LHF STUDY GUIDE **PASS THE HiSET® MATH TEST!**

PROBABILITY

Lesson 2 Dependent & Independent Probability

1. Dependent Probability

Sometimes a probability calculation ***depends on*** what happened before the event in question. Think about a grab bag with red, blue, and green prizes.
As prizes are picked at random from the bag, both the total number of prizes left in the bag and the number of prizes of each color change. These changing numbers are the numbers needed to do a probability calculation, so the probability calculation for the next pick will ***depend on*** which prizes have already been picked from the bag.

Example One
A bag of coins has 5 dimes, 10 nickels, and 12 pennies.
If the first random pick is a nickel, with no replacement, what is the probability that the second pick will be another nickel?

Note – The phrase "with no replacement" means that once picked, the coin is not returned to the bag.

This type of calculation is referred to as ***dependent probability*** because the probability calculation of the second pick ***depends on*** what happened with the first pick. This is because both the total outcomes and the number of desired outcomes (nickels) change after the first pick.

Before First Pick	**After First Pick**
5 dimes	5 dimes
10 nickels	9 nickels
12 pennies	12 pennies
27 total	26 total

After the first pick, which you are told is a nickel, there are now 9 nickels and 26 total coins.

$$\frac{\text{desired outcomes}}{\text{total outcomes}} \quad \frac{9}{26} \rightarrow 0.346 \rightarrow 34.6\%$$

Example Two

A bag of coins has 5 dimes, 10 nickels, and 12 pennies.
If the first random pick is a nickel, with no replacement, what is the probability that the second pick will be a dime?

The probability calculation for the second pick is dependent on what happened on the first pick. In this example, the total changes, but the number of desired outcomes (dimes) does not change.

Before First Pick	**After First Pick**
5 dimes	5 dimes
10 nickels	9 nickels
12 pennies	12 pennies
27 total	26 total

After the first pick, which you are told is a nickel, the total is now 26 coins, and there are still 5 dimes.

$$\frac{\text{desired outcomes}}{\text{total outcomes}} \quad \frac{5}{26} \rightarrow 0.192 \rightarrow 19.2\%$$

Example Three

The children at a party are picking prizes at random from a grab bag that contains 9 red prizes, 12 green prizes, and 10 purple prizes.
If the first child picks a green prize and the second child picks a red prize, what is the probability that the third child will pick a purple prize?

NOTE – There are 2 picks that will change the numbers.

NOTE – You are not told "no replacement," but it is clear from the situation that the prizes will not be put back into the bag.

The probability of the third pick is dependent on what happened on the first 2 picks.

Before Any Picks	**After 2 Picks**
9 red	8 red
12 green	11 green
10 purple	10 purple
31 total	29 total

After the first 2 picks the total is now 29 prizes, and there are still 10 purple prizes.

$$\frac{\text{desired outcomes}}{\text{total outcomes}} \quad \frac{10}{29} \rightarrow 0.345 \rightarrow 34.5\%$$

Example Four

A family provides a big bag of bite size candy for Halloween, and allows each trick or treater to pick 2 candies at random from the bag, without looking. The bag starts with 50 each of chocolate, fruit, nut, and gummy candies. The first 10 trick or treaters picked 5 chocolate, 8 fruit, 4 nut, and 3 gummy candies. If the next trick or treater's first pick is a gummy candy, what is the probability that her second pick will be a chocolate candy?

This is just like the previous two examples, but is more complicated and requires careful reading.

Before Any Picks	After 20 Picks From First 10 Trick or Treaters	After First Pick of the 11^{th} Trick or Treater
50 chocolate	45 chocolate	45 chocolate
50 fruit	42 fruit	42 fruit
50 nut	46 nut	46 nut
50 gummy	47 gummy	46 gummy
200 total	180 total	179 total

After the first pick of the 11^{th} trick or treater, there are now 179 total candies and 45 chocolate.

$$\frac{\text{desired outcomes}}{\text{total outcomes}} \quad \frac{45}{179} \rightarrow 0.25 \rightarrow 25\%$$

Practice One *Answers – p. 10*

1. A bag of coins contains 6 dimes, 10 nickels, and 5 pennies. If a dime is randomly picked from the bag, and not returned to the bag, what is the probability that the next random selection will be another dime?

A. $\frac{5}{21}$ B. $\frac{3}{10}$ C. $\frac{1}{5}$ D. $\frac{3}{4}$ E. $\frac{1}{4}$

2. A drawer contains 12 white socks, 13 black socks, 14 striped socks, and 5 green socks. If the first 2 socks removed at random, with no replacement, are white and black, what is the probability that the third sock picked will be black?

A. 31% B. 30% C. 3.1% D. 2.9% E. 29%

3. A class of 20 students is divided into Team A and Team B by each student picking at random from a bag with 10 Team A tickets and 10 Team B tickets. If the first 2 students both pick Team A tickets, what is the probability that the next student will pick a Team B ticket?

