# Conditional Probability Formulas

**Today I Can**

1. Understand and calculate conditional probabilities.

**Conditional Probability Formula**

For any two events $A$ and $B$, the probability of $B$ occurring, given that event $A$ has occurred is

$$P(B|A) = \frac{P(A \text{ and } B)}{P(A)} \quad \text{where } P(A) \neq 0$$

**Example 1.** In a study designed to test the effectiveness of a new drug, half of the volunteers received the drug. The other half of the volunteers received a placebo (doesn't contain medication). The probability of a volunteer receiving the drug and getting well was 45%.

(a) What is the probability of someone getting well, given that they receive the drug?

(b) What is the probability that someone getting well, if they did not receive the drug? This is called *the placebo effect*.

Conditional probabilities are usually not reversible:

$$P(A|B) \neq P(B|A)$$

**Example 2.** In a survey of pet owners, 45% own a dog, 27% own a cat, and 12% own both a dog and a cat.

(a) What is the probability that a dog owner also owns a cat?

(b) What is the probability that a cat owner also owns a dog?

Because $P(B|A) = \frac{P(A \text{ and } B)}{P(A)}$, then $P(A \text{ and } B) = P(A) \cdot P(B|A)$

You can use a tree diagram to help with conditional probability questions.

**Example 3.** A college reported the following based on their graduation data.

- 70% of freshmen had attended public schools
- 60% of freshmen who had attended public schools graduated within 5 years
- 80% of other freshmen graduated within 5 years

What percent of freshmen graduated within 5 years?