

## 0-6 Multiplying Probabilities

**Determine whether the events are *independent* or *dependent*. Then find the probability.**

1. A red die and a blue die are rolled. What is the probability of getting the result shown?



**SOLUTION:**

Since the outcome of tossing the red die does not affect the outcome of rolling the blue die, these events are independent.

$$P(3 \text{ and } 5)$$

$$= P(3) \cdot P(5) \quad \text{Probability of independent events}$$

$$= \frac{1}{6} \cdot \frac{1}{6} \text{ or } \frac{1}{36} \quad P(3) = \frac{1}{6} \text{ and } P(5) = \frac{1}{6}$$

The probability is  $\frac{1}{36}$ .

2. Yana has 4 black socks, 6 blue socks, and 8 white socks in his drawer. If he selects three socks at random with no replacement, what is the probability that he will first select a blue sock, then a black sock, and then another blue sock?

**SOLUTION:**

Since the socks are being selected with out replacement, the events are dependent.

$$P(\text{blue}) = \frac{6}{18} \text{ or } \frac{1}{3}$$

$$P(\text{black}|\text{blue}) = \frac{4}{17}$$

$$P(\text{blue}|\text{(blue and black)}) = \frac{5}{16}$$

$$P(\text{blue and black and blue})$$

$$= P(\text{black}) \cdot P(\text{blue}|\text{black}) \cdot P(\text{blue}|\text{(blue and black)})$$

$$= \frac{1}{3} \cdot \frac{4}{17} \cdot \frac{5}{16} \text{ or } \frac{5}{204}$$

The probability is  $\frac{5}{204}$  or about 0.025.

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A die is rolled twice. Find each probability.

3.  $P(2 \text{ and } 3)$

**SOLUTION:**

$P(2 \text{ and } 3)$

$$= P(2) \cdot P(3) \quad \text{Probability of independent events.}$$

$$= \frac{1}{6} \cdot \frac{1}{6} \text{ or } \frac{1}{36} \quad P(2) = \frac{1}{6} \text{ and } P(3) = \frac{1}{6}$$

The probability is  $\frac{1}{36}$ .

4.  $P(\text{two } 4\text{s})$

**SOLUTION:**

$P(4 \text{ and } 4)$

$$= P(4) \cdot P(4) \quad \text{Probability of independent events.}$$

$$= \frac{1}{6} \cdot \frac{1}{6} \text{ or } \frac{1}{36} \quad P(4) = \frac{1}{6} \text{ and } P(4) = \frac{1}{6}$$

The probability is  $\frac{1}{36}$ .

5.  $P(\text{no } 6\text{s})$

**SOLUTION:**

$P(\text{no } 6 \text{ and no } 6)$

$$= P(\text{no } 6) \cdot P(\text{no } 6) \quad \text{Probability of independent events}$$

$$= \frac{5}{6} \cdot \frac{5}{6} \text{ or } \frac{25}{36} \quad P(\text{no } 6) = \frac{5}{6}$$

The probability is  $\frac{25}{36}$ .

6.  $P(\text{two of the same number})$

**SOLUTION:**

$P(\text{two of the same numbers})$

$$= P(2 \text{ 1s}) + P(2 \text{ 2s}) + P(2 \text{ 3s}) + P(2 \text{ 4s}) + P(2 \text{ 5s}) + P(2 \text{ 6s})$$

$$= \frac{1}{6} \cdot \frac{1}{6} + \frac{1}{6} \cdot \frac{1}{6} + \frac{1}{6} \cdot \frac{1}{6} + \frac{1}{6} \cdot \frac{1}{6} + \frac{1}{6} \cdot \frac{1}{6} + \frac{1}{6} \cdot \frac{1}{6}$$

$$P(2 \text{ 1s}) \frac{1}{6} \cdot \frac{1}{6}$$

$$= 6 \left( \frac{1}{36} \right) = \frac{1}{6}$$

Simplify.

The probability is  $\frac{1}{6}$ .

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A bag contains 8 blue marbles, 6 red marbles, and 5 green marbles. Three marbles are drawn one at a time. Find each probability.

7. The second marble is green, given that the first marble is blue and not replaced.

*SOLUTION:*

$$P(\text{green}|\text{blue})$$

$$= \frac{P(\text{green and blue})}{P(\text{blue})} \quad \text{Conditional probability}$$

$$= \frac{\frac{40}{342}}{\frac{8}{19}}$$

$$P(\text{blue}) = \frac{8}{19} \text{ and } P(\text{green and blue}) = \frac{5}{19} \cdot \frac{8}{18}$$

$$= \frac{40}{342} \cdot \frac{19}{8} = \frac{5}{18}$$

Simplify.

The probability is  $\frac{5}{18}$ .

