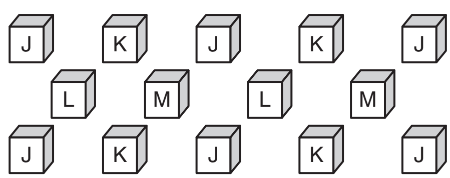
11. You have 8 black socks, 6 blue socks, 2 green socks, and 4 white socks in a drawer. You randomly draw out two socks, one after the other, without replacement. What is the probability that you will draw out a black sock first and a black sock second?

The probability of choosing a black sock first and a black sock second is $\frac{14}{95}$.

$$\begin{aligned} P(\text{black 1st and black 2nd}) &= P(\text{black 1st}) \cdot P(\text{black 2nd}) \\ &= \frac{8}{20} \cdot \frac{7}{19} \\ &= \frac{2}{5} \cdot \frac{7}{19} \\ &= \frac{14}{95} \end{aligned}$$

12. You draw a block at random from the set. Then, without replacing it, you draw another block at random from the set. What is the probability that the first block has a J on it or the second block has a K on it?



The probability of choosing a *J* block first or a *K* block second is $\frac{53}{91}$.

$$\begin{aligned} P(J\text{ 1st or }K\text{ 2nd}) &= P(J\text{ 1st}) + P(K\text{ 2nd}) - P(J\text{ 1st and }K\text{ 2nd}) \\ &= \frac{6}{14} + \frac{4}{14} - \left(\frac{6}{14}\right)\left(\frac{4}{13}\right) \\ &= \frac{6}{14} + \frac{4}{14} - \frac{24}{182} \\ &= \frac{78}{182} + \frac{52}{182} - \frac{24}{182} \\ &= \frac{106}{182} \\ &= \frac{53}{91} \end{aligned}$$

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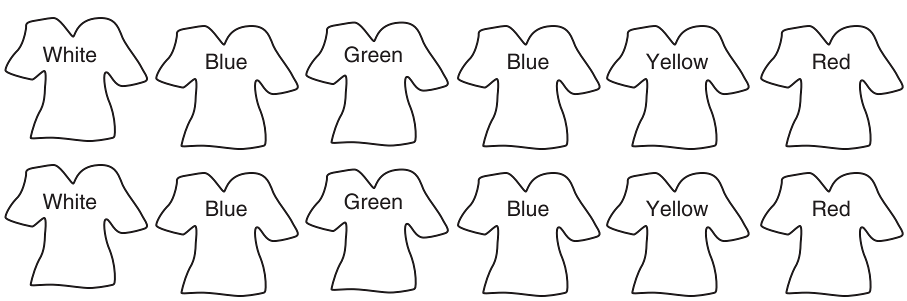
13. A standard deck of 52 playing cards is composed of four cards each of aces, Kings, Queens, and Jacks, as well as four cards of each number from 2 to 10. You randomly draw out a card and, without replacement, then draw out another card. What is the probability that the first card is a numbered card or the second card is a King?

The probability of choosing a numbered card first or a King second is $\frac{158}{221}$

Let N represent choosing a numbered card.

$$\begin{aligned}
P(N\text{ 1st or King 2nd}) &= P(N\text{ 1st}) + P(\text{King 2nd}) - P(N\text{ 1st and King 2nd}) \\
&= \frac{36}{52} + \frac{4}{52} - \left(\frac{36}{52}\right)\left(\frac{4}{51}\right) \\
&= \frac{1836}{2652} + \frac{204}{2652} - \frac{144}{2652} \\
&= \frac{1896}{3652} \\
&= \frac{158}{221}
\end{aligned}$$

14. The diagram shows the tee-shirts that you have in a drawer. You randomly remove two tee-shirts from the drawer, one after the other, without replacement. What is the probability that the first tee-shirt will be blue and the second tee-shirt will be blue?



The probability of choosing a blue tee-shirt first and another blue tee-shirt second is $\frac{1}{11}$.

$$\begin{aligned}
P(\text{blue 1st and blue 2nd}) &= P(\text{blue 1st}) \cdot P(\text{blue 2nd}) \\
&= \frac{4}{12} \cdot \frac{3}{11} \\
&= \frac{1}{3} \cdot \frac{3}{11} \\
&= \frac{1}{11}
\end{aligned}$$

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Do You Have a Better Chance of Winning the Lottery or Getting Struck By Lightning?

Investigate Magnitude through Theoretical Probability and Experimental Probability

Vocabulary

Write the term that best completes each statement.

1. A(n) experimental probability is the number of times an outcome occurs divided by the total number of trials performed.

