Exercise 1. In a particular college class, there are male and female students. Some students have long hair and some students have short hair. Write the symbols for the probabilities of the events for parts a through j. (Note that you cannot find numerical answers here. You were not given enough information to find any probability values yet; concentrate on understanding the symbols.)

- Let F be the event that a student is female.
- Let M be the event that a student is male.
- Let S be the event that a student has short hair.
- Let L be the event that a student has long hair.

a. The probability that a student does not have long hair.

b. The probability that a student is male or has short hair.

c. The probability that a student is a female and has long hair.

d. The probability that a student is male, given that the student has long hair.

e. The probability that a student has long hair, given that the student is male.

f. Of all the female students, the probability that a student has short hair.

g. Of all students with long hair, the probability that a student is female.

h. The probability that a student has long hair, given that the student is male.

i. The probability that a randomly selected student is a male student with short hair.

j. The probability that a student is female.

Solution

- $P(L^c) = P(S)$
- $P(M \text{ OR } S)$
- $P(F \text{ AND } L)$
- $P(M | L)$
e. $P(L | M)$
f. $P(S | F)$
g. $P(F | L)$
h. $P(F \text{ OR } L)$
i. $P(M \text{ AND } S)$
j. $P(F)$

Exercise 2. A box is filled with several party favors. It contains 12 hats, 15 noisemakers, ten finger traps, and five bags of confetti. Let $H = \text{the event of getting a hat.}$ Let $N = \text{the event of getting a noisemaker.}$ Let $F = \text{the event of getting a finger trap.}$ Let $C = \text{the event of getting a bag of confetti.}$ Find $P(H).$

Solution

$$\frac{12}{42} = \frac{2}{7} = 0.29$$

Exercise 3. A box is filled with several party favors. It contains 12 hats, 15 noisemakers, ten finger traps, and five bags of confetti. Let $H = \text{the event of getting a hat.}$ Let $N = \text{the event of getting a noisemaker.}$ Let $F = \text{the event of getting a finger trap.}$ Let $C = \text{the event of getting a bag of confetti.}$ Find $P(N).$

Solution

$$P(N) = \frac{15}{42} = \frac{5}{14} = 0.36$$
Exercise 4. A box is filled with several party favors. It contains 12 hats, 15 noisemakers, ten finger traps, and five bags of confetti.

Let $H$ = the event of getting a hat.

Let $N$ = the event of getting a noisemaker.

Let $F$ = the event of getting a finger trap.

Let $C$ = the event of getting a bag of confetti.

Find $P(F)$.

Solution

\[ P(F) = \frac{10}{42} = \frac{5}{21} = 0.24 \]

Exercise 5. A box is filled with several party favors. It contains 12 hats, 15 noisemakers, ten finger traps, and five bags of confetti.

Let $H$ = the event of getting a hat.

Let $N$ = the event of getting a noisemaker.

Let $F$ = the event of getting a finger trap.

Let $C$ = the event of getting a bag of confetti.

Find $P(C)$.

Solution

\[ P(C) = \frac{5}{42} = 0.12 \]

Exercise 6. A jar of 150 jelly beans contains 22 red jelly beans, 38 yellow, 20 green, 28 purple, 26 blue, and the rest are orange.

Let $B$ = the event of getting a blue jelly bean

Let $G$ = the event of getting a green jelly bean.

Let $O$ = the event of getting an orange jelly bean.

Let $P$ = the event of getting a purple jelly bean.

Let $R$ = the event of getting a red jelly bean.
Let $Y$ = the event of getting a yellow jelly bean.

Find $P(B)$.

Solution

$P(B) = \frac{26}{150} = \frac{13}{75} = 0.17$

Exercise 7. A jar of 150 jelly beans contains 22 red jelly beans, 38 yellow, 20 green, 28 purple, 26 blue, and the rest are orange.

Let $B$ = the event of getting a blue jelly bean

Let $G$ = the event of getting a green jelly bean.

Let $O$ = the event of getting an orange jelly bean.

Let $P$ = the event of getting a purple jelly bean.

Let $R$ = the event of getting a red jelly bean.

Let $Y$ = the event of getting a yellow jelly bean.

Find $P(G)$.

Solution

$P(G) = \frac{20}{150} = \frac{2}{15} = 0.13$

Exercise 8. A jar of 150 jelly beans contains 22 red jelly beans, 38 yellow, 20 green, 28 purple, 26 blue, and the rest are orange.

Let $B$ = the event of getting a blue jelly bean

Let $G$ = the event of getting a green jelly bean.

Let $O$ = the event of getting an orange jelly bean.

Let $P$ = the event of getting a purple jelly bean.

Let $R$ = the event of getting a red jelly bean.

Let $Y$ = the event of getting a yellow jelly bean.

Find $P(P)$. 
Exercise 9.  

A jar of 150 jelly beans contains 22 red jelly beans, 38 yellow, 20 green, 28 purple, 26 blue, and the rest are orange.

Let $B =$ the event of getting a blue jelly bean

Let $G =$ the event of getting a green jelly bean.

Let $O =$ the event of getting an orange jelly bean.

Let $P =$ the event of getting a purple jelly bean.

Let $R =$ the event of getting a red jelly bean.

Let $Y =$ the event of getting a yellow jelly bean.

Find $P(R)$.

Solution

$$P(R) = \frac{22}{150} = \frac{11}{75} = 0.15$$

Exercise 10.  

A jar of 150 jelly beans contains 22 red jelly beans, 38 yellow, 20 green, 28 purple, 26 blue, and the rest are orange.

Let $B =$ the event of getting a blue jelly bean

Let $G =$ the event of getting a green jelly bean.

Let $O =$ the event of getting an orange jelly bean.

Let $P =$ the event of getting a purple jelly bean.

Let $R =$ the event of getting a red jelly bean.

Let $Y =$ the event of getting a yellow jelly bean.

Find $P(Y)$.

Solution

$$P(Y) = \frac{38}{150} = \frac{19}{75} = 0.25$$

Exercise 11.  

A jar of 150 jelly beans contains 22 red jelly beans, 38 yellow, 20 green, 28 purple, 26 blue, and the rest are orange.
purple, 26 blue, and the rest are orange.

Let $B = \text{the event of getting a blue jelly bean}$

Let $G = \text{the event of getting a green jelly bean}$.

Let $O = \text{the event of getting an orange jelly bean}$.

Let $P = \text{the event of getting a purple jelly bean}$.

Let $R = \text{the event of getting a red jelly bean}$.

Let $Y = \text{the event of getting a yellow jelly bean}$.

Find $P(O)$.

Solution

\[
P(O) = \frac{150 - 22 - 38 - 20 - 28 - 26}{150} = \frac{16}{150} = \frac{8}{75} = 0.11
\]

Exercise 12. There are 23 countries in North America, 12 countries in South America, 47 countries in Europe, 44 countries in Asia, 54 countries in Africa, and 14 in Oceania (Pacific Ocean region).

Let $A = \text{the event that a country is in Asia}$.

Let $E = \text{the event that a country is in Europe}$.

Let $F = \text{the event that a country is in Africa}$.

Let $N = \text{the event that a country is in North America}$.

Let $O = \text{the event that a country is in Oceania}$.

Let $S = \text{the event that a country is in South America}$.

Find $P(A)$.

Solution

\[
P(A) = \frac{44}{194} = \frac{22}{97} = 0.23
\]

Exercise 13. There are 23 countries in North America, 12 countries in South America, 47 countries in Europe, 44 countries in Asia, 54 countries in Africa, and 14 in Oceania (Pacific Ocean region).

Let $A = \text{the event that a country is in Asia}$.
Let $E$ = the event that a country is in Europe.  
Let $F$ = the event that a country is in Africa.  
Let $N$ = the event that a country is in North America.  
Let $O$ = the event that a country is in Oceania.  
Let $S$ = the event that a country is in South America.  

Find $P(E)$.  

Solution  
$$P(E) = \frac{47}{194} = 0.24$$

Exercise 14. There are 23 countries in North America, 12 countries in South America, 47 countries in Europe, 44 countries in Asia, 54 countries in Africa, and 14 in Oceania (Pacific Ocean region).  
Let $A$ = the event that a country is in Asia.  
Let $E$ = the event that a country is in Europe.  
Let $F$ = the event that a country is in Africa.  
Let $N$ = the event that a country is in North America.  
Let $O$ = the event that a country is in Oceania.  
Let $S$ = the event that a country is in South America.  

Find $P(F)$.  

Solution  
$$P(F) = \frac{54}{194} = \frac{27}{97} = 0.28$$

Exercise 15. There are 23 countries in North America, 12 countries in South America, 47 countries in Europe, 44 countries in Asia, 54 countries in Africa, and 14 in Oceania (Pacific Ocean region).  
Let $A$ = the event that a country is in Asia.  
Let $E$ = the event that a country is in Europe.  
Let $F$ = the event that a country is in Africa.
Let $N$ = the event that a country is in North America.

Let $O$ = the event that a country is in Oceania.

Let $S$ = the event that a country is in South America.

Find $P(N)$.

Solution

\[ P(N) = \frac{23}{194} = 0.12 \]

Exercise 16. There are 23 countries in North America, 12 countries in South America, 47 countries in Europe, 44 countries in Asia, 54 countries in Africa, and 14 in Oceania (Pacific Ocean region).

Let $A$ = the event that a country is in Asia.

Let $E$ = the event that a country is in Europe.

Let $F$ = the event that a country is in Africa.

Let $N$ = the event that a country is in North America.

Let $O$ = the event that a country is in Oceania.

Let $S$ = the event that a country is in South America.

Find $P(O)$.

Solution

\[ P(O) = \frac{14}{194} = \frac{7}{97} = 0.07 \]

Exercise 17. There are 23 countries in North America, 12 countries in South America, 47 countries in Europe, 44 countries in Asia, 54 countries in Africa, and 14 in Oceania (Pacific Ocean region).

Let $A$ = the event that a country is in Asia.

Let $E$ = the event that a country is in Europe.

Let $F$ = the event that a country is in Africa.

Let $N$ = the event that a country is in North America.

Let $O$ = the event that a country is in Oceania.
Let $S$ = the event that a country is in South America.

Find $P(S)$.

Solution

$$P(S) = \frac{12}{194} = \frac{6}{97} = 0.06$$

Exercise 18. What is the probability of drawing a red card in a standard deck of 52 cards?

Solution

$$\frac{26}{52} = \frac{1}{2} = 0.5$$

Exercise 19. What is the probability of drawing a club in a standard deck of 52 cards?

Solution

$$\frac{13}{52} = \frac{1}{4} = 0.25$$

Exercise 20. What is the probability of rolling an even number of dots with a fair, six-sided die numbered one through six?

Solution

$$\frac{3}{6} = \frac{1}{2} = 0.5$$

Exercise 21. What is the probability of rolling a prime number of dots with a fair, six-sided die numbered one through six?

Solution

$$\frac{3}{6} = \frac{1}{2} = 0.5$$

Exercise 22. You see a game at a local fair. You have to throw a dart at a color wheel. Each section on the color wheel is equal in area.
Let $B$ = the event of landing on blue.

Let $R$ = the event of landing on red.

Let $G$ = the event of landing on green.

Let $Y$ = the event of landing on yellow.

If you land on $Y$, you get the biggest prize. Find $P(Y)$.

**Solution**

$$P(Y) = \frac{1}{8} = 0.125$$

**Exercise 23.** You see a game at a local fair. You have to throw a dart at a color wheel. Each section on the color wheel is equal in area.

Let $B$ = the event of landing on blue.

Let $R$ = the event of landing on red.

Let $G$ = the event of landing on green.

Let $Y$ = the event of landing on yellow.

If you land on red, you don’t get a prize. What is $P(R)$?
Solution

\[ P(R) = \frac{4}{8} = 0.5 \]

Exercise 24. On a baseball team, there are infielders and outfielders. Some players are great hitters, and some players are not great hitters.

Let \( I \) = the event that a player in an infielder.

Let \( O \) = the event that a player is an outfielder.

