

# Lesson 54

## Compound Probability

NAME:



Start by navigating to the Online Lesson for instructions.

### Objectives

- ✓ Calculate the probability of mutually exclusive events.
- ✓ Calculate the probability of inclusive events.
- ✓ Analyze a two-way table or Venn diagram.
- ✓ Construct a two-way table or Venn diagram.

### Why?

Venn diagrams and compound probability allow you to analyze overlapping information. You can make informed decisions about things like “What if I want to go to a school with a business AND a computer science program?”



### Warm Up

Use the months of the year to answer problems 1–4.

- 1) What months have 28 days?
- 2) All months have 30 days except which one(s)?
- 3) All months are spelled with at least five letters, except which one(s)?
- 4) Which month(s) are spelled with at least one “o”?



To continue, return to the Online Lesson.

### Explore

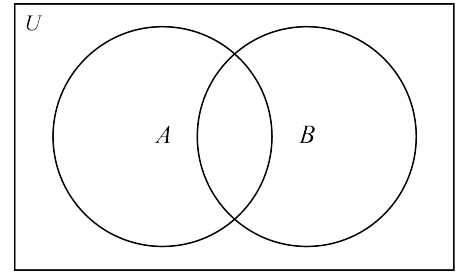
#### Sets and Venn Diagrams

Fill in the notes as you watch the video in the Online Lesson.

- A Venn diagram is a visual tool that uses overlapping circles to represent \_\_\_\_\_ among sets.
- Sets denote \_\_\_\_\_ and \_\_\_\_\_.

**Parts of a Venn Diagram**

The Universal Set	The Subsets
<ul style="list-style-type: none"> <li>• Represented by the rectangle</li> <li>• Labeled <math>U</math> in this diagram</li> <li>• Includes all elements contained inside it.</li> </ul>	<ul style="list-style-type: none"> <li>• Represented by the circles</li> <li>• Labeled <math>A</math> and <math>B</math> in this diagram</li> <li>• May contain elements in any/all parts of the circle.</li> </ul>

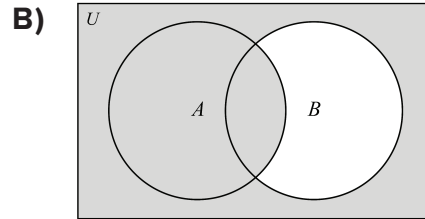
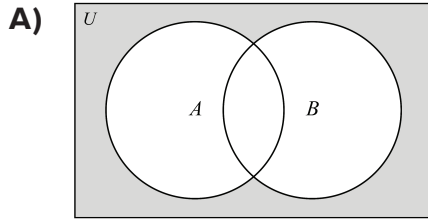


Venn Diagram	Notation and Wording
<p>_____</p>	<p><b>Subset notation:</b> <math>\subset</math></p> <p>Sets <math>A</math> and <math>B</math> are subsets of <math>U</math></p> <p><math>U</math> includes <math>A</math> and <math>B</math></p>
<p>_____</p>	<p><b>Union notation:</b> <math>\cup</math></p> <p>“or” is another word for union</p> <p>The union of <math>A</math> and <math>B</math></p> <p>Either <math>A</math> <b>or</b> <math>B</math></p>
<p>_____</p>	<p><b>Intersection notation:</b> <math>\cap</math></p> <p>“and” is another word for intersection</p> <p>The intersection of <math>A</math> and <math>B</math></p> <p>Must include <math>A</math> <b>and</b> <math>B</math></p>
<p>_____</p>	<p><b>Complement notation:</b> <math>'</math></p> <p>The complement of <math>A</math></p> <p>Also said “<math>A</math> not”</p>

**Example 1**

▶ Complete the example as you watch the video in the Online Lesson.

Describe the Venn diagram symbolically.

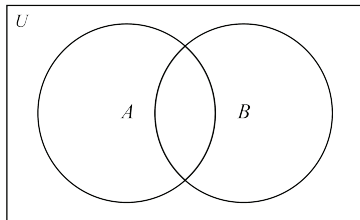


**Example 2**

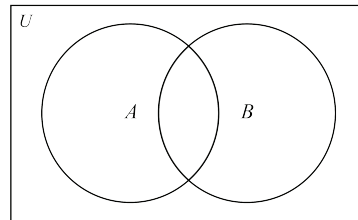
▶ Complete the example as you watch the video in the Online Lesson.