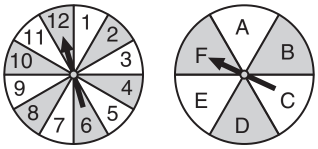
2. An experiment that models a real-life situation is a(n) simulation.

3. A(n) theoretical probability is the number of desired outcomes divided by the total number of possible outcomes.

Problem Set

Solve each problem using the multiplication rule of probability for compound independent events.

1. You spin each spinner once. What is the probability of spinning a number less than 7 followed by spinning either A or B?



The probability of a spin resulting in a number less than 7 and an A or B is $\frac{1}{6}$.

Let <7 represent of a spin resulting in a number less than 7.
Let L represent a spin resulting in the letters A or B.

$$P(<7 \text{ 1st and } L \text{ 2nd}) = P(<7 \text{ 1st}) \cdot P(L \text{ 2nd})$$
$$= \frac{6}{12} \cdot \frac{2}{6}$$
$$= \frac{1}{2} \cdot \frac{1}{3}$$
$$= \frac{1}{6}$$

2. A 6-sided number cube is rolled three times. What is the probability that the first time the number will be greater than 4, the second time it will be an even number, and the third time it will be a multiple of 2?

The probability of a number greater than 4 first, an even number second, and a multiple of 2 third is $\frac{1}{12}$.

Let $>$ 4 represent a roll resulting in a number greater than 4.

Let E represent a roll resulting in an even number.

Let M represent a roll resulting in a multiple of 2.

$$\begin{aligned} P(>4 \text{ 1st}, E \text{ 2nd, and } M \text{ 3rd}) &= P(>4 \text{ 1st}) \cdot P(E \text{ 2nd}) \cdot P(M \text{ 3rd}) \\ &= \frac{2}{6} \cdot \frac{3}{6} \cdot \frac{3}{6} \\ &= \frac{1}{3} \cdot \frac{1}{2} \cdot \frac{1}{2} \\ &= \frac{1}{12} \end{aligned}$$

3. An amusement park has job openings for high school students. Jake, Terrance, and Mia are each offered a job. They are allowed to choose two of the available types of jobs, and each will be randomly assigned one of the two types of jobs they have chosen. Jake chooses food service and custodial. Terrance chooses food service and operations. Mia chooses food service and merchandise. What is the probability that all three of the friends will be assigned the same type of job?

Types of Jobs	Number of Openings
Food service	64
Games	76
Custodial	16
Operations	24
Merchandise	32
Warehouse	44

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The probability all three friends will be assigned the same type of job is $\frac{64}{165}$.

Let J represent Jake being assigned a food service job.

Let T represent Terrance being assigned a food service job.

Let M represent Mia being assigned a food service job.

$$\begin{aligned} P(J, T, \text{and } M) &= P(J) \cdot P(T) \cdot P(M) \\ &= \frac{64}{(64 + 16)} \cdot \frac{64}{(64 + 24)} \cdot \frac{64}{(64 + 32)} \\ &= \frac{64}{80} \cdot \frac{64}{88} \cdot \frac{64}{96} \\ &= \frac{4}{5} \cdot \frac{8}{11} \cdot \frac{2}{3} \\ &= \frac{64}{165} \end{aligned}$$

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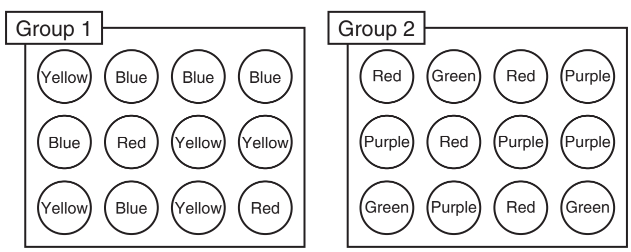
4. A website assigns a 5-digit password to you. Each digit is randomly chosen from 0 to 9. What is the probability that each digit in the password is less than 2?

The probability that each of the five digits is less than 2 is $\frac{1}{3125}$.

Let <2 represent choosing a digit less than 2.

$$\begin{aligned} P(\text{five} <2\text{'s}) &= P(<2) \cdot P(<2) \cdot P(<2) \cdot P(<2) \cdot P(<2) \\ &= \frac{2}{10} \cdot \frac{2}{10} \cdot \frac{2}{10} \cdot \frac{2}{10} \cdot \frac{2}{10} \\ &= \frac{1}{5} \cdot \frac{1}{5} \cdot \frac{1}{5} \cdot \frac{1}{5} \cdot \frac{1}{5} \\ &= \frac{1}{3125} \end{aligned}$$

5. You randomly choose a ball from each group. What is the probability that you will choose a red ball from each group?



The probability of choosing a red ball from Group 1 and a red ball from Group 2 is $\frac{1}{18}$.

$$\begin{aligned} P(\text{red 1st and red 2nd}) &= P(\text{red 1st}) \cdot P(\text{red 2nd}) \\ &= \frac{2}{12} \cdot \frac{4}{12} \\ &= \frac{1}{6} \cdot \frac{1}{3} \\ &= \frac{1}{18} \end{aligned}$$

6. You flip a coin 10 times. What is the probability that it will land heads up all 10 times?

The probability of the coin landing heads up for all ten flips is $\frac{1}{1024}$.

