

0-5 Adding Probabilities

1. **CARNIVAL GAMES** A spinner has sections of equal size. The table shows the results of several spins.

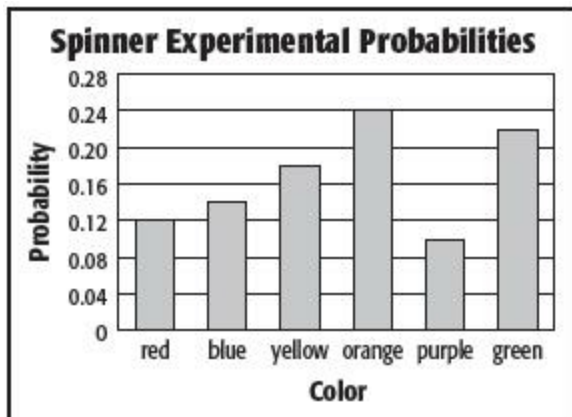
Color	Frequency
red	6
blue	7
yellow	9
orange	12
purple	5
green	11

- Copy the table and add a column to show the experimental probability of the spinner landing on each of the colors with the next spin.
- Create a bar graph that shows these experimental probabilities.
- Add a column to your table that shows the theoretical probability of the spinner landing on each of the colors with the next spin.
- Create a bar graph that shows these theoretical probabilities.
- Interpret and compare the graphs you created in parts **b** and **d**.

SOLUTION:

a. Total spins = $6 + 7 + 9 + 12 + 5 + 11$ or 50

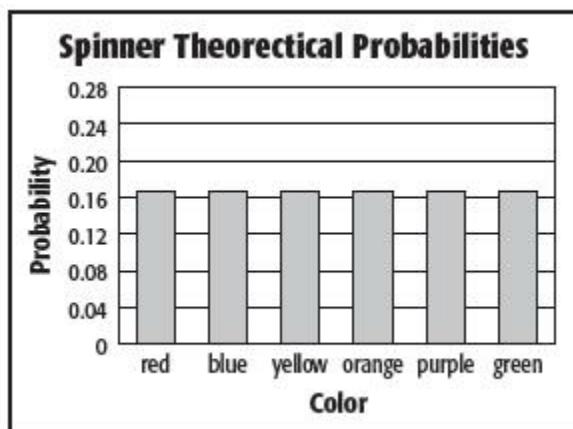
Color	Frequency	Experimental Probability
red	6	0.12
blue	7	0.14
yellow	9	0.18
orange	12	0.24
purple	6	0.10
green	11	0.22



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- The spinner has 6 equal outcomes.

0-5 Adding Probabilities

Color	Frequency	Experimental Probability	Theoretical Probability
red	6	0.12	$0.\overline{16}$
blue	7	0.14	$0.\overline{16}$
yellow	9	0.18	$0.\overline{16}$
orange	12	0.24	$0.\overline{16}$
purple	6	0.10	$0.\overline{16}$
green	11	0.22	$0.\overline{16}$



d.

e. Sample answer: Since all the bars in the graph of the theoretical probabilities are the same height, the graph represents a uniform distribution. This means that in theory, the chance of landing on any one of the colors is equally likely. The graph of the experimental probabilities indicates that in practice, it is more likely that the spinner will land on orange or green than on any of the other colors, since the heights of those bars are taller than any others in the graph.

0-5 Adding Probabilities

Determine whether the events are *mutually exclusive* or *not mutually exclusive*. Then find the probability.

2. Two dice are rolled.
- $P(\text{sum of 10 or doubles})$
 - $P(\text{sum of 6 or 7})$
 - $P(\text{sum} < 3 \text{ or sum} > 10)$

SOLUTION:

- a. Because $5 + 5 = 10$, these events are not mutually exclusive.
 $P(\text{sum of 10 or doubles}) = P(10) + P(\text{doubles}) - P(10 \text{ and doubles})$

$$= \frac{3}{36} + \frac{6}{36} - \frac{1}{36} \text{ or } \frac{2}{9}.$$

- b. The events are mutually exclusive, because the sum cannot be both 6 and 7.
 $P(6 \text{ or } 7) = P(6) + P(7)$

$$P(6 \text{ or } 7) = \frac{5}{36} + \frac{6}{36} \text{ or } \frac{11}{36}.$$

- c. The events are mutually exclusive, because the sum cannot be both less than 3 and greater than 10.
 $P(\text{sum} < 3 \text{ or sum} > 10) = P(\text{sum} < 3) + P(\text{sum} > 10)$

$$P(\text{sum} < 3 \text{ or sum} > 10) = \frac{1}{36} + \frac{3}{36} \text{ or } \frac{1}{9}.$$

3. A card is drawn at random from a standard deck of cards.
- $P(\text{club or diamond})$
 - $P(\text{ace or spade})$
 - $P(\text{jack or red card})$

SOLUTION:

- a. The events are mutually exclusive, because a card cannot be both a club (c) and a diamond (d).
 $P(\text{club or diamond}) = P(c) + P(d)$

$$P(\text{club or diamond}) = \frac{13}{52} + \frac{13}{52} \text{ or } \frac{1}{2}.$$

- b. Because there is an ace (A) of spades (S), these events are not mutually exclusive.
 $P(\text{ace or spade}) = P(A) + P(S) - P(A \text{ and } S)$

$$P(\text{ace or spade}) = \frac{4}{52} + \frac{13}{52} - \frac{1}{52} \text{ or } \frac{4}{13}.$$

- c. Because 2 jacks (J) are red (R), these events are not mutually exclusive.
 $P(\text{jack or red}) = P(J) + P(R) - P(J \text{ and } R)$

$$P(\text{jack or red}) = \frac{4}{52} + \frac{26}{52} - \frac{2}{52} \text{ or } \frac{7}{13}.$$

0-5 Adding Probabilities

4. In a French class, there are 10 freshmen, 8 sophomores, and 2 juniors. Of these students, 9 freshmen, 2 sophomores, and 1 junior are female. A student is selected at random.
- $P(\text{freshman or female})$
 - $P(\text{sophomore or male})$
 - $P(\text{freshman or sophomore})$

SOLUTION:

The class contains $10 + 8 + 2$ or 20 students.