Shade the Venn diagram to represent the notation.

A)  $B \cap A'$

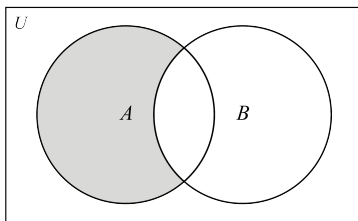


B)  $A' \cup B' = (A \cap B)'$

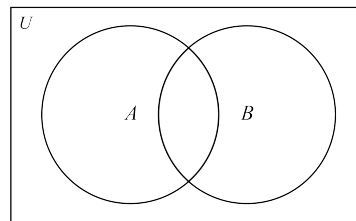


**Checkpoint: Sets and Venn Diagrams**

A) Describe the Venn diagram using symbols.



B) Shade the Venn diagram to represent the notation:  $B$



 To continue, return to the Online Lesson.

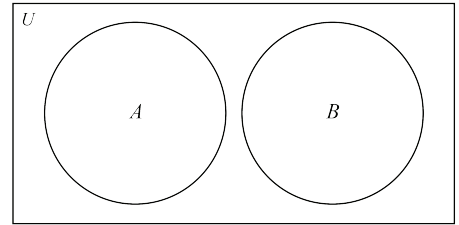
## 📺 Compound Events

🎥 Fill in the notes as you watch the video in the Online Lesson.

- A \_\_\_\_\_ in probability is made up of two or more simple events that happen together or in sequence.

### Mutually Exclusive Events

- \_\_\_\_\_ events cannot occur at the same time.
- If events have nothing in common, the sets will \_\_\_\_\_.



- For \_\_\_\_\_ exclusive events:  $P(A \cap B) = 0$
- If  $A$  and  $B$  are mutually exclusive events, then the \_\_\_\_\_,  $\cup$ , of the events is:

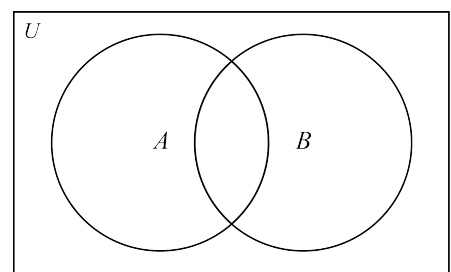
$$P(A \text{ or } B) = P(A) + P(B)$$

or

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

### Inclusive events

- \_\_\_\_\_ occur when parts of a set overlap or intersect with another set.
- To prevent \_\_\_\_\_, subtract the intersection,  $\cap$ , from the sum of  $A$  and  $B$ :
- Ask yourself, “What elements do  $A$  AND  $B$  \_\_\_\_\_?”



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

**Example 3**

▶ Complete the example as you watch the video in the Online Lesson.

Sort the set,  $\{1, 2, \dots, 14\}$ , into factors of 18 and multiples of 4. Then find the probabilities.

A)  $P(\text{factor of 18 or multiple of 4})$

B)  $P(\text{factor of 18 and multiple of 4})$

C)  $P(\text{multiple of 4 or not a factor of 18})$

U

**Example 4**

▶ Complete the example as you watch the video in the Online Lesson.

Determine probabilities of a standard deck of cards.

A)  $P(\text{king or queen}) = P(K) + P(Q)$

B)  $P(\text{ace or hearts}) = P(A) + P(\heartsuit) - P(A \heartsuit)$

C)  $P(\text{face card} \cup \text{red})$

D) A red face card

E) A black ten or a red seven

**Spades****Hearts****Diamonds****Clubs**

**Checkpoint: Compound Events**

Determine probabilities of a standard card deck. State whether the problems are mutually exclusive or inclusive events.


A)  $P(10 \cup J)$

B)  $P(10 \cup \text{red})$

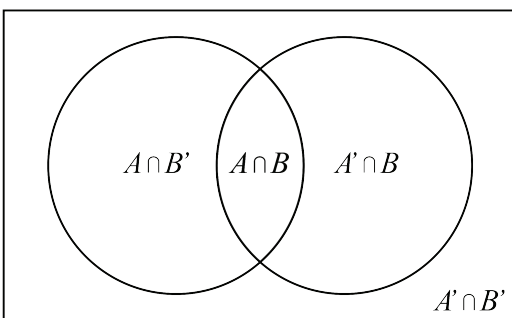


To continue, return to the Online Lesson.

