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Lesson 6: Striving for Independence

Practice Understanding

Learning Focus

Determine if events are independent.

Use representations to find probabilities.

How do I determine if one event is independent of another event?

Open Up the Math

Launch, Explore, Discuss

You've learned a lot about probability in this unit using different representations, including two-way tables, Venn diagrams, and tree diagrams. You've also learned some relationships between conditional probabilities, the probability of the union of two events, and the probability of the intersection of two events. Just in case that wasn't enough, you learned to determine if events are independent. In this lesson, you'll be asked to put all that knowledge and your best reasoning to work to solve some new probability problems with old contexts. Let's get started!

1. Out of the $2{,}000$ students who attend a certain high school, $1{,}800$ students own cell phones, 800 own a tablet, and 700 have both.

a. Create a Venn diagram model for this situation. Use proper probability notation as you answer the following problems.

b. What is the probability that a randomly selected student owns a cell phone?

c. What is the probability that a randomly selected students owns both a cell phone and a tablet?

d. If a randomly selected student owns a cell phone, what is the probability that this student also owns a tablet?

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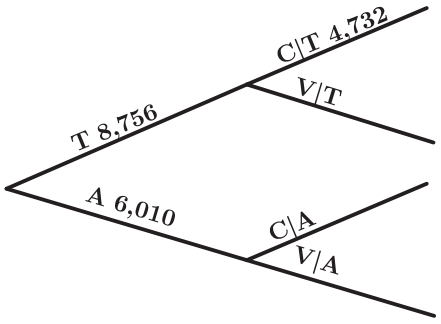
e. How are problems c and d different?

f. Are the outcomes "owns a cell phone" and "owns a tablet" independent? Explain.

2. The following is a partially completed tree diagram from Lesson 2 where we compared preferences for chocolate or vanilla ice cream.

a. Circle the parts of the diagram that would be used to determine if choosing chocolate is independent of being a teen or an adult.

b. Complete the diagram so that choosing chocolate is independent of being teen or adult.



3. Many people are surprised to find that the *Titanic* picked up passengers in three ports before the disastrous attempt to sail the Atlantic. Rose and Jack found this data about survival of the passengers from two of the different ports and displayed it in the table below. Source: openup.org/USpsDV.

	Survived	Did Not Survive	Total
Southampton, UK	304	610	914
Cherbourg, France	150	120	270
Total	454	730	1,184

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a. Determine if survival is independent of boarding from Southampton for this data. Show why or why not.

b. If survival is not independent of the port, determine how many people boarding from Southampton would need to survive in order to make it independent.

4. Determine whether the second event would be dependent or independent of the first event. Explain.

a. Rolling a six-sided die, then drawing a card from a deck of 52 cards.

b. Drawing a card from a deck of 52 cards and not replacing it, then drawing another card from the same deck.

c. Rolling a six-sided die, then rolling it again.

d. Pulling a marble out of a bag, replacing it, then pulling a marble out of the same bag.

5. The probability that a student takes an art class at Imagination High School is 0.5. The probability that a student takes a music class is 0.3. The probability that they take an art or music class is 0.65.

a. Find the probability that a student takes both an art and a music class.

b. Are the events "takes an art class" and "takes a music class" independent? Explain.

c. Are the events "takes an art class" and "takes a music class" mutually exclusive? Explain.

Ready for More?

When Drug A and Drug B are taken together, they operate independently. Drug A is effective 85% of the time. Drug B is effective 90% of the time. If both drugs are taken together, what is the probability that neither drug is effective?

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Takeaways

Helpful hints for using probability rules to determine independence:

Lesson Summary

In this lesson, we combined the rules and relationships we have learned for probability to determine if events are independent and to find conditions that make events independent. We learned that when conditional probabilities such as $P(A|B)$ are available, it is efficient to see if the conditional probability is equal to $P(A)$ to determine if A and B are independent. If probabilities of unions and intersections are available, it may be more efficient to use the Multiplication Rule to test for independence.

Retrieval

Solve each quadratic equation.

1. $n^2 - 9n - 36 = 0$

2. $x^2 + 12x + 48 = 0$

For problems 3–5, use the following information:

- Two events, event A and event B, are not mutually exclusive.
- $P(A) = \frac{3}{10}$, $P(\text{not } B) = \frac{7}{10}$, and $P(A \text{ and } B) = \frac{1}{10}$.

3. Find $P(B)$.

4. Find $P(A \text{ or } B)$.

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5. Find $P(A|B)$.