Let \( H \) = the event that a player is a great hitter.

Let \( N \) = the event that a player is not a great hitter.

Write the symbols for the probability that a player is not an outfielder.

Solution \[ P(O^c) = P(I) \]

Exercise 25. On a baseball team, there are infielders and outfielders. Some players are great hitters, and some players are not great hitters.

Let \( I \) = the event that a player in an infielder.

Let \( O \) = the event that a player is an outfielder.

Let \( H \) = the event that a player is a great hitter.

Let \( N \) = the event that a player is not a great hitter.

Write the symbols for the probability that a player is an outfielder or is a great hitter.

Solution \[ P(O \text{ OR } H) \]

Exercise 26. On a baseball team, there are infielders and outfielders. Some players are great hitters, and some players are not great hitters.

Let \( I \) = the event that a player in an infielder.

Let \( O \) = the event that a player is an outfielder.

Let \( H \) = the event that a player is a great hitter.

Let \( N \) = the event that a player is not a great hitter.
Write the symbols for the probability that a player is an infielder and is not a great hitter.

Solution \[ P(I \text{ AND } N) \]

Exercise 27. On a baseball team, there are infielders and outfielders. Some players are great hitters, and some players are not great hitters.

Let \( I \) = the event that a player in an infielder.

Let \( O \) = the event that a player is an outfielder.

Let \( H \) = the event that a player is a great hitter.

Let \( N \) = the event that a player is not a great hitter.

Write the symbols for the probability that a player is a great hitter, given that the player is an infielder.

Solution \[ P(H | I) \]

Exercise 28. On a baseball team, there are infielders and outfielders. Some players are great hitters, and some players are not great hitters.

Let \( I \) = the event that a player in an infielder.

Let \( O \) = the event that a player is an outfielder.

Let \( H \) = the event that a player is a great hitter.

Let \( N \) = the event that a player is not a great hitter.

Write the symbols for the probability that a player is an infielder, given that the player is a great hitter.

Solution \[ P(I | H) \]

Exercise 29. On a baseball team, there are infielders and outfielders. Some players are great hitters, and some players are not great hitters.

Let \( I \) = the event that a player in an infielder.

Let \( O \) = the event that a player is an outfielder.
Let $H$ = the event that a player is a great hitter.

Let $N$ = the event that a player is not a great hitter.

Write the symbols for the probability that of all the outfielders, a player is not a great hitter.

Solution $P(N | O)$

Exercise 30. On a baseball team, there are infielders and outfielders. Some players are great hitters, and some players are not great hitters.

Let $I$ = the event that a player is in an infielder.

Let $O$ = the event that a player is an outfielder.

Let $H$ = the event that a player is a great hitter.

Let $N$ = the event that a player is not a great hitter.

Write the symbols for the probability that of all the great hitters, a player is an outfielder.

Solution $P(O | H)$

Exercise 31. On a baseball team, there are infielders and outfielders. Some players are great hitters, and some players are not great hitters.

Let $I$ = the event that a player is in an infielder.

Let $O$ = the event that a player is an outfielder.

Let $H$ = the event that a player is a great hitter.

Let $N$ = the event that a player is not a great hitter.

Write the symbols for the probability that a player is an infielder or is not a great hitter.

Solution $P(I \text{ OR } N)$

Exercise 32. On a baseball team, there are infielders and outfielders. Some players are great hitters, and some players are not great hitters.
Let $I$ = the event that a player in an infielder.
Let $O$ = the event that a player is an outfielder.
Let $H$ = the event that a player is a great hitter.
Let $N$ = the event that a player is not a great hitter.

Write the symbols for the probability that a player is an outfielder and is a great hitter.

Solution $P(O \text{ AND } H)$

Exercise 33. On a baseball team, there are infielders and outfielders. Some players are great hitters, and some players are not great hitters.

Let $I$ = the event that a player in an infielder.
Let $O$ = the event that a player is an outfielder.
Let $H$ = the event that a player is a great hitter.
Let $N$ = the event that a player is not a great hitter.

Write the symbols for the probability that a player is an infielder.

Solution $P(I)$

Exercise 34. What is the word for the set of all possible outcomes?

Solution Sample space

Exercise 35. What is conditional probability?

Solution The likelihood that an event will occur given that another event has already occurred.

Exercise 36. A shelf holds 12 books. Eight are fiction and the rest are nonfiction. Each is a different book with a unique title. The fiction books are numbered one to eight. The nonfiction books are numbered one to four. Randomly select one book

Let $F$ = event that book is fiction
Let \( N \) = event that book is nonfiction

What is the sample space?

Solution: \( \{F_1, F_2, F_3, F_4, F_5, F_6, F_7, F_8, N_1, N_2, N_3, N_4\} \)

Exercise 37. What is the sum of the probabilities of an event and its complement?

Solution: 1

Exercise 38. You are rolling a fair, six-sided number cube. Let \( E \) = the event that it lands on an even number. Let \( M \) = the event that it lands on a multiple of three.

What does \( P(E|M) \) mean in words?

Solution: the probability of landing on an even number given that the number is a multiple of three

Exercise 39. You are rolling a fair, six-sided number cube. Let \( E \) = the event that it lands on an even number. Let \( M \) = the event that it lands on a multiple of three.

What does \( P(E \text{ OR } M) \) mean in words?

Solution: the probability of landing on an even number or a multiple of three

Exercise 40. \( E \) and \( F \) mutually exclusive events. \( P(E) = 0.4; P(F) = 0.5 \). Find \( P(E|F) \).

Solution: 0

Exercise 41. \( J \) and \( K \) are independent events. \( P(J|K) = 0.3 \). Find \( P(J) \).

Solution: \( P(J) = 0.3 \)

Exercise 42. \( U \) and \( V \) are mutually exclusive events. \( P(U) = 0.26; P(V) = 0.37 \). Find:

\( a. \) \( P(U \text{ AND } V) = \)

\( b. \) \( P(U|V) = \)
c. \( P(U \text{ OR } V) = \)

Solution
a. 0  
b. 0  
c. 0.63

Exercise 43.  
\( Q \) and \( R \) are independent events. \( P(Q) = 0.4 \) and \( P(Q \text{ AND } R) = 0.1 \). Find \( P(R) \).

Solution  
\[ P(Q \text{ AND } R) = P(Q)P(R) \]
\[ 0.1 = (0.4)P(R) \]
\[ P(R) = 0.25 \]

Exercise 44.  
Forty-eight percent of all Californians registered voters prefer life in prison without parole over the death penalty for a person convicted of first degree murder. Among Latino California registered voters, 55% prefer life in prison without parole over the death penalty for a person convicted of first degree murder. 37.6% of all Californians are Latino.

In this problem, let:

\( C = \) Californians (registered voters) preferring life in prison without parole over the death penalty for a person convicted of first degree murder.

\( L = \) Latino Californians

Suppose that one Californian is randomly selected.

Find \( P(C) \).

Solution  
0.48

Exercise 45.  
Forty-eight percent of all Californians registered voters prefer life in prison without parole over the death penalty for a person convicted of first degree murder. Among Latino California registered voters, 55% prefer life in prison without parole over the death penalty for a person convicted of first degree murder. 37.6% of all Californians are Latino.

In this problem, let:

\( C = \) Californians (registered voters) preferring life in prison without parole over the death penalty for a person convicted of first degree murder.

\( L = \) Latino Californians
Suppose that one Californian is randomly selected.

Find \( P(L) \).

Solution 0.376

Exercise 46. Forty-eight percent of all Californians registered voters prefer life in prison without parole over the death penalty for a person convicted of first degree murder. Among Latino California registered voters, 55% prefer life in prison without parole over the death penalty for a person convicted of first degree murder. 37.6% of all Californians are Latino.

In this problem, let:

- \( C \) = Californians (registered voters) preferring life in prison without parole over the death penalty for a person convicted of first degree murder.
- \( L \) = Latino Californians

Suppose that one Californian is randomly selected.

Find \( P(C|L) \).

Solution 0.55

Exercise 47. Forty-eight percent of all Californians registered voters prefer life in prison without parole over the death penalty for a person convicted of first degree murder. Among Latino California registered voters, 55% prefer life in prison without parole over the death penalty for a person convicted of first degree murder. 37.6% of all Californians are Latino.

In this problem, let:

- \( C \) = Californians (registered voters) preferring life in prison without parole over the death penalty for a person convicted of first degree murder.
- \( L \) = Latino Californians

Suppose that one Californian is randomly selected.

In words, what is \( C|L \)?

Solution \( C|L \) means, given the person chosen is a Latino Californian, the person is a
registered voter who prefers life in prison without parole for a person convicted of first degree murder.

Exercise 48.  

Forty-eight percent of all Californians registered voters prefer life in prison without parole over the death penalty for a person convicted of first degree murder. Among Latino California registered voters, 55% prefer life in prison without parole over the death penalty for a person convicted of first degree murder. 37.6% of all Californians are Latino.

In this problem, let:
- $C = \text{Californians (registered voters) preferring life in prison without parole over the death penalty for a person convicted of first degree murder.}$
- $L = \text{Latino Californians}$

Suppose that one Californian is randomly selected.

Find $P(L \text{ AND } C)$.

Solution 0.2068

Exercise 49.  

In this problem, let:
- $C = \text{Californians (registered voters) preferring life in prison without parole over the death penalty for a person convicted of first degree murder.}$
- $L = \text{Latino Californians}$

Suppose that one Californian is randomly selected.

In words, what is $L \text{ AND } C$?

Solution $L \text{ AND } C$ is the event that the person chosen is a Latino California registered voter who prefers life without parole over the death penalty for a person convicted of first degree murder.

Exercise 50.  

Forty-eight percent of all Californians registered voters prefer life in prison without parole over the death penalty for a person convicted of first degree murder. Among Latino California registered voters, 55% prefer life in prison without parole over the death penalty for a person convicted of first degree murder. 37.6% of all Californians are Latino.

In this problem, let:
• \( C \) = Californians (registered voters) preferring life in prison without parole over the death penalty for a person convicted of first degree murder.

• \( L \) = Latino Californians

Suppose that one Californian is randomly selected.

Are \( L \) and \( C \) independent events? Show why or why not.

Solution

No, because \( P(C) \) does not equal \( P(C|L) \).

Exercise 51. Forty-eight percent of all Californians registered voters prefer life in prison without parole over the death penalty for a person convicted of first degree murder. Among Latino California registered voters, 55% prefer life in prison without parole over the death penalty for a person convicted of first degree murder. 37.6% of all Californians are Latino.

In this problem, let:

• \( C \) = Californians (registered voters) preferring life in prison without parole over the death penalty for a person convicted of first degree murder.

• \( L \) = Latino Californians

Suppose that one Californian is randomly selected.

Find \( P(L \text{ OR } C) \).

Solution

0.6492

Exercise 52. Forty-eight percent of all Californians registered voters prefer life in prison without parole over the death penalty for a person convicted of first degree murder. Among Latino California registered voters, 55% prefer life in prison without parole over the death penalty for a person convicted of first degree murder. 37.6% of all Californians are Latino.

In this problem, let:

• \( C \) = Californians (registered voters) preferring life in prison without parole over the death penalty for a person convicted of first degree murder.

• \( L \) = Latino Californians

Suppose that one Californian is randomly selected.
In words, what is \( L \text{ OR } C \)?

**Solution**

\( L \text{ OR } C \) is the event that the person chosen is a Latino Californian or is a California registered voter who prefers life without parole over the death penalty for a person convicted of first degree murder.

**Exercise 53**

Forty-eight percent of all Californians registered voters prefer life in prison without parole over the death penalty for a person convicted of first degree murder. Among Latino California registered voters, 55% prefer life in prison without parole over the death penalty for a person convicted of first degree murder. 37.6% of all Californians are Latino.

In this problem, let:

- \( C \) = Californians (registered voters) preferring life in prison without parole over the death penalty for a person convicted of first degree murder.
- \( L \) = Latino Californians

Suppose that one Californian is randomly selected. Are \( L \) and \( C \) mutually exclusive events? Show why or why not.