## Two-Way Tables

 Fill in the notes as you watch the video in the Online Lesson.

- A two-way table organizes information using \_\_\_\_\_.
- The information in the table cells can be \_\_\_\_\_.
- Combining Venn diagrams, sets, and two-way tables:



	<b>A</b>	<b>A'</b>
<b>B</b>	$A \cap B$ A and B intersect	$A' \cap B$ not A and B
<b>B'</b>	$A \cap B'$ A and not B	$A' \cap B'$ not A and not B

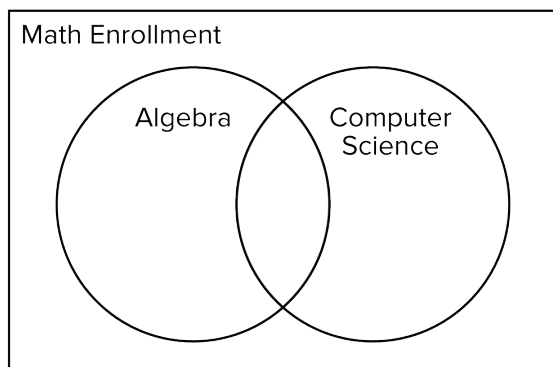
**Example 5**

▶ Complete the example as you watch the video in the Online Lesson.

The math department has 75 students enrolled, with the highest enrollment in Algebra (22 students) and Computer Science (19 students). Five students selected both courses, and the remaining students selected another math option.

**A)** Create the Venn diagram.

**B)** Create a two-way table.

**C)** The probability of students enrolled in Algebra or Computer Science

**D)** The probability of students in Algebra and Computer Science, or neither

## 📺 Two-Way Tables (cont.)

🎥 *Fill in the notes as you watch the video in the Online Lesson.*

- A \_\_\_\_\_ table contains proportions or percentages rather than counts.
  - Since most groups \_\_\_\_\_, percentages allow for a more fair comparison of events (or subgroups).
- Joint relative frequency tables calculate proportions or percentages \_\_\_\_\_.
  - The \_\_\_\_\_ is calculated from the population total.

### Example 6

🎥 *Complete the example as you watch the video in the Online Lesson.*

A group of 200 athletes was asked if they ate a snack and if they completed a warm-up before their games.

**Determine the number of athletes that fit the description.**

**A)** Athletes who did not complete a warm-up

	<b>W</b>	<b>W'</b>
<b>S</b>	45%	5%
<b>S'</b>	44%	6%

**B)** Athletes who did not snack and completed a warm-up

**Checkpoint: Two-Way Tables**

The moon is in the sky for 300 nights each calendar year in Pennsylvania. Of the 195 clear nights recorded, there was no moon on 35 nights.

**A)** Create a two-way table.

**B)** Determine the probability that the night is overcast and there is no moon.

**C)**  $P(\text{clear or moon})$

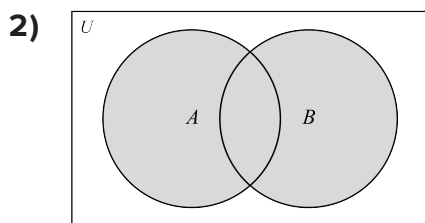
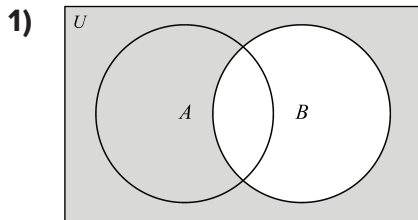


**To continue, return to the Online Lesson.**

 Practice 1

Complete problems on a separate sheet of paper.

Describe the Venn diagram in symbols.



Sketch and shade the Venn diagram to represent the notation.

- 3)  $A \cap B$
- 4)  $A$
- 5) What is the difference between mutually exclusive and inclusive?
- 6) What is a compound event in probability?

For problems 7–12, determine probabilities of a standard card deck.

- 7) Drawing a face card or an ace
- 8)  $P(\text{seven} \cup \text{clubs})$
- 9)  $P(\text{two or red})$
- 10) Probability of a red two
- 11)  $P(\text{five and six})$
- 12) Which problems are mutually exclusive? Explain.

For problems 13–18, the set of numbers,  $N:\{4, 5, 6, \dots, 14, 15\}$ , contains the subsets for prime numbers and even numbers.