8. The second marble is red, given that the first marble is green and is replaced.

*SOLUTION:*

$$P(\text{red}|\text{green})$$

$$= \frac{P(\text{red and green})}{P(\text{green})} \quad \text{Conditional probability}$$

$$= \frac{\frac{30}{61}}{\frac{5}{19}}$$

$$P(\text{green}) = \frac{5}{19} \text{ and } P(\text{red and green}) = \frac{6}{19} \cdot \frac{5}{19}$$

$$= \frac{30}{361} \cdot \frac{19}{5} = \frac{6}{19}$$

Simplify.

The probability is  $\frac{6}{19}$ .

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9. The third marble is red, given that the first two are red and blue and not replaced.

**SOLUTION:**

$$P(\text{red}|\text{red and blue})$$

$$= \frac{P(\text{red and (red and blue)})}{P(\text{(red and blue)})} \quad \text{Conditional probability}$$

$$= \frac{\frac{240}{5814}}{\frac{48}{342}}$$

$$P(\text{red and blue}) = \frac{6}{19} \cdot \frac{8}{18} \text{ and}$$

$$P(\text{red and (red and blue)}) = \frac{6}{19} \cdot \frac{5}{18} \cdot \frac{8}{17}$$

$$= \frac{240}{5814} \cdot \frac{342}{48} = \frac{5}{17}$$

Simplify.

The probability is  $\frac{5}{17}$ .

10. The third marble is green, given that the first two are red and are replaced.

**SOLUTION:**

$$P(\text{green}|\text{red and red})$$

$$= \frac{P(\text{green and (red and red)})}{P(\text{(red and red)})} \quad \text{Conditional probability}$$

$$= \frac{\frac{180}{19^3}}{\frac{36}{19^2}}$$

$$P(\text{red and red}) = \frac{6}{19} \cdot \frac{6}{19} \text{ and}$$

$$P(\text{green and (red and red)}) = \frac{5}{19} \cdot \frac{6}{19} \cdot \frac{6}{19}$$

$$= \frac{180}{19^3} \cdot \frac{19^2}{36} = \frac{5}{19}$$

Simplify.

The probability is  $\frac{5}{19}$ .

**DVDS** There are 8 action, 3 comedy, and 5 drama DVDs on a shelf. Suppose three DVDs are selected at random from the shelf. Find each probability.

11.  $P(3 \text{ action})$ , with replacement

**SOLUTION:**

$$P(3 \text{ action}) = \frac{8}{16} \cdot \frac{8}{16} \cdot \frac{8}{16} = \frac{1}{8} \quad P(\text{action}) = \frac{8}{16}$$

The probability is  $\frac{1}{8}$ .

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12.  $P(2 \text{ action, then a comedy), without replacement}$

**SOLUTION:**

$$P(\text{action, action, and comedy}) = \frac{3}{16} \cdot \frac{8}{15} \cdot \frac{7}{14} = \frac{1}{20}$$

The probability is  $\frac{1}{20}$ .

13. **CARDS** You draw a card from a standard deck of cards and show it to a friend. The friend tells you that the card is red. What is the probability that you correctly guess that the card is the ace of diamonds?

**SOLUTION:**

Given that the card is red, the probability it is an ace is  $\frac{1}{26}$ .

The probability is  $\frac{1}{26}$ .

14. **HONOR ROLL** Suppose the probability that a student takes AP Calculus and is on the honor roll is 0.0035, and the probability that a student is on the honor roll is 0.23. Find the probability that a student takes AP Calculus given that he or she is on the honor roll.

**SOLUTION:**

$P(\text{AP Calc}|\text{honor roll})$

$$= \frac{P(\text{AP Calc and honor roll})}{P(\text{honor roll})} \quad \text{Conditional probability}$$

$$= \frac{0.0035}{0.23} \quad P(\text{honor roll})=0.23 \text{ and}$$

$$P(\text{AP Calc and honor roll}) = 0.0035$$

$$\approx 0.015$$

Simplify.

The probability is about 0.015.

15. **DRIVING TESTS** The table shows how students in Mr. Diaz's class fared on their first driving test. Some took a class to prepare, while others did not. Find each probability.

Status	Class	No Class
passed	64	48
failed	18	32

- Paige passed, given that she took the class.
- Madison failed, given that she did not take the class.
- Jamal did not take the class, given that he passed.

**SOLUTION:**

Calculate the column and row totals.

