Name _____ Date _____

LESSON 11.4

# Study Guide

*For use with the lesson "Find Probabilities of Disjoint and Overlapping Events"*

**GOAL** **Find probabilities of compound events.**

## Vocabulary

The union or intersection of two events is called a **compound event.**

Two events are **overlapping** if they have one or more outcomes in common.

Two events are **disjoint,** or **mutually exclusive,** if they have no outcomes in common.

## EXAMPLE 1 Find probability of disjoint events

**A card is randomly selected from a standard deck of 52 cards. What is the probability that it is a 5 *or* an ace?**

Let event $A$ be selecting a 5 and event $B$ be selecting an ace. $A$ has 4 outcomes and $B$ has 4 outcomes. Because $A$ and $B$ are disjoint, the probability is:

$$P(A \text{ or } B) = P(A) + P(B) = \frac{4}{52} + \frac{4}{52} = \frac{8}{52} = \frac{2}{13} \approx 0.154$$

## EXAMPLE 2 Find probability of overlapping events

**A card is randomly selected from a standard deck of 52 cards. What is the probability that it is a club *or* a 3?**

Let event $A$ be selecting a club and event $B$ be selecting a 3. $A$ has 13 outcomes and $B$ has 4 outcomes. Of these, 1 outcome is common to $A$ and $B$. The probability of selecting a club *or* a 3 is:

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B) = \frac{13}{52} + \frac{4}{52} - \frac{1}{52} = \frac{16}{52} = \frac{4}{13} \approx 0.308$$

## EXAMPLE 3 Use a formula to find $P(A \text{ and } B)$

**Given $P(A) = 0.3$, $P(B) = 0.72$, and $P(A \text{ or } B) = 0.6$, find $P(A \text{ and } B)$.**

| | |
|---|---|
| $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$ | Write general formula. |
| $0.6 = 0.3 + 0.72 - P(A \text{ and } B)$ | Substitute known probabilities. |
| $P(A \text{ and } B) = 0.42$ | Solve for $P(A \text{ and } B)$. |

## Exercises for Examples 1, 2, and 3

**A card is randomly selected from a standard deck of 52 cards. Find the probability of the given event.**

**1.** Selecting a queen *or* a 4

**2.** Selecting a spade *or* a 5

**3.** Find $P(A \text{ and } B)$ when $P(A) = 0.25$, $P(B) = 0.40$, and $P(A \text{ or } B) = 0.55$.

## EXAMPLE 4 Find probabilities of complements

When two six-sided dice are rolled, there are 36 possible outcomes. Find the probability of the given event.

**a.** The sum is less than or equal to 3.

**b.** The sum is greater than 3.

### Solution

**a.** The outcomes for which the sum is less than or equal to 3 are (1, 1), (2, 1), and (1, 2).

$$P(\text{sum} \leq 3) = \frac{3}{36} = \frac{1}{12} \approx 0.083$$

**b.** $P(\text{sum} > 3) = 1 - P(\text{sum} \leq 3)$

$$= 1 - \frac{1}{12}$$

$$= \frac{11}{12}$$

$$\approx 0.917$$

## EXAMPLE 5 Use a complement in real life

**Annual Salary** A university conducted a national research study of recipients of PhD degrees. From the research data, the university determined that the probability that these recipients had annual salaries in excess of $95,000 was 0.834. What is the probability that a recipient from the study had an annual salary of $95,000 or less?

### Solution

The probability that a recipient had an annual salary of $95,000 or less is the complement of the event that a recipient had an annual salary in excess of $95,000.

$$P(\text{salary} \leq \$95{,}000) = 1 - P(\text{salary} > \$95{,}000)$$

$$= 1 - 0.834$$

$$= 0.166$$

## Exercises for Examples 4 and 5

**Find $P(\overline{A})$.**

**4.** $P(A) = 0.63$

**5.** $P(A) = \frac{1}{8}$

**6.** $P(A) = 0.45$

**7.** $P(A) = 0.09$

**8.** In Example 5 if the probability that the recipients of PhD degrees had annual salaries in excess of $95,000 was 0.668, what is the probability that a recipient from the study had an annual salary of $95,000 or less?