**Solution**

No, because \( P(L \text{ AND } C) \) does not equal 0.

**Exercise 54.**

*Table 1.13* shows a random sample of musicians and how they learned to play their instruments.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Self-taught</th>
<th>Studied in School</th>
<th>Private Instruction</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>12</td>
<td>38</td>
<td>22</td>
<td>72</td>
</tr>
<tr>
<td>Male</td>
<td>19</td>
<td>24</td>
<td>15</td>
<td>58</td>
</tr>
<tr>
<td>Total</td>
<td>31</td>
<td>62</td>
<td>37</td>
<td>130</td>
</tr>
</tbody>
</table>

Find \( P(\text{musician is a female}) \).

**Solution**

\[
P(\text{musician is a female}) = \frac{72}{130} = \frac{36}{65} = 0.55
\]
Exercise 55. **Table 1.13** shows a random sample of musicians and how they learned to play their instruments.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Self-taught</th>
<th>Studied in School</th>
<th>Private Instruction</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>12</td>
<td>38</td>
<td>22</td>
<td>72</td>
</tr>
<tr>
<td>Male</td>
<td>19</td>
<td>24</td>
<td>15</td>
<td>58</td>
</tr>
<tr>
<td>Total</td>
<td>31</td>
<td>62</td>
<td>37</td>
<td>130</td>
</tr>
</tbody>
</table>

Find $P($musician is a male AND had private instruction$)$.

Solution

$P($musician is a male AND had private instruction$) = \frac{15}{130} = \frac{3}{26} = 0.12$

Exercise 56. **Table 1.13** shows a random sample of musicians and how they learned to play their instruments.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Self-taught</th>
<th>Studied in School</th>
<th>Private Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>12</td>
<td>38</td>
<td>22</td>
</tr>
<tr>
<td>Male</td>
<td>19</td>
<td>24</td>
<td>15</td>
</tr>
<tr>
<td>Total</td>
<td>31</td>
<td>62</td>
<td>37</td>
</tr>
</tbody>
</table>

Find $P($musician is a female OR is self taught$)$.

Solution

$P($musician is a female OR is self taught$) = \frac{72}{130} + \frac{31}{130} - \frac{12}{130} = \frac{91}{130} = \frac{7}{10} = 0.7$

Exercise 57. **Table 1.13** shows a random sample of musicians and how they learned to play their instruments.
<table>
<thead>
<tr>
<th>Gender</th>
<th>Self-taught</th>
<th>Studied in School</th>
<th>Private Instruction</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>12</td>
<td>38</td>
<td>22</td>
<td>72</td>
</tr>
<tr>
<td>Male</td>
<td>19</td>
<td>24</td>
<td>15</td>
<td>58</td>
</tr>
<tr>
<td>Total</td>
<td>31</td>
<td>62</td>
<td>37</td>
<td>130</td>
</tr>
</tbody>
</table>

Are the events “being a female musician” and “learning music in school” mutually exclusive events?

Solution

\[
P(\text{being a female musician AND learning music in school}) = \frac{38}{130} = \frac{19}{65} = 0.29
\]

\[
P(\text{being a female musician})P(\text{learning music in school}) = \left(\frac{72}{130}\right)\left(\frac{62}{130}\right) = \frac{4,464}{16,900} = \frac{1,116}{4,225} = 0.26
\]

No, they are not independent because \(P(\text{being a female musician AND learning music in school})\) is not equal to \(P(\text{being a female musician})P(\text{learning music in school})\).

Exercise 58.

The probability that a man develops some form of cancer in his lifetime is 0.4567. The probability that a man has at least one false positive test result (meaning the test comes back for cancer when the man does not have it) is 0.51. Let: \(C\) = a man develops cancer in his lifetime; \(P\) = man has at least one false positive. Construct a tree diagram of the situation.

Solution

```
Experiment
   Cancer
      C 0.4567
      P 0
      P' 1

   False Positive
      P 0.51
      P' 0.49
```
An article in the New England Journal of Medicine, reported about a study of smokers in California and Hawaii. In one part of the report, the self-reported ethnicity and smoking levels per day were given. Of the people smoking at most ten cigarettes per day, there were 9,886 African Americans, 2,745 Native Hawaiians, 12,831 Latinos, 8,378 Japanese Americans, and 7,650 Whites. Of the people smoking 11 to 20 cigarettes per day, there were 6,514 African Americans, 3,062 Native Hawaiians, 4,932 Latinos, 10,680 Japanese Americans, and 9,877 Whites. Of the people smoking 21 to 30 cigarettes per day, there were 1,671 African Americans, 1,419 Native Hawaiians, 1,406 Latinos, 4,715 Japanese Americans, and 6,062 Whites. Of the people smoking at least 31 cigarettes per day, there were 759 African Americans, 788 Native Hawaiians, 800 Latinos, 2,305 Japanese Americans, and 3,970 Whites.

Complete the table below using the data provided. Suppose that one person from the study is randomly selected. Find the probability that person smoked 11 to 20 cigarettes per day.

<table>
<thead>
<tr>
<th>Smoking Level</th>
<th>African American</th>
<th>Native Hawaiian</th>
<th>Latino</th>
<th>Japanese Americans</th>
<th>Whites</th>
<th>TOTALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1–10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11–20</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>21–30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>31+</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTALS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Solution

<table>
<thead>
<tr>
<th>Smoking Level</th>
<th>African American</th>
<th>Native Hawaiian</th>
<th>Latino</th>
<th>Japanese Americans</th>
<th>Whites</th>
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</table>
Exercise 60. An article in the New England Journal of Medicine, reported about a study of smokers in California and Hawaii. In one part of the report, the self-reported ethnicity and smoking levels per day were given. Of the people smoking at most ten cigarettes per day, there were 9,886 African Americans, 2,745 Native Hawaiians, 12,831 Latinos, 8,378 Japanese Americans, and 7,650 Whites. Of the people smoking 11 to 20 cigarettes per day, there were 6,514 African Americans, 3,062 Native Hawaiians, 4,932 Latinos, 10,680 Japanese Americans, and 9,877 Whites. Of the people smoking 21 to 30 cigarettes per day, there were 1,671 African Americans, 1,419 Native Hawaiians, 1,406 Latinos, 4,715 Japanese Americans, and 6,062 Whites. Of the people smoking at least 31 cigarettes per day, there were 759 African Americans, 788 Native Hawaiians, 800 Latinos, 2,305 Japanese Americans, and 3,970 Whites.

Suppose that one person from the study is randomly selected. Find the probability that person smoked 11 to 20 cigarettes per day.

Solution \[
\frac{35,065}{100,450}
\]

Exercise 61. An article in the New England Journal of Medicine, reported about a study of smokers in California and Hawaii. In one part of the report, the self-reported ethnicity and smoking levels per day were given. Of the people smoking at most ten cigarettes per day, there were 9,886 African Americans, 2,745 Native Hawaiians, 12,831 Latinos, 8,378 Japanese Americans, and 7,650 Whites. Of the people smoking 11 to 20 cigarettes per day, there were 6,514 African Americans, 3,062 Native Hawaiians, 4,932 Latinos, 10,680 Japanese Americans, and 9,877 Whites. Of the people smoking 11 to 20 cigarettes per day, there were 6,514 African Americans, 3,062 Native Hawaiians, 4,932 Latinos, 10,680 Japanese Americans, and 9,877 Whites. Of the people smoking 21 to 30 cigarettes per day, there were 1,671 African Americans, 1,419 Native Hawaiians, 1,406 Latinos, 4,715 Japanese Americans, and 6,062 Whites. Of the people smoking at least 31 cigarettes per day, there were 759 African Americans, 788 Native Hawaiians, 800 Latinos, 2,305 Japanese Americans, and 3,970 Whites.

Suppose that one person from the study is randomly selected. Find the probability that person smoked 11 to 20 cigarettes per day.
Latinos, 4,715 Japanese Americans, and 6,062 Whites. Of the people smoking at least 31 cigarettes per day, there were 759 African Americans, 788 Native Hawaiians, 800 Latinos, 2,305 Japanese Americans, and 3,970 Whites.

Find the probability that the person was Latino.

Solution
\[
\frac{19,969}{100,450}
\]

Exercise 62. An article in the New England Journal of Medicine, reported about a study of smokers in California and Hawaii. In one part of the report, the self-reported ethnicity and smoking levels per day were given. Of the people smoking at most ten cigarettes per day, there were 9,886 African Americans, 2,745 Native Hawaiians, 12,831 Latinos, 8,378 Japanese Americans, and 7,650 Whites. Of the people smoking 11 to 20 cigarettes per day, there were 6,514 African Americans, 3,062 Native Hawaiians, 4,932 Latinos, 10,680 Japanese Americans, and 9,877 Whites. Of the people smoking 21 to 30 cigarettes per day, there were 1,671 African Americans, 1,419 Native Hawaiians, 1,406 Latinos, 4,715 Japanese Americans, and 6,062 Whites. Of the people smoking at least 31 cigarettes per day, there were 759 African Americans, 788 Native Hawaiians, 800 Latinos, 2,305 Japanese Americans, and 3,970 Whites.

In words, explain what it means to pick one person from the study who is “Japanese American AND smokes 21 to 30 cigarettes per day.” Also, find the probability.

Solution
To pick one person from the study who is Japanese American AND smokes 21 to 30 cigarettes per day means that the person has to meet both criteria: both Japanese American and smokes 21 to 30 cigarettes. The sample space should include everyone in the study. The probability is

\[
\frac{4,715}{100,450}
\]
Latinos, 4,715 Japanese Americans, and 6,062 Whites. Of the people smoking at least 31 cigarettes per day, there were 759 African Americans, 788 Native Hawaiians, 800 Latinos, 2,305 Japanese Americans, and 3,970 Whites.

In words, explain what it means to pick one person from the study who is “Japanese American OR smokes 21 to 30 cigarettes per day.” Also, find the probability.

Solution

To pick one person from the study who is Japanese American or smoke 21 to 30 cigarettes per day, means that the person only has to meet on of these two criteria. You can pick a Japanese American who smokes any number of cigarettes per day, or you can pick anyone who smokes 21 to 30 cigarettes per day. The sample space should include everyone in the study. The probability is \( \frac{36,636}{100,450} \)

Exercise 64.

An article in the New England Journal of Medicine, reported about a study of smokers in California and Hawaii. In one part of the report, the self-reported ethnicity and smoking levels per day were given. Of the people smoking at most ten cigarettes per day, there were 9,886 African Americans, 2,745 Native Hawaiians, 12,831 Latinos, 8,378 Japanese Americans, and 7,650 Whites. Of the people smoking 11 to 20 cigarettes per day, there were 6,514 African Americans, 3,062 Native Hawaiians, 4,932 Latinos, 10,680 Japanese Americans, and 9,877 Whites. Of the people smoking 21 to 30 cigarettes per day, there were 1,671 African Americans, 1,419 Native Hawaiians, 1,406 Latinos, 4,715 Japanese Americans, and 6,062 Whites. Of the people smoking at least 31 cigarettes per day, there were 759 African Americans, 788 Native Hawaiians, 800 Latinos, 2,305 Japanese Americans, and 3,970 Whites.

In words, explain what it means to pick one person from the study who is “Japanese American GIVEN that person smokes 21 to 30 cigarettes per day.” Also, find the probability.

Solution

To pick one person from the study who is Japanese American given that person smokes 21-30 cigarettes per day, means that the person must fulfill both criteria and the sample space is reduced to those who smoke 21-30 cigarettes per day. The probability is \( \frac{4,715}{15,273} \)

Exercise 65.