Status	Class	No Class	Totals
passed	64	48	112
failed	18	32	50
Totals	82	80	162

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a.

$$P(\text{pass}|\text{class})$$

$$= \frac{P(\text{pass and class})}{P(\text{class})} \quad \text{Conditional probability}$$

$$= \frac{\frac{64}{162}}{\frac{82}{162}} \quad P(\text{class}) = \frac{82}{162} \text{ and } P(\text{pass and class}) = \frac{64}{162}$$

$$= \frac{64}{82} = \frac{21}{41} \quad \text{Simplify.}$$

b.

$$P(\text{fail}|\text{class})$$

$$= \frac{P(\text{fail and no class})}{P(\text{no class})} \quad \text{Conditional probability}$$

$$= \frac{\frac{32}{162}}{\frac{80}{162}} \quad P(\text{no class}) = \frac{80}{162} \text{ and } P(\text{fail and no class}) = \frac{32}{162}$$

$$= \frac{32}{80} = \frac{2}{5} \quad \text{Simplify.}$$

c.

$$P(\text{no class}|\text{pass})$$

$$= \frac{P(\text{no class and pass})}{P(\text{pass})} \quad \text{Conditional probability}$$

$$= \frac{\frac{48}{162}}{\frac{112}{162}} \quad P(\text{pass}) = \frac{112}{162} \text{ and } P(\text{no class and pass}) = \frac{48}{162}$$

$$= \frac{48}{112} = \frac{3}{4} \quad \text{Simplify.}$$

16. **SCHOOL CLUBS** King High School tallied the number of males and females that were members of at least one after each probability.

Gender	Clubs	No Clubs
male	156	242
female	312	108

- a. A student is a member of a club given that he is male.  
b. A student is not a member of a club given that she is female.  
c. A student is a male given that he is not a member of a club.

**SOLUTION:**

Calculate the column and row totals.

Gender	Clubs	No	Totals
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		Clubs	
male	156	242	398
female	312	108	420
Totals	468	350	818

$P(\text{club member}|\text{male})$

$$= \frac{P(\text{club member and male})}{P(\text{male})} \quad \text{Conditional probability}$$

$$= \frac{\frac{156}{818}}{\frac{398}{818}}$$

$$P(\text{male}) = \frac{398}{818} \text{ and}$$

$$P(\text{club member and male}) = \frac{156}{818}$$

a.  $= \frac{156}{398} = \frac{78}{199}$

Simplify.

$$P(\text{club member}|\text{male}) = \frac{P(\text{club member and male})}{P(\text{male})} \quad \text{Conditional probability}$$

$$= \frac{\frac{156}{818}}{\frac{398}{818}}$$

$$P(\text{male}) = \frac{398}{818} \text{ and } P(\text{club member and ma})$$

$$= \frac{156}{398} = \frac{78}{199}$$

Simplify.

$P(\text{non member}|\text{female})$

$$= \frac{P(\text{non member and female})}{P(\text{female})} \quad \text{Conditional probability}$$

$$= \frac{\frac{108}{815}}{\frac{420}{815}}$$

$$P(\text{female}) = \frac{420}{818} \text{ and}$$

$$P(\text{non member and female}) = \frac{108}{818}$$

b.  $= \frac{108}{420} = \frac{9}{35}$

Simplify.

$$P(\text{non member}|\text{female}) = \frac{P(\text{non member and female})}{P(\text{female})} \quad \text{Conditional probability}$$

$$= \frac{\frac{108}{815}}{\frac{420}{815}}$$

$$P(\text{female}) = \frac{420}{818} \text{ and } P(\text{non member an})$$

$$= \frac{108}{420} = \frac{9}{35}$$

Simplify.

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c.

$$P(\text{male}|\text{non member})$$

$$= \frac{P(\text{male and non member})}{P(\text{non member})} \quad \text{Conditional probability}$$

$$= \frac{\frac{242}{818}}{\frac{350}{818}}$$

$$P(\text{non member}) = \frac{350}{818} \text{ and}$$

$$P(\text{male and non member}) = \frac{242}{818}$$

$$= \frac{242}{350} = \frac{121}{175}$$

Simplify.

17. **FOOTBALL ATTENDANCE** The number of students who have attended a football game at North Coast High School is shown. Find each probability.

Class	Freshman	Sophomore	Junior	Senior
attended	48	90	224	254
not attended	182	141	36	8

- a. A student is a freshman and has not attended a game.  
 b. A student has attended a game and is an upperclassman (a junior or senior).

**SOLUTION:**

Calculate the column and row totals.

class	Freshman	Sophomore	Junior	Senior	Totals
attended	48	90	224	254	616
not attended	182	141	36	8	367
Totals	230	231	260	262	983

- a. Given that the student is a freshman, the  $P(\text{not attended}) = \frac{182}{230} = \frac{91}{115}$  or about 79.1%.  
 b. Given that the student attended the game, the  $P(\text{upperclassman}) = \frac{478}{616} = \frac{239}{308}$  or about 77.6%.