- 13) Create a two-way table.
- 14) Create a Venn diagram.
- 15)  $P(\text{multiple of 3 or even})$
- 16)  $P(\text{factor of 15 and prime})$
- 17) Determine the probability of choosing an even number that is not prime.
- 18) Determine the probability of choosing a number that is not even and not prime.

For problems 19–24, use the two-way table and write answers as a percentage, rounded to the nearest tenth.

The table compares the types of colleges and the degrees offered by 30 colleges in the state of Maine.

	Private	Public (Not Private)
Associate College	3.33%	23.33%
Other	50%	23.33%

- 19) Determine the percentage of associate degree colleges in Maine.
- 20) Determine the number of public associate degree colleges.
- 21) Determine the percentage of colleges that are non-associate degree colleges.
- 22) Determine the number of private, non-associate colleges.
- 23) Explain if this data represents mutually exclusive or inclusive events.
- 24) If one college were randomly selected, which one is the least likely to be selected? Explain.



To continue, return to the Online Lesson.

 **Mastery Check** **Show What You Know**

All possible products of two fairly rolled dice are recorded in the table.

	1	2	3	4	5	6
1	1	2	3	4	5	6
2	2	4	6	8	10	12
3	3	6	9	12	15	18
4	4	8	12	16	20	24
5	5	10	15	20	25	30
6	6	12	18	24	30	36

**A)** An odd number or a multiple of 5 is rolled.

**B)**  $P(\text{perfect square} \cup \text{product is } 6)$

**C)**  $P(\text{prime} \cap \text{factor of } 36)$

When two dice are rolled, the sum is represented by the set,  $S = \{2, 3, \dots, 11, 12\}$ .

D) Explain if a Venn diagram with the subsets labeled “Sum is even” and “Sum is odd” represents mutually exclusive or inclusive events.

E) Construct a two-way table that groups the numbers by multiples of two and multiples of three.

### Say What You Know

In your own words, talk about what you have learned using the objectives for this lesson and your work on this page.

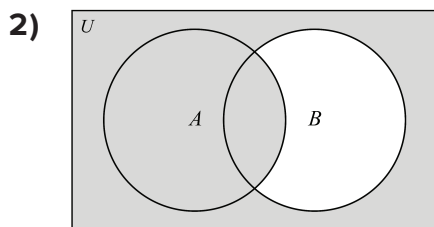
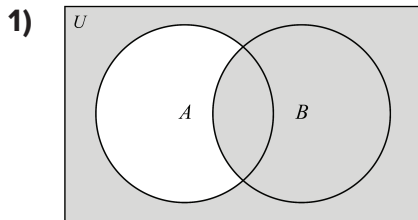


To continue, return to the Online Lesson.

 Practice 2

Complete problems on a separate sheet of paper.

Describe the Venn diagram in symbols.



Sketch and shade the Venn diagram to represent the notation.

3)  $A'$

4)  $A \cap B'$

For problems 5–8, a job application survey was completed by 150 randomly selected people.

Job Applicant Survey

		College Diploma	
		Yes	No
Work Experience	Yes	41%	23%
	No	18%	18%

5)  $P(\text{has diploma})$

6) The number of people who have a diploma and no experience

7) The number of people who have a diploma or experience

8)  $P(\text{no diploma and no experience})$

For problems 9–14, use the set of numbers.

$$C: \left\{ -20i, -7, -\frac{1}{3}, \frac{5i}{6}, \sqrt{5}, e, 3, \pi, \frac{11}{2}, 12, 13i \right\}$$

- 9) Create a two-way table for rational,  $\mathbb{Q}$ , and irrational,  $\mathbb{I}$ , numbers.
- 10) Create a Venn diagram for rational,  $\mathbb{Q}$ , and irrational,  $\mathbb{I}$ , numbers.
- 11)  $P(\mathbb{Q}')$
- 12)  $P(\mathbb{I})'$
- 13) A rational number
- 14) A rational and irrational number

For problems 15–20, all possible sums for two dice are recorded in the table.

15) A sum of 5

16) A sum of 3 or 11

17)  $P(\text{sum of } 9)'$

18)  $P(\text{sum of } 6)$

19) Not the sum of either 12 or 3

20) What sum is most likely to be rolled? Explain.

	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
5	6	7	8	9	10	11
6	7	8	9	10	11	12



To continue, return to the Online Lesson.