NAME DATE PERIOD

Lesson 5: Declaring Independence

Solidify Understanding

Learning Focus

Determine if two events are independent.

Find the probabilities of independent events.

Under what conditions is an event independent of another event?

How does knowing that events are independent help find probabilities?

Open Up the Math

Launch, Explore, Discuss

At Fried Freddy's, Tyrell helped Freddy determine the amount and type of food Freddy should prepare each day for his restaurant. As a result, Freddy's food waste decreased dramatically. As time went by, Freddy noticed that another factor he needed to consider was the day of the week. He noticed that he was overpreparing during the week and sometimes under-preparing on the weekend. Tyrell and Freddy worked together and started collecting data to find the average number of orders he received of chicken and fish on a weekday and compared it to the average number of orders he received of each on the weekend. After two months, they had enough information to create the two-way table below:

	Fish	**Chicken**	**Total**
Weekday	65	79	144
Weekend	130	158	288
Total	195	237	432

1. As usual, Freddy starts with a little analysis of the data. Help Freddy by finding these probabilities. Write your answers both as fractions and percentages.

   a. $P(\text{Fish}|\text{Weekday})$

   b. $P(\text{Chicken}|\text{Weekend})$

NAME DATE PERIOD

c. $P(\text{Fish and Weekend})$

d. $P(\text{Fish})$

e. $P(\text{Weekday})$

2. What do you notice about these probabilities?

   a. Would you say that the probability that a customer orders fish depends on the day of the week? Explain.

   b. Would you say that the amount of fish needed depends on the day of the week? Explain.

3. Using the test for independence from the last lesson, show that the probability of a customer ordering fish is independent of whether it is a weekday or weekend.

4. Another relationship we worked with in the last lesson was $P(A|B) = \frac{P(A \text{ and } B)}{B}$.

   a. Write a statement of this relationship using:

   $$P(\underline{\hspace{4cm}}) = \frac{P(\text{Fish and Weekday})}{P(\underline{\hspace{4cm}})}$$

   b. Solve this relationship for $P(\text{Fish and Weekday})$.

   Since these probabilities are independent, $P(\text{Fish}|\text{Weekday}) = P(\text{Fish})$

   Make this substitution and write the equation for $P(\text{Fish and Weekday})$.

   Verify that the equation is true using the probabilities you found earlier.

This relationship between probabilities of independent events is used in two ways. It can be used to determine if events are independent and to find probabilities when independence has been established. It is called the Multiplication Rule and is written:

$P(A \text{ and } B) = P(A) \cdot P(B)$.

NAME DATE PERIOD

Sometimes the nature of the problem makes it apparent that events are independent.

5. Let's start with a classic number cube that has six sides labeled 1–6 that is rolled once, picked up, and rolled again.

   a. Would you say that the probability of rolling a 6 in the first roll is independent of the probability of rolling a 6 in the second roll? Why?

   b. What is the probability of rolling a 5 in the first roll?

   $P(R5) =$

   c. What is the probability of rolling a 5 in the second roll?

   $P(R5) =$

   d. What is the probability of rolling 5 in the first roll and 5 in the second roll?

   $P(R5 \text{ and } R5) =$

6. You're at a carnival and you're watching a game that has a big color wheel with eight different colors of equal area. People pay money to spin the wheel to win a giant stuffed animal if the wheel lands on yellow.

   a. Is each spin an independent event? Explain.

   b. As you watch, you see that 6 people in a row have landed on red. You think about jumping up and playing the game because now you are more likely to get a yellow. Is this a good idea?

   c. You reach in your pocket and don't have any money to spin the wheel, so you just sit and watch. The wheel landed on red again and you start to wonder if this is a fair game. What argument can you make to the carnival manager about the game?

Ready for More?

Johnny K has a bag of sour candies colored red, blue, green, and yellow that contains 25 of each candy. What is the probability that he pulls out a red, eats it, and then pulls out another red?

NAME DATE PERIOD

Takeaways

Multiplication Rule for independent events:

Using the Multiplication Rule to find the probability of the intersection of events A, B, and C:

Lesson Summary

In this lesson, we used two methods to show that events are independent. The first method relies on conditional probability, and the second method is the Multiplication Rule. We also used the Multiplication Rule to find the probability of the intersection of two independent events.

Retrieval

Find the x-intercepts, y-intercept, line of symmetry, and vertex for the quadratic functions.

1. $f(x) = (x-7)^2 - 4$

2. $g(x) = x^2 + 8x + 7$

For problems 3–5, use the two-way frequency table to find the probabilities.

	Own Bike	Don't Own Bike	Total
Age 16–25	152	48	200
Age 26–35	86	114	200
Total	238	162	400

3. $P(\text{Own Bike}) =$

4. $P(\text{Own Bike} \mid \text{Age 26–35}) =$

NAME DATE PERIOD

5. $P(\text{Age 16–25 or Don't Own a Bike}) =$