An article in the New England Journal of Medicine, reported about a study of smokers in California and Hawaii. In one part of the report, the self-reported
ethnicity and smoking levels per day were given. Of the people smoking at most ten cigarettes per day, there were 9,886 African Americans, 2,745 Native Hawaiians, 12,831 Latinos, 8,378 Japanese Americans, and 7,650 Whites. Of the people smoking 11 to 20 cigarettes per day, there were 6,514 African Americans, 3,062 Native Hawaiians, 4,932 Latinos, 10,680 Japanese Americans, and 9,877 Whites. Of the people smoking 21 to 30 cigarettes per day, there were 1,671 African Americans, 1,419 Native Hawaiians, 1,406 Latinos, 4,715 Japanese Americans, and 6,062 Whites. Of the people smoking at least 31 cigarettes per day, there were 759 African Americans, 788 Native Hawaiians, 800 Latinos, 2,305 Japanese Americans, and 3,970 Whites.

Prove that smoking level/day and ethnicity are dependent events.

Solution

It can be shown that for any ethnicity, \( E \), \( P(E) \) is not equal to \( P(E|S) \), where \( S \) represents any smoking level. Thus, smoking level/day and ethnicity are not independent, which means they are dependent.

Exercise 66.

The graph in Figure 1.10 displays the sample sizes and percentages of people in different age and gender groups who were polled concerning their approval of Mayor Ford’s actions in office. The total number in the sample of all the age groups is 1,045.

a. Define three events in the graph.

b. Describe in words what the entry 40 means.
c. Describe in words the complement of the entry in question 2.
d. Describe in words what the entry 0.30 means.
e. Out of the males and females, what percent are males?
f. Out of the females, what percent disapprove of Mayor Ford?
g. Out of all the age groups, what percent approve of Mayor Ford?
h. Find $P(\text{Approve}|\text{Male})$.
i. Out of the age groups, what percent are more than 44 years old?
j. Find $P(\text{Approve}|\text{Age < 35})$.

Solution

a. Three events are, for instance, the individual is Male, the individual is between 18 and 34 years of age, the individual approves of Mayor Ford.

b. The entry 0.40 is the percent of all age groups that approve of Mayor Ford.

c. The entry 0.60 is the percent of all age groups that disapprove of Mayor Ford.

d. The entry 0.30 is the percent of the age group 18 to 34 that approve of Mayor Ford.

e. 0.4574

f. 0.63

g. 0.40

h. 0.44
Exercise 67. Explain what is wrong with the following statements. Use complete sentences.

a. If there is a 60% chance of rain on Saturday and a 70% chance of rain on Sunday, then there is a 130% chance of rain over the weekend.

b. The probability that a baseball player hits a home run is greater than the probability that he gets a successful hit.

Solution

a. You can’t calculate the joint probability knowing the probability of both events occurring, which is not in the information given; the probabilities should be multiplied, not added; and probability is never greater than 100%

b. A home run by definition is a successful hit, so he has to have at least as many successful hits as home runs.

Exercise 68. The graph shown is based on more than 170,000 interviews done by Gallup that took place from January through December 2012. The sample consists of employed Americans 18 years of age or older. The Emotional Health Index Scores are the sample space. We randomly sample one Emotional Health Index Score.
Find the probability that an Emotional Health Index Score is 82.7.

Solution

0.1429

Exercise 69. The graph shown is based on more than 170,000 interviews done by Gallup that took place from January through December 2012. The sample consists of employed Americans 18 years of age or older. The Emotional Health Index Scores are the sample space. We randomly sample one Emotional Health Index Score.

Find the probability that an Emotional Health Index Score is 81.0.
Exercise 70. The graph shown is based on more than 170,000 interviews done by Gallup that took place from January through December 2012. The sample consists of employed Americans 18 years of age or older. The Emotional Health Index Scores are the sample space. We randomly sample one Emotional Health Index Score.

Find the probability that an Emotional Health Index Score is more than 81?

Solution

0.5

Exercise 71. The graph shown is based on more than 170,000 interviews done by Gallup that took place from January through December 2012. The sample consists of employed Americans 18 years of age or older. The Emotional Health Index Scores are the sample space. We randomly sample one Emotional Health Index Score.
Find the probability that an Emotional Health Index Score is between 80.5 and 82?

Solution 0.3571

Exercise 72. The graph shown is based on more than 170,000 interviews done by Gallup that took place from January through December 2012. The sample consists of employed Americans 18 years of age or older. The Emotional Health Index Scores are the sample space. We randomly sample one Emotional Health Index Score.

If we know an Emotional Health Index Score is 81.5 or more, what is the
Exercise 73. The graph shown is based on more than 170,000 interviews done by Gallup that took place from January through December 2012. The sample consists of employed Americans 18 years of age or older. The Emotional Health Index Scores are the sample space. We randomly sample one Emotional Health Index Score.

What is the probability that an Emotional Health Index Score is 80.7 or 82.7?

Solution

0.2142

Exercise 74. The graph shown is based on more than 170,000 interviews done by Gallup that took place from January through December 2012. The sample consists of employed Americans 18 years of age or older. The Emotional Health Index Scores are the sample space. We randomly sample one Emotional Health Index Score.
What is the probability that an Emotional Health Index Score is less than 80.2 given that it is already less than 81.

Solution 0.4286

Exercise 75. The graph shown is based on more than 170,000 interviews done by Gallup that took place from January through December 2012. The sample consists of employed Americans 18 years of age or older. The Emotional Health Index Scores are the sample space. We randomly sample one Emotional Health Index Score.
What occupation has the highest emotional index score?

Solution: Physician (83.7)

Exercise 76.

The graph shown is based on more than 170,000 interviews done by Gallup that took place from January through December 2012. The sample consists of employed Americans 18 years of age or older. The Emotional Health Index Scores are the sample space. We randomly sample one Emotional Health Index Score.

What occupation has the lowest emotional index score?

Solution: Service (79.6)

Exercise 77.

The graph shown is based on more than 170,000 interviews done by Gallup that took place from January through December 2012. The sample consists of employed Americans 18 years of age or older. The Emotional Health Index Scores are the sample space. We randomly sample one Emotional Health Index Score.
What is the range of the data?

Solution  
\[83.7 - 79.6 = 4.1\]

Exercise 78. The graph shown is based on more than 170,000 interviews done by Gallup that took place from January through December 2012. The sample consists of employed Americans 18 years of age or older. The Emotional Health Index Scores are the sample space. We randomly sample one Emotional Health Index Score.
Compute the average EHIS.

Solution \[ \text{mean}(EHIS) = 81.3 \]

Exercise 79. The graph shown is based on more than 170,000 interviews done by Gallup that took place from January through December 2012. The sample consists of employed Americans 18 years of age or older. The Emotional Health Index Scores are the sample space. We randomly sample one Emotional Health Index Score.

![Emotional Health Index Score](image)

If all occupations are equally likely for a certain individual, what is the probability that he or she will have an occupation with lower than average EHIS?

Solution \[ P(\text{Occupation} < 81.3) = 0.5 \]

Exercise 80. On February 28, 2013, a Field Poll Survey reported that 61% of California registered voters approved of allowing two people of the same gender to marry and have regular marriage laws apply to them. Among 18 to 39 year
olds (California registered voters), the approval rating was 78%. Six in ten California registered voters said that the upcoming Supreme Court’s ruling about the constitutionality of California’s Proposition 8 was either very or somewhat important to them. Out of those CA registered voters who support same-sex marriage, 75% say the ruling is important to them. In this problem, let:

• C = California registered voters who support same-sex marriage.
• B = California registered voters who say the Supreme Court’s ruling about the constitutionality of California’s Proposition 8 is very or somewhat important to them.
• A = California registered voters who are 18 to 39 years old.

a. Find P(C).

b. Find P(B).

c. Find P(C|A).

d. Find P(B|C).

e. In words, what is C|A?

f. In words, what is B|C?

g. Find P(C AND B).

h. In words, what is C AND B?

i. Find P(C OR B).

j. Are C and B mutually exclusive events? Show why or why not.
Solution

a. $P(C) = 0.61$

b. $P(B) = 0.6$

c. $P(C|A) = 0.78$

d. $P(B|C) = 0.75$

e. California registered voters who support same-sex marriage from the group of California registered voters who are 18 to 39 years old.

f. California registered voters who say the Supreme Court’s ruling about the constitutionality of California’s Proposition 8 is very or somewhat important to them from the group of California registered voters who support same-sex marriage

g. $P(C \text{ AND } B) = P(B|C)P(C) = 0.4575$

h. California registered voters who support same-sex marriage and who say the Supreme Court’s ruling about the constitutionality of California’s Proposition 8 is very or somewhat important to them

i. $P(C \text{ OR } B) = P(C) + P(B) - P(C \text{ AND } B) = 0.7525$

j. No, because $P(C \text{ AND } B)$ is not equal to zero.

Exercise 81.

After Rob Ford, the mayor of Toronto, announced his plans to cut budget costs in late 2011, the Forum Research polled 1,046 people to measure the mayor’s popularity. Everyone polled expressed either approval or disapproval. These are the results their poll produced:

- In early 2011, 60 percent of the population approved of Mayor Ford’s actions
in office.

- In mid-2011, 57 percent of the population approved of his actions.
- In late 2011, the percentage of popular approval was measured at 42 percent.

a. What is the sample size for this study?

b. What proportion in the poll disapproved of Mayor Ford, according to the results from late 2011?

c. How many people polled responded that they approved of Mayor Ford in late 2011?

d. What is the probability that a person supported Mayor Ford, based on the data collected in mid-2011?

e. What is the probability that a person supported Mayor Ford, based on the data collected in early 2011?

Solution

a. The Forum Research surveyed 1,046 Torontonians

b. 58%

c. 42% of 1,046 = 439 (rounding to the nearest integer)

d. 0.57

e. 0.60

Exercise 82. The casino game, roulette, allows the gambler to bet on the probability of a ball, which spins in the roulette wheel, landing on a particular color, number,
or range of numbers. The table used to place bets contains 38 numbers, and each number is assigned to a color and a range.

a. List the sample space of the 38 possible outcomes in roulette.

b. You bet on red. Find $P(\text{red})$.

c. You bet on –1st 12– (1st Dozen). Find $P(\text{–1st 12–})$.

d. You bet on an even number. Find $P(\text{even number})$.

e. Is getting an odd number the complement of getting an even number? Why?

f. Find two mutually exclusive events.

g. Are the events Even and 1st Dozen independent?

Solution

a. $\mathcal{S} = \{0, 00, 1, 2, 3, \ldots, 35, 36\}$.

b. $P(\text{red}) = \frac{18}{38} = \frac{9}{19} = 0.47$
c. \( P(\text{1st 12-}) = \frac{12}{38} = \frac{6}{19} = 0.32 \)

d. \( P(\text{EVEN}) = \frac{18}{38} = \frac{9}{19} = 0.47 \)

e. No. The sample space includes the numbers one to 36 and \( \{0, 00\} \).

f. Even and Odd (another answer is Black and Red.)

g. No. \( P(\text{EVEN} | \text{1st Dozen}) = 0.5 \), while \( P(\text{EVEN}) = 0.47 \).

Exercise 83. The casino game, roulette, allows the gambler to bet on the probability of a ball, which spins in the roulette wheel, landing on a particular color, number, or range of numbers. The table used to place bets contains of 38 numbers, and each number is assigned to a color and a range.

Compute the probability of winning the following types of bets:

a. Betting on two lines that touch each other on the table as in 1-2-3-4-5-6

b. Betting on three numbers in a line, as in 1-2-3
c. Betting on one number

d. Betting on four numbers that touch each other to form a square, as in 10-11-13-14

e. Betting on two numbers that touch each other on the table, as in 10-11 or 10-13

f. Betting on 0-00-1-2-3

g. Betting on 0-1-2; or 0-00-2; or 00-2-3

Solution

a. \( P(\text{Betting on two line that touch each other on the table}) = \frac{6}{38} \)

b. \( P(\text{Betting on three numbers in a line}) = \frac{3}{38} \)

c. \( P(\text{Betting on one number}) = \frac{1}{38} \)

d. \( P(\text{Betting on four number that touch each other to form a square}) = \frac{4}{38} \)

e. \( P(\text{Betting on two number that touch each other on the table}) = \frac{2}{38} \)

f. \( P(\text{Betting on 0-00-1-2-3}) = \frac{5}{38} \)

g. \( P(\text{Betting on 0-1-2; or 0-00-2; or 00-2-3}) = \frac{3}{38} \)

Exercise 84. The casino game, roulette, allows the gambler to bet on the probability of a ball, which spins in the roulette wheel, landing on a particular color, number,
or range of numbers. The table used to place bets contains of 38 numbers, and each number is assigned to a color and a range.

