Independent Events

Two events are **independent** if the occurrence of one has no effect on the occurrence of the other. For instance, if a coin is tossed twice, the outcome of the first toss (heads or tails) has no effect on the outcome of the second toss.

PROBABILITY OF INDEPENDENT EVENTS

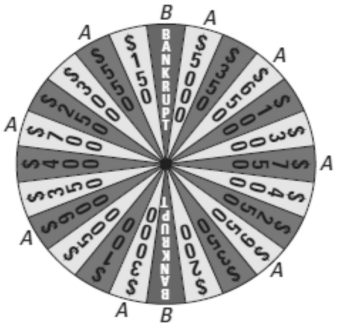
If A and B are independent events, then the probability that both A and B occur is $P(A \text{ and } B) = P(A) \cdot P(B)$.

And = ∩

Independent Events

EXAMPLE 1 *Probability of Two Independent Events*

You are playing a game that involves spinning the money wheel shown. During your turn you get to spin the wheel twice. What is the probability that you get more than \$500 on your first spin and then go bankrupt on your second spin?



Independent Events

EXAMPLE 2 *Probability of Three Independent Events*

BASEBALL During the 1997 baseball season, the Florida Marlins won 5 out of 7 home games and 3 out of 7 away games against the San Francisco Giants. During the 1997 National League Division Series with the Giants, the Marlins played the first two games at home and the third game away. The Marlins won all three games. Estimate the probability of this happening. ▶ Source: The Florida Marlins

Independent Events

EXAMPLE 3 *Probability of Independent Events*

You are playing a game. On your first turn you roll two number cubes and roll doubles. On your second roll, you roll a ten. What is the probability of this occurring?

Independent Events - You Try

Find the probability of rolling the given events when rolling two dice:

1. sum of 8, then doubles

2. an even sum, then a sum greater than 8

Using a Complement

EXAMPLE 4 *Using a Complement to Find a Probability*

The probability of selecting a rotten apple from a basket of apples is 12%. What is the probability of selecting three good apples when selecting one from each of the three different baskets?

Using a Complement - You Try

Using the same information... The probability of selecting a rotten apple from a basket of apples is 12%.

Find the probability of the given event.

1. **Selecting 2 good apples and 1 rotten apple**

2. **selecting 3 rotten apples**

Dependent Events

Two events A and B are **dependent events** if the occurrence of one affects the occurrence of the other. The probability that B will occur given that A has occurred is called the **conditional probability** of B given A and is written $P(B \mid A)$.

PROBABILITY OF DEPENDENT EVENTS

If A and B are dependent events, then the probability that both A and B occur is $P(A \text{ and } B) = P(A) \cdot P(B \mid A)$.

Remember our symbols: Or = ∪ And = ∩

B|A : The | symbol means "given". There is a condition that must be met.

Dependent Events

EXAMPLE 5 *Finding Conditional Probabilities*

The table shows the number of endangered and threatened animal species in the United States as of November 30, 1998. Find (a) the probability that a listed animal is a reptile and (b) the probability that an endangered animal is a reptile.

▶ Source: United States Fish and Wildlife Service

	Mammals	Birds	Reptiles	Amphibians	Other
Endangered	59	75	14	9	198
Threatened	8	15	21	7	69

Dependent and Independent Events

EXAMPLE 6 *Comparing Dependent and Independent Events*

You randomly select two cards from a standard 52-card deck. What is the probability that the first card is not a face card (a king, queen, or jack) and the second card is a face card if (a) you replace the first card before selecting the second, and (b) you do *not* replace the first card?

Dependent Events

EXAMPLE 7 *Probability of Three Dependent Events*

You and two friends go to a restaurant and order a sandwich. The menu has 10 types of sandwiches and each of you is equally likely to order any type. What is the probability that each of you orders a different type?

Dependent Events

EXAMPLE 8 *Probability of Dependent Events Probabilities*

A gumball machine contains 100 gumballs, 20 of each of the colors red, blue, green, white, and yellow. What is the probability of you and your friend both getting red gumballs?

Think... Is the first gumball being put back??

SOLUTION

Because the gumballs are not replaced in the machine, A and B are dependent events. Notice that for $P(B|A)$ there will be one less red gumball and one less gumball in the total. So, the probability is:

$$P(A \text{ and } B) = P(A) \cdot P(B|A) = \frac{20}{100} \cdot \frac{19}{99} = \frac{1}{5} \cdot \frac{19}{99} = \frac{19}{495} \approx 0.0384$$

Dependent Events - You Try

Using the same information... A gumball machine contains 100 gumballs, 20 of each of the colors red, blue, green, white, and yellow.

Find the probability of the dependent events:

1. **blue, then white**

2. **green, then red, then blue**

3. **blue, then blue, then blue**

4. **yellow, then yellow**