Let H represent a result of heads up for one coin flip.

$$\begin{aligned} P(10\ H\text{'s}) &= P(H) \cdot P(H) \cdot P(H) \cdot P(H) \cdot P(H) \cdot P(H) \cdot P(H) \cdot P(H) \cdot P(H) \cdot P(H) \\ &= \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \\ &= \frac{1}{1024} \end{aligned}$$

Solve each problem by determining the experimental probability using a random number generator on a graphing calculator.

7. Using the random number generator on a calculator, you press **ENTER** 40 times to simulate 200 trials. A number that represents a successful outcome appears 12 times. What is the experimental probability of a successful outcome?

experimental probability $= \frac{12}{200} = \frac{3}{50}$

8. Using the random number generator on a calculator, you press **ENTER** 60 times to simulate 300 trials. A number that represents a successful outcome appears 6 times. What is the experimental probability of a successful outcome?

experimental probability $= \frac{6}{300} = \frac{1}{50}$

9. Using the random number generator on a calculator, you press **ENTER** 35 times to simulate 175 trials. A number that represents a successful outcome appears 15 times. What is the experimental probability of a successful outcome?

experimental probability $= \frac{15}{175} = \frac{3}{35}$

10. Using the random number generator on a calculator, you press **ENTER** 65 times to simulate 325 trials. A number that represents a successful outcome appears 10 times. What is the experimental probability of a successful outcome?

experimental probability $= \frac{10}{325} = \frac{2}{65}$

11. Using the random number generator on a calculator, you press **ENTER** 50 times to simulate 250 trials. A number that represents a successful outcome appears 22 times. What is the experimental probability of a successful outcome?

experimental probability $= \frac{12}{250} = \frac{6}{125}$

12. Using the random number generator on a calculator, you press **ENTER** 30 times to simulate 150 trials. A number that represents a successful outcome appears 25 times. What is the experimental probability of a successful outcome?

experimental probability $= \frac{25}{150} = \frac{1}{6}$

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Compare the theoretical probability and the experimental probability in each situation.

13. A bag contains 36 red balls, 17 green balls, and 28 white balls. You randomly choose 25 balls and 4 of them are red. Compare the theoretical and experimental probabilities of drawing a red ball out of the bag.

The theoretical probability is greater.

theoretical probability $= \frac{36}{81} \approx 0.44$

experimental probability $= \frac{4}{25} = 0.16$

14. You randomly choose a letter of the alphabet 30 times, and 5 of them are vowels (a, e, i, o, or u). Compare the theoretical and experimental probabilities of choosing a vowel.

The theoretical probability is greater.

theoretical probability $= \frac{5}{26} \approx 0.19$

experimental probability $= \frac{5}{30} \approx 0.17$

15. You flip a coin 30 times and it lands on tails 18 times. Compare the theoretical and experimental probabilities of the coin landing on tails.

The experimental probability is greater.

theoretical probability $= \frac{1}{2} = 0.5$

experimental probability $= \frac{18}{30} = 0.6$

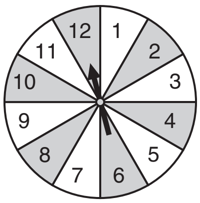
16. You roll a 6-sided number cube 25 times, and 15 of the rolls land on a number greater than 2. Compare the theoretical and experimental probabilities the cube landing on a number greater than 2.

The theoretical probability is greater.

theoretical probability $= \frac{4}{6} \approx 0.67$

experimental probability $= \frac{15}{25} = 0.6$

17. You spin the spinner 50 times, and 32 of those times it lands on a number greater than 5. Compare the theoretical and experimental probabilities of the spinner landing on a number greater than 5.



The experimental probability is greater.

theoretical probability $= \frac{7}{12} \approx 0.58$

experimental probability $= \frac{32}{50} = 0.64$

18. A jar contains 12 silver marbles, 8 gold marbles, and 6 purple marbles. You randomly choose 10 of the marbles and 4 are purple. Compare the theoretical and experimental probabilities of choosing a purple marble.

The experimental probability is greater.

theoretical probability $= \frac{6}{26} \approx 0.23$

experimental probability $= \frac{4}{10} = 0.4$