Compute the probability of winning the following types of bets:

a. Betting on a color

b. Betting on one of the dozen groups

c. Betting on the range of numbers from 1 to 18

d. Betting on the range of numbers 19–36

e. Betting on one of the columns

f. Betting on an even or odd number (excluding zero)

Solution

a. \( P(\text{Red}) = P(\text{Black}) = \frac{18}{38} \); \( P(\text{Red OR Black}) = P(\text{Red}) + P(\text{Black}) = \frac{36}{38} \)

b. \( P(\text{Dozen groups}) = \frac{12}{38} \)
c. \( P(\text{Betting on the large range of number from 1 to 18}) = \frac{18}{38} \)

d. \( P(\text{Betting on the range of number 19–36}) = \frac{18}{38} \)

e. \( P(\text{Column bet}) = \frac{12}{38} \)

f. \( P(\text{Even}) = P(\text{Odd}) = \frac{18}{38}; P(\text{Even OR Odd}) = P(\text{Even}) + P(\text{Odd}) = \frac{36}{38} \)

Exercise 85.

Suppose that you have eight cards. Five are green and three are yellow. The five green cards are numbered 1, 2, 3, 4, and 5. The three yellow cards are numbered 1, 2, and 3. The cards are well shuffled. You randomly draw one card.

- \( G = \text{card drawn is green} \)
- \( E = \text{card drawn is even-numbered} \)

a. List the sample space.

b. \( P(G) = \) 

c. \( P(G | E) = \) 

d. \( P(G \text{ AND } E) = \) 

e. \( P(G \text{ OR } E) = \) 

f. Are \( G \) and \( E \) mutually exclusive? Justify your answer numerically.

Solution

a. \{G1, G2, G3, G4, G5, Y1, Y2, Y3\}
Exercise 86.

Roll two fair dice. Each die has six faces.

a. List the sample space.

b. Let $A$ be the event that either a three or four is rolled first, followed by an even number. Find $P(A)$.

c. Let $B$ be the event that the sum of the two rolls is at most seven. Find $P(B)$.

d. In words, explain what “$P(A|B)$” represents. Find $P(A|B)$.

e. Are $A$ and $B$ mutually exclusive events? Explain your answer in one to three complete sentences, including numerical justification.

f. Are $A$ and $B$ independent events? Explain your answer in one to three complete sentences, including numerical justification.

Solution

a.

<table>
<thead>
<tr>
<th>1st roll</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
</table>
The 2nd Roll:

<table>
<thead>
<tr>
<th></th>
<th>(1,1)</th>
<th>(1,2)</th>
<th>(1,3)</th>
<th>(1,4)</th>
<th>(1,5)</th>
<th>(1,6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(2,1)</td>
<td>(2,2)</td>
<td>(2,3)</td>
<td>(2,4)</td>
<td>(2,5)</td>
<td>(2,6)</td>
</tr>
<tr>
<td>2</td>
<td>(3,1)</td>
<td>(3,2)</td>
<td>(3,3)</td>
<td>(3,4)</td>
<td>(3,5)</td>
<td>(3,6)</td>
</tr>
<tr>
<td>3</td>
<td>(4,1)</td>
<td>(4,2)</td>
<td>(4,3)</td>
<td>(4,4)</td>
<td>(4,5)</td>
<td>(4,6)</td>
</tr>
<tr>
<td>4</td>
<td>(5,1)</td>
<td>(5,2)</td>
<td>(5,3)</td>
<td>(5,4)</td>
<td>(5,5)</td>
<td>(5,6)</td>
</tr>
<tr>
<td>5</td>
<td>(6,1)</td>
<td>(6,2)</td>
<td>(6,3)</td>
<td>(6,4)</td>
<td>(6,5)</td>
<td>(6,6)</td>
</tr>
</tbody>
</table>

b. \( P(A) = \frac{6}{36} \)

c. \( P(B) = \frac{21}{36} \)

d. \( P(A \mid B) \) represents the probability of two thrown dice having a sum that is at most seven given that the first die rolled is either a three or a four: \( P(A \mid B) = \frac{7}{21} \)

e. No, they are not mutually exclusive because \( A \) and \( B \) can occur at the same time. \( P(A \text{ AND } B) = \frac{7}{36} \)

f. Yes, knowing that \( B \) occurs does not change the probability that \( A \) occurs. \( P(A \mid B) = \frac{7}{21} = \frac{12}{36} = P(A) \)

Exercise 87. A special deck of cards has ten cards. Four are green, three are blue, and three
are red. When a card is picked, its color of it is recorded. An experiment consists of first picking a card and then tossing a coin.

a. List the sample space.

b. Let A be the event that a blue card is picked first, followed by landing a head on the coin toss. Find P(A).

c. Let B be the event that a red or green is picked, followed by landing a head on the coin toss. Are the events A and B mutually exclusive? Explain your answer in one to three complete sentences, including numerical justification.

d. Let C be the event that a red or blue is picked, followed by landing a head on the coin toss. Are the events A and C mutually exclusive? Explain your answer in one to three complete sentences, including numerical justification.

Solution

NOTE

The coin toss is independent of the card picked first.


b. \[P(A) = P(\text{blue})P(\text{head}) = \left(\frac{3}{10}\right)\left(\frac{1}{2}\right) = \frac{3}{20}\]  

c. Yes, A and B are mutually exclusive because they cannot happen at the same time; you cannot pick a card that is both blue and also (red or green).  
\[P(A \text{ AND } B) = 0\]

d. No, A and C are not mutually exclusive because they can occur at the same time. In fact, C includes all of the outcomes of A; if the card chosen is blue it is also (red or blue). \[P(A \text{ AND } C) = P(A) = \frac{3}{20}\]
Exercise 88. An experiment consists of first rolling a die and then tossing a coin.

a. List the sample space.

b. Let $A$ be the event that either a three or a four is rolled first, followed by landing a head on the coin toss. Find $P(A)$.

c. Let $B$ be the event that the first and second tosses land on heads. Are the events $A$ and $B$ mutually exclusive? Explain your answer in one to three complete sentences, including numerical justification.

Solution

NOTE

the coin toss is independent of the number rolled first.

a. $\{(1,H) \ (1,T) \ (2,H) \ (2,T) \ (3,H) \ (3,T) \ (4,H) \ (4,T) \ (5,H) \ (5,T) \ (6,H) \ (6,T)\}$

b. $P(A) = P(3 \ OR \ 4)P(H) = \left( \frac{2}{6} \right) \left( \frac{1}{2} \right) = \frac{2}{12}$

c. Yes, $A$ and $B$ are mutually exclusive; you cannot roll a (three or four) and a number less than two at the same time. $P(A \ AND \ B) = 0$

Exercise 89. An experiment consists of tossing a nickel, a dime, and a quarter. Of interest is the side the coin lands on.

a. List the sample space.

b. Let $A$ be the event that there are at least two tails. Find $P(A)$.

c. Let $B$ be the event that the first and second tosses land on heads. Are the events $A$ and $B$ mutually exclusive? Explain your answer in one to three complete sentences, including justification.
Solution

a. $S = \{(HHH), (HHT), (HTH), (THH), (THT), (TTH), (TTT)\}$

b. $\frac{4}{8}$

c. Yes, because if A has occurred, it is impossible to obtain two tails. In other words, $P(A \text{ AND } B) = 0$.

Exercise 90.

Consider the following scenario:

Let $P(C) = 0.4$.

Let $P(D) = 0.5$.

Let $P(C|D) = 0.6$.

a. Find $P(C \text{ AND } D)$.

b. Are $C$ and $D$ mutually exclusive? Why or why not?

c. Are $C$ and $D$ independent events? Why or why not?

d. Find $P(C \text{ OR } D)$.

e. Find $P(D|C)$.

Solution

a. $P(C \text{ AND } D) = P(D)P(C|D) = (0.5)(0.6) = 0.3$

b. No, $C$ and $D$ are not mutually exclusive because $P(C \text{ AND } D) \neq 0$

c. No, $C$ and $D$ are not independent because the occurrence of $D$ changes the probability of $C$ occurring $P(C|D) \neq P(C)$

d. $P(C \text{ OR } D) = P(C) + P(D) - P(C \text{ AND } D) = 0.4 + 0.5 - 0.3 = 0.6$
Y and Z are independent events.

a. Rewrite the basic Addition Rule \( P(Y \text{ OR } Z) = P(Y) + P(Z) - P(Y \text{ AND } Z) \) using the information that Y and Z are independent events.

b. Use the rewritten rule to find \( P(Z) \) if \( P(Y \text{ OR } Z) = 0.71 \) and \( P(Y) = 0.42 \).

Solution

a. If Y and Z are independent, then \( P(Y \text{ AND } Z) = P(Y)P(Z) \), so \( P(Y \text{ OR } Z) = P(Y) + P(Z) - P(Y)P(Z) \).

b. 0.5

Exercise 92. G and H are mutually exclusive events. \( P(G) = 0.5 \) P(H) = 0.3

a. Explain why the following statement MUST be false: \( P(H \mid G) = 0.4 \).

b. Find \( P(H \text{ OR } G) \).

c. Are G and H independent or dependent events? Explain in a complete sentence.

Solution

a. If G and H are mutually exclusive they cannot happen at the same time. Thus, knowing that G has occurred means that H cannot occur and so it must be the case that \( P(H \mid G) = 0 \).

b. \( P(H \text{ Or } G) = P(H) + P(G) - P(H \text{ AND } G) = 0.3 + 0.5 - 0 = 0.8 \)

c. G and H are dependent events. Mutually exclusive events are by nature dependent because knowing that one has occurred fully determines the probability of the other occurring, which is zero because the events cannot both occur at the same time.
Exercise 93. Approximately 281,000,000 people over age five live in the United States. Of these people, 55,000,000 speak a language other than English at home. Of those who speak another language at home, 62.3% speak Spanish. Let: \( E \) = speaks English at home; \( E' \) = speaks another language at home; \( S \) = speaks Spanish; Finish each probability statement by matching the correct answer.

<table>
<thead>
<tr>
<th>Probability Statements</th>
<th>Answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. ( P(E') = )</td>
<td>i. 0.8043</td>
</tr>
<tr>
<td>b. ( P(E) = )</td>
<td>ii. 0.623</td>
</tr>
<tr>
<td>c. ( P(S \text{ and } E') = )</td>
<td>iii. 0.1957</td>
</tr>
<tr>
<td>d. ( P(S</td>
<td>E') = )</td>
</tr>
</tbody>
</table>

Table 1.18

Solution iii; i; iv; ii

Exercise 94. In 1994, the U.S. government held a lottery to issue 55,000 Green Cards (permits for non-citizens to work legally in the U.S.). Renate Deutsch, from Germany, was one of approximately 6.5 million people who entered this lottery. Let \( G \) = won green card.

a. What was Renate’s chance of winning a Green Card? Write your answer as a probability statement.

b. In the summer of 1994, Renate received a letter stating she was one of 110,000 finalists chosen. Once the finalists were chosen, assuming that each finalist had an equal chance to win, what was Renate’s chance of winning a Green Card? Write your answer as a conditional probability statement. Let \( F = \)
was a finalist.

c. Are G and F independent or dependent events? Justify your answer numerically and also explain why.

d. Are G and F mutually exclusive events? Justify your answer numerically and explain why.

Solution

a. \( P(G) = 0.008 \)

b. \( P(G | \text{Finalist}) = 0.5 \)

c. These events are dependent, because \( P(G) \) does not equal \( P(G | \text{Finalist}) \). She has a better chance of winning a green card once she becomes a finalist.

d. No. Every winner comes out of the pool of finalists, so \( P(G \text{ AND Finalist}) \) does not equal 0.