- a. Because 9 freshmen (Fr) are female (F), these events are not mutually exclusive.

$$P(\text{freshman or female}) = P(\text{Fr}) + P(\text{F}) - P(\text{Fr and F})$$

$$P(\text{Fr or F}) = \frac{10}{20} + \frac{12}{20} - \frac{9}{20} \text{ or } \frac{13}{20}.$$

- b. Because there are 6 sophomores (S) who are males (M), these events are not mutually exclusive.

$$P(\text{sophomore or male}) = P(\text{S}) + P(\text{M}) - P(\text{S and M})$$

$$P(\text{S or M}) = \frac{8}{20} + \frac{8}{20} - \frac{6}{20} \text{ or } \frac{1}{2}.$$

- c. The events are mutually exclusive, because a student cannot be both a freshman (F) and a sophomore (S).

$$P(\text{freshman or sophomore}) = P(\text{F}) + P(\text{S})$$

$$P(\text{F or S}) = \frac{10}{20} + \frac{8}{20} \text{ or } \frac{9}{10}.$$

0-5 Adding Probabilities

5. There are 40 vehicles on a rental car lot. All are either sedans or SUVs. There are 18 red vehicles, and 3 of them are sedans. There are 15 blue vehicles, and 9 of them are SUVs. Of the remaining vehicles, all are black and 2 are SUVs. A vehicle is selected at random.
- $P(\text{blue or black})$
 - $P(\text{red or SUV})$
 - $P(\text{black or sedan})$

SOLUTION:

There are 18 red (R), 15 blue (Bl), and 7 black (Bk) vehicles of which 14 are sedans (S) and 26 are SUVs.

- a. The events are mutually exclusive, because a vehicle is not both blue and black.

$$P(\text{blue or black}) = P(\text{Bl}) + P(\text{Bk})$$

$$P(\text{blue or black}) = \frac{15}{40} + \frac{7}{40} \text{ or } \frac{11}{20}.$$

- b. Because there are red SUVs, these events are not mutually exclusive.

$$P(\text{red or SUV}) = P(\text{R}) + P(\text{SUV}) - P(\text{R and SUV})$$

$$P(\text{red or SUV}) = \frac{18}{40} + \frac{26}{40} - \frac{15}{40} \text{ or } \frac{29}{40}.$$

- c. Because there are black sedans, these events are not mutually exclusive.

$$P(\text{black or sedan}) = P(\text{Bk}) + P(\text{S}) - P(\text{Bk and S})$$

$$P(\text{black or sedan}) = \frac{7}{40} + \frac{14}{40} - \frac{5}{40} \text{ or } \frac{2}{5}.$$

6. **DRIVING** A survey of Longview High School students found that the probability of a student driving while texting was 0.16, the probability of a student getting into an accident while driving was 0.07, and the probability of a student getting into an accident while driving and texting was 0.05. What is the probability of a student driving while texting or getting into an accident while driving?

SOLUTION:

Since some students text while driving T and have accidents A , these events are not mutually exclusive.

$$P(T \text{ or } A) = P(T) + P(A) - P(T \text{ and } A)$$

$$P(T \text{ or } A) = 0.16 + 0.07 - 0.05 \text{ or } 0.18$$

The probability is 0.18 or 18%.

7. **REASONING** Explain why the rule $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$ can be used for both mutually exclusive and not mutually exclusive events.

SOLUTION:

When events are mutually exclusive, $P(A \text{ and } B)$ will always equal 0, so the probability will simplify to $P(A) + P(B)$.

0-5 Adding Probabilities

ODDS Another measure of the chance that an event will occur is called *odds*. The odds of an event occurring is a ratio that compares the number of ways an event can occur s (successes) to the number of ways it cannot occur f (failure), or s to f . The sum of the number of success and failures equals the number of possible outcomes.

8. A card is drawn from a standard deck of 52 cards. Find the odds in favor of drawing a heart. Then find the odds against drawing an ace.

SOLUTION:

For drawing a heart, $s = 13$ and $f = 52 - 13$ or 39. The odds of drawing a heart are 13 to 39 or 1 to 3.

For not drawing an ace, $s = 52 - 4$ or 48 and $f = 4$. The odds against drawing an ace are 48 to 4 or 12 to 1.







9. Two fair coins are tossed. Find the odds in favor of both landing on heads. Then find the odds in favor of exactly one landing on tails.

SOLUTION:

For both heads, $s = 1$ and $f = 4 - 1$ or 3. The odds of both landing on heads are 1 to 3.

For exactly one landing on tails, $s = 2$ and $f = 4 - 2$ or 2. The odds of exactly one landing on tails are 2 to 2 or 1 to 1.

10. The results of rolling a die 120 times are shown.

Roll						
Frequency	16	24	17	25	30	8

Find the experimental odds against rolling a 1 or a 6. Then find the experimental odds in favor of rolling a number less than 3.

SOLUTION:

For not rolling a 1 or a 6, $s = 120 - (16 + 8)$ or 96 and $f = 120 - 96$ or 24. The odds against rolling a 1 or 6 are 96 to 24 or 4 to 1.

For rolling a number less than 3, $s = 16 + 24$ or 40 and $f = 120 - 40$ or 80. The odds of rolling a number less than 3 are 40 to 80 or 1 to 2.