Exercise 95.

Three professors at George Washington University did an experiment to determine if economists are more selfish than other people. They dropped 64 stamped, addressed envelopes with $10 cash in different classrooms on the George Washington campus. 44% were returned overall. From the economics classes 56% of the envelopes were returned. From the business, psychology, and history classes 31% were returned.

Let: \( R = \text{money returned}; E = \text{economics classes}; O = \text{other classes} \)

a. Write a probability statement for the overall percent of money returned.

b. Write a probability statement for the percent of money returned out of the economics classes.

c. Write a probability statement for the percent of money returned out of the other classes.
d. Is money being returned independent of the class? Justify your answer numerically and explain it.

e. Based upon this study, do you think that economists are more selfish than other people? Explain why or why not. Include numbers to justify your answer.

Solution

a. \( P(R) = 0.44 \)

b. \( P(R | E) = 0.56 \)

c. \( P(R | O) = 0.31 \)

d. No, whether the money is returned is not independent of which class the money was placed in. There are several ways to justify this mathematically, but one is that the money placed in economics classes is not returned at the same overall rate; \( P(R | E) \neq P(R) \).

e. No, this study definitely does not support that notion; in fact, it suggests the opposite. The money placed in the economics classrooms was returned at a higher rate than the money place in all classes collectively; \( P(R | E) > P(R) \).

Exercise 96.

The following table of data obtained from www.baseball-almanac.com shows it information for four well-known players. Suppose that one hit from the table is randomly selected.

<table>
<thead>
<tr>
<th>Name</th>
<th>Single</th>
<th>Double</th>
<th>Triple</th>
<th>Home Run</th>
<th>Total Hits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Babe Ruth</td>
<td>1,517</td>
<td>506</td>
<td>136</td>
<td>714</td>
<td>2,873</td>
</tr>
<tr>
<td>Jackie Robinson</td>
<td>1,054</td>
<td>273</td>
<td>54</td>
<td>137</td>
<td>1,518</td>
</tr>
<tr>
<td>Ty Cobb</td>
<td>3,603</td>
<td>174</td>
<td>295</td>
<td>114</td>
<td>4,189</td>
</tr>
<tr>
<td>Hank Aaron</td>
<td>2,294</td>
<td>624</td>
<td>98</td>
<td>755</td>
<td>3,771</td>
</tr>
<tr>
<td>------------</td>
<td>-------</td>
<td>-----</td>
<td>----</td>
<td>-----</td>
<td>-------</td>
</tr>
<tr>
<td>Total</td>
<td>8,471</td>
<td>1,577</td>
<td>583</td>
<td>1,720</td>
<td>12,351</td>
</tr>
</tbody>
</table>

Are the hit being made by Hank Aaron and the hit being a double independent events?

a. Yes, because \( P(\text{hit by Hank Aaron}|\text{hit is a double}) = P(\text{hit by Hank Aaron}) \)

b. No, because \( P(\text{hit by Hank Aaron}|\text{hit is a double}) \neq P(\text{hit is a double}) \)

c. No, because \( P(\text{hit is by Hank Aaron}|\text{hit is a double}) \neq P(\text{hit by Hank Aaron}) \)

d. Yes, because \( P(\text{hit is by Hank Aaron}|\text{hit is a double}) = P(\text{hit is a double}) \)

Solution: c

Exercise 97.

United Blood Services is a blood bank that serves more than 500 hospitals in 18 states. According to their website, a person with type O blood and a negative Rh factor (Rh–) can donate blood to any person with any bloodtype. Their data show that 43% of people have type O blood and 15% of people have Rh– factor; 52% of people have type O or Rh– factor.

a. Find the probability that a person has both type O blood and the Rh– factor.

b. Find the probability that a person does NOT have both type O blood and the Rh– factor.

Solution:

a. \( P(\text{type O OR Rh–}) = P(\text{type O}) + P(\text{Rh–}) - P(\text{type O AND Rh–}) \) = 0.43 + 0.15 – 0.06 = 0.52

6% of people have type O, Rh– blood

b. \( P(\text{NOT(type O AND Rh–)}) = 1 - P(\text{type O AND Rh–}) = 1 - 0.06 = 0.94 \)
94% of people do not have type O, Rh− blood

Exercise 98.

At a college, 72% of courses have final exams and 46% of courses require research papers. Suppose that 32% of courses have a research paper and a final exam. Let \( F \) be the event that a course has a final exam. Let \( R \) be the event that a course requires a research paper.

\( a. \) Find the probability that a course has a final exam or a research project.

\( b. \) Find the probability that a course has \textit{NEITHER} of these two requirements.

Solution

\( a. \) \( P(R \text{ OR } F) = P(R) + P(F) - P(R \text{ AND } F) = 0.72 + 0.46 - 0.32 = 0.86 \)

\( b. \) \( P(\text{NEITHER } R \text{ NOR } F) = 1 - P(R \text{ OR } F) = 1 - 0.86 = 0.14 \)

Exercise 99.

In a box of assorted cookies, 36% contain chocolate and 12% contain nuts. Of those, 8% contain both chocolate and nuts. Sean is allergic to both chocolate and nuts.

\( a. \) Find the probability that a cookie contains chocolate or nuts (he can’t eat it).

\( b. \) Find the probability that a cookie does not contain chocolate or nuts (he can eat it).

Solution

\( a. \) Let \( C = \) the event that the cookie contains chocolate. Let \( N = \) the event that the cookie contains nuts.

\( b. \) \( P(C \text{ OR } N) = P(C) + P(N) - P(C \text{ AND } N) = 0.36 + 0.12 - 0.08 = 0.40 \)

\( c. \) \( P(\text{NEITHER chocolate NOR nuts}) = 1 - P(C \text{ OR } N) = 1 - 0.40 = 0.60 \)

Exercise 100.

A college finds that 10% of students have taken a distance learning class and that 40% of students are part time students. Of the part time students, 20%
have taken a distance learning class. Let $D$ = event that a student takes a
distance learning class and $E$ = event that a student is a part time student

a. Find $P(D \text{ AND } E)$.

b. Find $P(E \mid D)$.

c. Find $P(D \text{ OR } E)$.

d. Using an appropriate test, show whether $D$ and $E$ are independent.

e. Using an appropriate test, show whether $D$ and $E$ are mutually exclusive.

Solution

a. $P(D \text{ AND } E) = P(D \mid E)P(E) = (0.20)(0.40) = 0.08$

b. $P(E \mid D) = \frac{P(D \text{ AND } E)}{P(D)} = \frac{0.08}{0.10} = 0.80$

c. $P(D \text{ OR } E) = P(D) + P(E) - P(D \text{ AND } E) = 0.10 + 0.40 - 0.08 = 0.42$

d. Not independent: $P(D \mid E) = 0.20$ which does not equal $P(D) = 0.10$

e. Not mutually exclusive: $P(D \text{ AND } E) = 0.08$. Being mutually exclusive would require $P(D \text{ AND } E) = 0$, which is not true here.

Exercise 101.
The table shows the political party affiliation of each of 67 members of the US
Senate in June 2012, and when they are up for reelection.

<table>
<thead>
<tr>
<th>Up for reelection:</th>
<th>Democratic Party</th>
<th>Republican Party</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>November 2014</td>
<td>20</td>
<td>13</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>November</td>
<td>10</td>
<td>24</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>
What is the probability that a randomly selected senator has an “Other” affiliation?

Solution: 0

Exercise 102. The table shows the political party affiliation of each of 67 members of the US Senate in June 2012, and when they are up for reelection.

<table>
<thead>
<tr>
<th>Up for reelection:</th>
<th>Democratic Party</th>
<th>Republican Party</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>November 2014</td>
<td>20</td>
<td>13</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>November 2016</td>
<td>10</td>
<td>24</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What is the probability that a randomly selected senator is up for reelection in November 2016?

Solution: \( \frac{34}{67} \)

Exercise 103. The table shows the political party affiliation of each of 67 members of the US Senate in June 2012, and when they are up for reelection.
What is the probability that a randomly selected senator is a Democrat and up for reelection in November 2016?

Solution
\[
\frac{10}{67}
\]

Exercise 104. The table shows the political party affiliation of each of 67 members of the US Senate in June 2012, and when they are up for reelection.

<table>
<thead>
<tr>
<th>Up for reelection</th>
<th>Democratic Party</th>
<th>Republican Party</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>November 2014</td>
<td>20</td>
<td>13</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>November 2016</td>
<td>10</td>
<td>24</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What is the probability that a randomly selected senator is a Republican or is up for reelection in November 2014?

Solution
\[
\frac{57}{67}
\]
Exercise 105. *The table shows the political party affiliation of each of 67 members of the US Senate in June 2012, and when they are up for reelection.*

<table>
<thead>
<tr>
<th>Up for reelection:</th>
<th>Democratic Party</th>
<th>Republican Party</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>November 2014</td>
<td>20</td>
<td>13</td>
<td>0</td>
<td>34</td>
</tr>
<tr>
<td>November 2016</td>
<td>10</td>
<td>24</td>
<td>0</td>
<td>34</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>68</td>
</tr>
</tbody>
</table>

Suppose that a member of the US Senate is randomly selected. Given that the randomly selected senator is up for reelection in November 2016, what is the probability that this senator is a Democrat?

Solution

\[
\frac{10}{34}
\]

Exercise 106. *The table shows the political party affiliation of each of 67 members of the US Senate in June 2012, and when they are up for reelection.*

<table>
<thead>
<tr>
<th>Up for reelection:</th>
<th>Democratic Party</th>
<th>Republican Party</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>November 2014</td>
<td>20</td>
<td>13</td>
<td>0</td>
<td>34</td>
</tr>
<tr>
<td>November 2016</td>
<td>10</td>
<td>24</td>
<td>0</td>
<td>34</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>68</td>
</tr>
</tbody>
</table>
Suppose that a member of the US Senate is randomly selected. What is the probability that the senator is up for reelection in November 2014, knowing that this senator is a Republican?

Solution  
\[
\frac{13}{37}
\]

Exercise 107. The table shows the political party affiliation of each of 67 members of the US Senate in June 2012, and when they are up for reelection.

<table>
<thead>
<tr>
<th>Up for reelection:</th>
<th>Democratic Party</th>
<th>Republican Party</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>November 2014</td>
<td>20</td>
<td>13</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>November 2016</td>
<td>10</td>
<td>24</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The events “Republican” and “Up for reelection in 2016” are _______.

a. mutually exclusive.

b. independent.
Exercise 108. The table shows the political party affiliation of each of 67 members of the US Senate in June 2012, and when they are up for reelection.

<table>
<thead>
<tr>
<th>Up for reelection:</th>
<th>Democratic Party</th>
<th>Republican Party</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>November 2014</td>
<td>20</td>
<td>13</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>November 2016</td>
<td>10</td>
<td>24</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The events “Other” and “Up for reelection in November 2016” are ________

a. mutually exclusive.

b. independent.

c. both mutually exclusive and independent.

d. neither mutually exclusive nor independent.

Solution a

Exercise 109. Table 1.19 gives the number of suicides estimated in the U.S. for a recent year by age, race (black or white), and sex. We are interested in possible
relationships between age, race, and sex. We will let suicide victims be our population.

<table>
<thead>
<tr>
<th>Race and Sex</th>
<th>1−14</th>
<th>15−24</th>
<th>25−64</th>
<th>over 64</th>
<th>TOTALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>white, male</td>
<td>210</td>
<td>3,360</td>
<td>13,610</td>
<td>22,050</td>
<td></td>
</tr>
<tr>
<td>white, female</td>
<td>80</td>
<td>580</td>
<td>3,380</td>
<td>4,930</td>
<td></td>
</tr>
<tr>
<td>black, male</td>
<td>10</td>
<td>460</td>
<td>1,060</td>
<td>1,670</td>
<td></td>
</tr>
<tr>
<td>black, female</td>
<td>0</td>
<td>40</td>
<td>270</td>
<td>330</td>
<td></td>
</tr>
<tr>
<td>all others</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTALS</td>
<td>310</td>
<td>4,650</td>
<td>18,780</td>
<td>29,760</td>
<td></td>
</tr>
</tbody>
</table>

Do not include "all others" for parts f and g.

a. Fill in the column for the suicides for individuals over age 64.

b. Fill in the row for all other races.

c. Find the probability that a randomly selected individual was a white male.

d. Find the probability that a randomly selected individual was a black female.

e. Find the probability that a randomly selected individual was black

f. Find the probability that a randomly selected individual was male.

g. Out of the individuals over age 64, find the probability that a randomly selected individual was a black or white male.

Solution

a.
<table>
<thead>
<tr>
<th>Race and Sex</th>
<th>1–14</th>
<th>15–24</th>
<th>25–64</th>
<th>over 64</th>
<th>TOTALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>white, male</td>
<td>210</td>
<td>3,360</td>
<td>13,610</td>
<td>4,870</td>
<td>22,050</td>
</tr>
<tr>
<td>white, female</td>
<td>80</td>
<td>580</td>
<td>3,380</td>
<td>890</td>
<td>4,930</td>
</tr>
<tr>
<td>black, male</td>
<td>10</td>
<td>460</td>
<td>1,060</td>
<td>140</td>
<td>1,670</td>
</tr>
<tr>
<td>black, female</td>
<td>0</td>
<td>40</td>
<td>270</td>
<td>20</td>
<td>330</td>
</tr>
<tr>
<td>all others</td>
<td>10</td>
<td>210</td>
<td>460</td>
<td>100</td>
<td>780</td>
</tr>
<tr>
<td>TOTALS</td>
<td>310</td>
<td>4,650</td>
<td>18,780</td>
<td>6,020</td>
<td>29,760</td>
</tr>
</tbody>
</table>

\[
c. \quad \frac{22,050}{29,760}
\]

\[
d. \quad \frac{330}{29,760}
\]

\[
e. \quad \frac{2,000}{29,760}
\]

\[
f. \quad \frac{23,720}{29,760}
\]

\[
g. \quad \frac{5,010}{6,020}
\]

**Exercise 110.** _The table of data obtained from www.baseball-almanac.com shows hit information for four well-known baseball players. Suppose that one hit from the table is randomly selected._
<table>
<thead>
<tr>
<th>NAME</th>
<th>Single</th>
<th>Double</th>
<th>Triple</th>
<th>Home Run</th>
<th>TOTAL HITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Babe Ruth</td>
<td>1,517</td>
<td>506</td>
<td>136</td>
<td>714</td>
<td>2,873</td>
</tr>
<tr>
<td>Jackie</td>
<td>1,054</td>
<td>273</td>
<td>54</td>
<td>137</td>
<td>1,518</td>
</tr>
<tr>
<td>Robinson</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ty Cobb</td>
<td>3,603</td>
<td>174</td>
<td>295</td>
<td>114</td>
<td>4,189</td>
</tr>
<tr>
<td>Hank Aaron</td>
<td>2,294</td>
<td>624</td>
<td>98</td>
<td>755</td>
<td>3,771</td>
</tr>
<tr>
<td>TOTAL</td>
<td>8,471</td>
<td>1,577</td>
<td>583</td>
<td>1,720</td>
<td>12,351</td>
</tr>
</tbody>
</table>

Table 1.22

Find \( P(\text{hit was made by Babe Ruth}) \).

\[
a. \frac{1518}{2873} \\
b. \frac{2873}{12351} \\
c. \frac{583}{12351} \\
d. \frac{4189}{12351}
\]

Solution: b

Exercise 111. Find \( P(\text{hit was made by Ty Cobb}|\text{The hit was a Home Run}) \).

\[
a. \frac{4189}{12351} \\
\]
Exercise 112. Table 1.21 identifies a group of children by one of four hair colors, and by type of hair.

<table>
<thead>
<tr>
<th>Hair Type</th>
<th>Brown</th>
<th>Blond</th>
<th>Black</th>
<th>Red</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wavy</td>
<td>20</td>
<td>15</td>
<td>3</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td>Straight</td>
<td>80</td>
<td>15</td>
<td></td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Totals</td>
<td>20</td>
<td></td>
<td>215</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Complete the table.

b. What is the probability that a randomly selected child will have wavy hair?

c. What is the probability that a randomly selected child will have either brown or blond hair?

d. What is the probability that a randomly selected child will have wavy brown hair?

e. What is the probability that a randomly selected child will have red hair, given that he or she has straight hair?
f. If \( B \) is the event of a child having brown hair, find the probability of the complement of \( B \).

g. In words, what does the complement of \( B \) represent?

Solution

<table>
<thead>
<tr>
<th>Hair Type</th>
<th>Brown</th>
<th>Blond</th>
<th>Black</th>
<th>Red</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wavy</td>
<td>20</td>
<td>5</td>
<td>15</td>
<td>3</td>
<td>43</td>
</tr>
<tr>
<td>Straight</td>
<td>80</td>
<td>15</td>
<td>65</td>
<td>12</td>
<td>172</td>
</tr>
<tr>
<td>Totals</td>
<td>100</td>
<td>20</td>
<td>80</td>
<td>15</td>
<td>215</td>
</tr>
</tbody>
</table>

b. \( \frac{43}{215} \)

c. \( \frac{120}{215} \)

d. \( \frac{20}{215} \)

e. \( \frac{12}{172} \)

f. \( \frac{115}{215} \)

Exercise 113. In a previous year, the weights of the members of the San Francisco 49ers and the Dallas Cowboys were published in the San Jose Mercury News. The factual data were compiled into the following table.

| Shirt# | \( \leq 210 \) | 211–250 | 251–290 | >290 |
For the following, suppose that you randomly select one player from the 49ers or Cowboys.

a. Find the probability that his shirt number is from 1 to 33.

b. Find the probability that he weighs at most 210 pounds.

c. Find the probability that his shirt number is from 1 to 33 AND he weighs at most 210 pounds.

d. Find the probability that his shirt number is from 1 to 33 OR he weighs at most 210 pounds.

e. Find the probability that his shirt number is from 1 to 33 GIVEN that he weighs at most 210 pounds.

Solution

a. \( \frac{26}{106} \)

b. \( \frac{33}{106} \)

c. \( \frac{21}{106} \)

d. \( \left( \frac{26}{106} \right) + \left( \frac{33}{106} \right) - \left( \frac{21}{106} \right) = \left( \frac{38}{106} \right) \)
Exercise 114. This tree diagram shows the tossing of an unfair coin followed by drawing one bead from a cup containing three red (R), four yellow (Y) and five blue (B) beads. For the coin, \( P(H) = \frac{2}{3} \) and \( P(T) = \frac{1}{3} \) where H is heads and T is tails.

Find \( P(\text{tossing a Head on the coin AND a Red bead}) \)

a. \( \frac{2}{3} \)

b. \( \frac{5}{15} \)

c. \( \frac{6}{36} \)

d. \( \frac{5}{36} \)

Solution c
Exercise 115.  
This tree diagram shows the tossing of an unfair coin followed by drawing one bead from a cup containing three red (R), four yellow (Y) and five blue (B) beads. For the coin, \( P(H) = \frac{2}{3} \) and \( P(T) = \frac{1}{3} \) where H is heads and T is tails.

\[
\begin{array}{c}
\text{H} \quad \frac{2}{3} \\
\quad \quad \text{R} \quad \frac{3}{12} \\
\quad \quad \quad \text{Y} \quad \frac{4}{12} \\
\quad \quad \quad \text{B} \quad \frac{5}{12} \\
\text{T} \quad \frac{1}{3} \\
\quad \quad \text{R} \quad \frac{3}{12} \\
\quad \quad \quad \text{Y} \quad \frac{4}{12} \\
\quad \quad \quad \text{B} \quad \frac{5}{12}
\end{array}
\]

Find \( P(\text{Blue bead}) \).

a. \( \frac{15}{36} \)

b. \( \frac{10}{36} \)

c. \( \frac{10}{12} \)

d. \( \frac{6}{36} \)

Solution a

Exercise 116.  
A box of cookies contains three chocolate and seven butter cookies. Miguel randomly selects a cookie and eats it. Then he randomly selects another cookie
and eats it. (How many cookies did he take?)

a. Draw the tree that represents the possibilities for the cookie selections. Write the probabilities along each branch of the tree.

b. Are the probabilities for the flavor of the second cookie that Miguel selects independent of his first selection? Explain.

c. For each complete path through the tree, write the event it represents and find the probabilities.

d. Let S be the event that both cookies selected were the same flavor. Find P(S).

e. Let T be the event that the cookies selected were different flavors. Find P(T) by two different methods: by using the complement rule and by using the branches of the tree. Your answers should be the same with both methods.

f. Let U be the event that the second cookie selected is a butter cookie. Find P(U).

Solution

<table>
<thead>
<tr>
<th>1st Cookie</th>
<th>2nd Cookie</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>3/10</td>
<td>2/9</td>
</tr>
<tr>
<td></td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>7/10</td>
</tr>
<tr>
<td></td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>7/9</td>
</tr>
<tr>
<td></td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>3/9</td>
</tr>
<tr>
<td></td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>6/9</td>
</tr>
</tbody>
</table>

a.

b. No, the probabilities for the second selection depend on what happened on the first selection. The composition of the box of cookies is changed when one of them is eaten (not replaced).
Exercise 117. A previous year, the weights of the members of the **San Francisco 49ers** and the **Dallas Cowboys** were published in the San Jose Mercury News. The factual data are compiled into **Table 1.15**.

<table>
<thead>
<tr>
<th>Shirt#</th>
<th>≤ 210</th>
<th>211–250</th>
<th>251–290</th>
<th>290≤</th>
</tr>
</thead>
<tbody>
<tr>
<td>1–33</td>
<td>21</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>34–66</td>
<td>6</td>
<td>18</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>66–99</td>
<td>6</td>
<td>12</td>
<td>22</td>
<td>5</td>
</tr>
</tbody>
</table>

**Table 1.15**

For the following, suppose that you randomly select one player from the 49ers or Cowboys. If having a shirt number from one to 33 and weighing at most 210...
pounds were independent events, then what should be true about \( P(\text{Shirt# 1-33}| \leq 210 \text{ pounds}) \)

**Solution**

\[ P(\text{shirt# 1-33}) = P(\text{shirt# 1-33}| \leq 210 \text{ pounds}) \]

**Exercise 118.**

The probability that a male develops some form of cancer in his lifetime is 0.4567. The probability that a male has at least one false positive test result (meaning the test comes back for cancer when the man does not have it) is 0.51. Some of the following questions do not have enough information for you to answer them. Write “not enough information” for those answers. Let \( C = \text{a man develops cancer in his lifetime} \) and \( P = \text{man has at least one false positive}. \)

- **a.** \( P(C) = \text{______} \)
- **b.** \( P(P|C) = \text{______} \)
- **c.** \( P(P|C') = \text{______} \)
- **d.** If a test comes up positive, based upon numerical values, can you assume that man has cancer? Justify numerically and explain why or why not.

**Solution**

- **a.** \( P(C) = 0.4567 \)
- **b.** not enough information
- **c.** not enough information
- **d.** No, because over half (0.51) of men have at least one false positive text

**Exercise 119.**

Given events \( G \) and \( H: P(G) = 0.43; P(H) = 0.26; P(H \text{ AND } G) = 0.14 \)

- **a.** Find \( P(H \text{ OR } G) \).
- **b.** Find the probability of the complement of event \((H \text{ AND } G)\).
c. Find the probability of the complement of event (H OR G).

Solution

a. \( P(H \text{ OR } G) = P(H) + P(G) - P(H \text{ AND } G) = 0.26 + 0.43 - 0.14 = 0.55 \)

b. \( P(H \text{ AND } G^c) = 1 - P(H \text{ AND } G) = 1 - 0.14 = 0.86 \)

c. \( P(H \text{ OR } G^c) = 1 - 0.55 = 0.45 \)

Exercise 120.

Given events J and K: \( P(J) = 0.18; \ P(K) = 0.37; \ P(J \text{ OR } K) = 0.45 \)

a. Find \( P(J \text{ AND } K) \).

b. Find the probability of the complement of event \( (J \text{ AND } K) \).

c. Find the probability of the complement of event \( (J \text{ AND } K) \).

Solution

a. \( P(J \text{ OR } K) = P(J) + P(K) - P(J \text{ AND } K); \ \ \ 0.45 = 0.18 + 0.37 - P(J \text{ AND } K) \); solve to find \( P(J \text{ AND } K) = 0.10 \)

b. \( P(\text{NOT (J AND K)}) = 1 - P(J \text{ AND } K) = 1 - 0.10 = 0.90 \)

c. \( P(\text{NOT (J OR K)}) = 1 - P(J \text{ OR } K) = 1 - 0.45 = 0.55 \)

Exercise 121.

Suppose that you have eight cards. Five are green and three are yellow. The cards are well shuffled.

Suppose that you randomly draw two cards, one at a time, with replacement.

Let \( G_1 = \text{first card is green} \)

Let \( G_2 = \text{second card is green} \)

a. Draw a tree diagram of the situation.
b. Find \( P(G_1 \text{ AND } G_2) \).

c. Find \( P(\text{at least one green}) \).

d. Find \( P(G_2 | G_1) \).

e. Are \( G_2 \) and \( G_1 \) independent events? Explain why or why not.

Solution

\[
\begin{array}{c|c}
\text{1st Card} & \text{2nd Card} \\
\hline
\frac{5}{8} \text{ Green} & \frac{5}{8} \text{ Green} \\
\frac{3}{8} \text{ Yellow} & \frac{3}{8} \text{ Yellow} \\
\end{array}
\]

Draw Two Cards

\[ P(GG) = \left( \frac{5}{8} \right) \left( \frac{5}{8} \right) = \frac{25}{64} \]

c. \( P(\text{at least one green}) = P(GG) + P(GY) + P(YG) = \frac{25}{64} + \frac{15}{64} + \frac{15}{64} = \frac{55}{64} \)

d. \( P(G | G) = \frac{5}{8} \)

e. Yes, they are independent because the first card is placed back in the bag before the second card is drawn; the composition of cards in the bag remains the same from draw one to draw two.

Exercise 122. Suppose that you randomly draw two cards, one at a time, \textit{without} replacement.
\( G_1 = \text{first card is green} \)

\( G_2 = \text{second card is green} \)

a. Draw a tree diagram of the situation.

b. Find \( P(G_1 \text{ AND } G_2) \).

c. Find \( P(\text{at least one green}) \).

d. Find \( P(G_2|G_1) \).

e. Are \( G_2 \) and \( G_1 \) independent events? Explain why or why not.

Solution

\[
\begin{array}{c|c}
\text{1st Card} & \text{2nd Card} \\
\hline
\text{Green} & \frac{5}{6} & \frac{4}{7} \\
\text{Yellow} & \frac{3}{8} & \text{Yellow} \\
\end{array}
\]

Draw Two Cards

a.

b. \( \left( \frac{5}{8} \right) \left( \frac{4}{7} \right) \)

c. \( \left( \frac{5}{8} \right) \left( \frac{3}{7} \right) + \left( \frac{3}{8} \right) \left( \frac{5}{7} \right) + \left( \frac{3}{8} \right) \left( \frac{4}{7} \right) \)

d. \( \frac{4}{7} \)

e. No
Exercise 123. The percent of licensed U.S. drivers (from a recent year) that are female is 48.60. Of the females, 5.03% are age 19 and under; 81.36% are age 20–64; 13.61% are age 65 or over. Of the licensed U.S. male drivers, 5.04% are age 19 and under; 81.43% are age 20–64; 13.53% are age 65 or over.

Complete the following.

a. Construct a table or a tree diagram of the situation.

b. Find \( P(\text{driver is female}) \).

c. Find \( P(\text{driver is age 65 or over} \mid \text{driver is female}) \).

d. Find \( P(\text{driver is age 65 or over AND female}) \).

e. In words, explain the difference between the probabilities in part c and part d.

f. Find \( P(\text{driver is age 65 or over}) \).

g. Are being age 65 or over and being female mutually exclusive events? How do you know?

Solution

a. |        | <20 | 20–64 | >64  | Totals |
---|------|-----|-------|------|-------|
Female |      | 0.0244 | 0.3954 | 0.0661 | 0.486 |
Male   |      | 0.0259 | 0.4186 | 0.0695 | 0.514 |
Totals |      | 0.0503 | 0.8140 | 0.1356 | 1

b. \( P(F) = 0.486 \)

c. \( P(>64 \mid F) = 0.1361 \)
d. \(P(>64 \text{ and } F) = P(F)P(>64 | F) = (0.486)(0.1361) = 0.0661\)

e. \(P(>64 | F)\) is the percentage of female drivers who are 65 or older and \(P(>64 \text{ and } F)\) is the percentage of drivers who are female and 65 or older.

f. \(P(>64) = P(>64 \text{ and } F) + P(>64 \text{ and } M) = 0.1356\)

g. No, being female and 65 or older are not mutually exclusive because they can occur at the same time \(P(>64 \text{ and } F) = 0.0661\)

Exercise 124. **The percent of licensed U.S. drivers (from a recent year) that are female is 48.60. Of the females, 5.03\% are age 19 and under; 81.36\% are age 20–64; 13.61\% are age 65 or over. Of the licensed U.S. male drivers, 5.04\% are age 19 and under; 81.43\% are age 20–64; 13.53\% are age 65 or over.**

Suppose that 10,000 U.S. licensed drivers are randomly selected.

**a.** How many would you expect to be male?

**b.** Using the table or tree diagram, construct a contingency table of gender versus age group.

**c.** Using the contingency table, find the probability that out of the age 20–64 group, a randomly selected driver is female.

**Solution**

**a.** 5,140

**b.**

<table>
<thead>
<tr>
<th></th>
<th>&lt;20</th>
<th>20–64</th>
<th>&gt;64</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>0.0244</td>
<td>0.3954</td>
<td>0.0661</td>
<td>0.486</td>
</tr>
<tr>
<td>Male</td>
<td>0.0259</td>
<td>0.4186</td>
<td>0.0695</td>
<td>0.514</td>
</tr>
<tr>
<td>Totals</td>
<td>0.0503</td>
<td>0.8140</td>
<td>0.1356</td>
<td>1</td>
</tr>
</tbody>
</table>
Exercise 125. Approximately 86.5% of Americans commute to work by car, truck, or van. Out of that group, 84.6% drive alone and 15.4% drive in a carpool. Approximately 3.9% walk to work and approximately 5.3% take public transportation.

a. Construct a table or a tree diagram of the situation. Include a branch for all other modes of transportation to work.

b. Assuming that the walkers walk alone, what percent of all commuters travel alone to work?

c. Suppose that 1,000 workers are randomly selected. How many would you expect to travel alone to work?

d. Suppose that 1,000 workers are randomly selected. How many would you expect to drive in a carpool?

Solution

<table>
<thead>
<tr>
<th></th>
<th>Car, Truck or Van</th>
<th>Walk</th>
<th>Public Transportation</th>
<th>Other</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alone</td>
<td>0.7318</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not Alone</td>
<td>0.1332</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Totals</td>
<td>0.8650</td>
<td>0.0390</td>
<td>0.0530</td>
<td>0.0430</td>
<td>1</td>
</tr>
</tbody>
</table>

b. If we assume that all walkers are alone and that none from the other two groups travel alone (which is a big assumption) we have: \( P(\text{Alone}) = 0.7318 + 0.0390 = 0.7708. \)

c. Make the same assumptions as in (b) we have: \((0.7708)(1000) = 771 \)
Exercise 126.

When the Euro coin was introduced in 2002, two math professors had their statistics students test whether the Belgian one Euro coin was a fair coin. They spun the coin rather than tossing it and found that out of 250 spins, 140 showed a head (event H) while 110 showed a tail (event T). On that basis, they claimed that it is not a fair coin.

a. Based on the given data, find \( P(H) \) and \( P(T) \).

b. Use a tree to find the probabilities of each possible outcome for the experiment of tossing the coin twice.

c. Use the tree to find the probability of obtaining exactly one head in two tosses of the coin.

d. Use the tree to find the probability of obtaining at least one head.

Solution

a. \( P(H) = \frac{140}{250} \); \( P(T) = \frac{110}{250} \)

b. 

![Tree Diagram for Coin Toss Experiment](image-url)
Exercise 127.

The following are real data from Santa Clara County, CA. As of a certain time, there had been a total of 3,059 documented cases of AIDS in the county. They were grouped into the following categories:

<table>
<thead>
<tr>
<th></th>
<th>Homosexual/Bisexual</th>
<th>IV Drug User*</th>
<th>Heterosexual Contact</th>
<th>Other</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>0</td>
<td>70</td>
<td>136</td>
<td>49</td>
<td>_____</td>
</tr>
<tr>
<td>Male</td>
<td>2,146</td>
<td>463</td>
<td>60</td>
<td>135</td>
<td>_____</td>
</tr>
<tr>
<td>Totals</td>
<td>_____</td>
<td>_____</td>
<td>_____</td>
<td>_____</td>
<td>_____</td>
</tr>
</tbody>
</table>

* includes homosexual/bisexual IV drug users

Suppose a person with AIDS in Santa Clara County is randomly selected.

a. Find $P(\text{Person is female}).$

b. Find $P(\text{Person has a risk factor heterosexual contact}).$

c. Find $P(\text{Person is female OR has a risk factor of IV drug user}).$

d. Find $P(\text{Person is female AND has a risk factor of homosexual/bisexual}).$

e. Find $P(\text{Person is male AND has a risk factor of IV drug user}).$

f. Find $P(\text{Person is female GIVEN person got the disease from heterosexual contact}).$
g. Construct a Venn diagram. Make one group females and the other group heterosexual contact.

<table>
<thead>
<tr>
<th></th>
<th>Homosexual/Bisexual</th>
<th>IV Drug User*</th>
<th>Heterosexual Contact</th>
<th>Other</th>
<th>Totals</th>
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</thead>
<tbody>
<tr>
<td>Female</td>
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<td>70</td>
<td>136</td>
<td>49</td>
<td>255</td>
</tr>
<tr>
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<td>2,146</td>
<td>463</td>
<td>60</td>
<td>135</td>
<td>2,804</td>
</tr>
<tr>
<td>Totals</td>
<td>2,146</td>
<td>533</td>
<td>196</td>
<td>184</td>
<td>3,059</td>
</tr>
</tbody>
</table>

* includes homosexual/bisexual IV drug users

a. \( \frac{255}{3059} \)

b. \( \frac{196}{3059} \)

c. \( \frac{718}{3059} \)

d. 0

e. \( \frac{463}{3059} \)

f. \( \frac{136}{196} \)
Exercise 128. Answer these questions using probability rules. Do NOT use the contingency table. Three thousand fifty-nine cases of AIDS had been reported in Santa Clara County, CA, through a certain date. Those cases will be our population. Of those cases, 6.4% obtained the disease through heterosexual contact and 7.4% are female. Out of the females with the disease, 53.3% got the disease from heterosexual contact.

a. Find \( P(\text{Person is female}) \).

b. Find \( P(\text{Person obtained the disease through heterosexual contact}) \).

c. Find \( P(\text{Person is female GIVEN person got the disease from heterosexual contact}) \)

d. Construct a Venn diagram representing this situation. Make one group females and the other group heterosexual contact. Fill in all values as probabilities.

Solution

a. \( P(F) = 0.074 \)

b. \( P(HC) = 0.064 \)

c. \( P(F \mid HC) = \frac{P(F \text{ AND } HC)}{P(HC)} = \left[ \frac{P(F)P(HC \mid F)}{P(HC)} \right] = \frac{(0.074)(0.533)}{(0.064)} = 0.6163 \)
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