A. 56% B. 5.6% C. 65% D. 1.8% E. 0.56%

4. A bag contains 3 white chocolate truffles, 3 milk chocolate truffles, and 3 dark chocolate truffles. After you eat your first random pick of a milk chocolate truffle, what is the probability that your second random pick will be a dark chocolate truffle?

A. 2.67 B. 375 C. 0.45 D. 0.375 E. 0.5

5. A teacher is handing out pencils by picking at random from a bag that contains 10 yellow pencils, 15 red pencils, and 12 black pencils. If the first pencil she picks is yellow, what is the probability that the next pencil she picks will be red?

A. 39% B. 4.2% C. 42% D. 40% E. 3.9%

6. A group of 30 volunteers is planning a bake sale to raise money. Each person will bake 2 items, and will choose at random from a bag with slips of paper to determine which 2 items they will bake. The bag contains 10 cake slips, 20 cookies slips, 14 pie slips, and 16 brownies slips. The random picks of the first 6 people were 1 cake, 3 cookies, 3 pie, and 5 brownies. If the 7^{th} person picks a cake and a pie slip, what is the probability that the first pick of the 8^{th} person will be a cookies slip?

A. $\frac{17}{48}$ B. $\frac{17}{46}$ C. $\frac{8}{23}$ D. $\frac{17}{60}$ E. $\frac{1}{3}$

7. A chocolate assortment has 6 nougat filled, 6 caramel filled, 8 mint filled, and 12 cherry filled candies. All the candies look the same on the outside, so when 5 friends picked candies, the type of filling was chosen at random. On the first pick 1 nougat, 2 cherry, and 2 caramel were chosen. What is the probability that on the next round of picks, the third person to choose will get a caramel, if the first two people both pick mint?

A. $\frac{4}{25}$ B. $\frac{4}{27}$ C. $\frac{1}{5}$ D. $\frac{6}{25}$ E. $\frac{1}{6}$

8. An art class of 10 students is doing a project using colored felt. Each student can pick 3 pieces of whatever color felt they want from a box containing 20 red, 20 black, 20 white, 20 yellow, 20 blue, and 20 purple pieces of felt. The first 7 students choose 5 red, 3 black, 2 white, 4 yellow, 3 blue, and 4 purple pieces of felt. The next student to choose decides to close their eyes and randomly pick their pieces of felt. If this student's first pick is white, what is the probability that the second pick will be purple?

A. $\frac{15}{98}$ B. $\frac{1}{6}$ C. $\frac{16}{99}$ D. $\frac{8}{49}$ E. $\frac{10}{49}$

2. Independent Probability

In some situations, the probability calculation of a second or third event ***does not depend on*** what happened with the events before it. This type of calculation is referred to as ***independent probability***. Tossing coins and rolling number cubes are examples of independent probability.

Example One

A coin is tossed and lands on heads. What is the probability that it will land on heads if it is tossed again?

Before First Toss	After First Toss
1 tail	1 tail
1 head	1 head
2 total	2 total

The desired outcomes and total outcomes do not change after the first toss.
For the second toss, there are still 2 total possible outcomes and 1 desired outcome.

$$\frac{\text{desired outcomes}}{\text{total outcomes}} \quad \frac{\text{1 way to get heads}}{\text{2 total possible outcomes}} \quad \frac{1}{2} \rightarrow 0.5 \rightarrow 50\%$$

Example Two

A 6-sided number cube is rolled and lands on 4, and then is rolled again and lands on 4 again. What is the probability that it will land on 4 on the third roll?

Before First Roll	After First Roll	After Second Roll
1 way to roll a 1	1 way to roll a 1	1 way to roll a 1
1 way to roll a 2	1 way to roll a 2	1 way to roll a 2
1 way to roll a 3	1 way to roll a 3	1 way to roll a 3
1 way to roll a 4	1 way to roll a 4	1 way to roll a 4
1 way to roll a 5	1 way to roll a 5	1 way to roll a 5
1 way to roll a 6	1 way to roll a 6	1 way to roll a 6
6 possible outcomes	6 possible outcomes	6 possible outcomes

The desired outcomes and total outcomes do not change after each roll.
For the third roll, there are still 6 possible outcomes and 1 desired outcome.

$$\frac{\text{desired outcomes}}{\text{total outcomes}} \quad \frac{\text{1 way to roll a 4}}{\text{6 total possible outcomes}} \quad \frac{1}{6} \rightarrow 0.17 \rightarrow 17\%$$

Note – We are **not** calculating the probability of rolling a 4 on the all three rolls. The first two rolls have already happened, and those results are stated in the problem. We are calculating the probability of one thing happening, getting a 4 on the third roll.

Calculating the probability of rolling three 4s in a row is very different and described in the next example.

Example Three

What is the probability of rolling a 6-sided number cube three times, and it landing on 4 three times in a row?

In this example we are calculating the probability of three things happening together, getting a 4 on three rolls in a row.

Since every roll has the same probability, $\frac{1}{6}$, of landing on 4, we are dealing with independent probability.

When dealing with independent probability, to get the probability of the same event happening 3 times in a row, find the probability of it happening once, and then multiply that probability 3 times.

$\frac{1}{6} \text{ x } \frac{1}{6} \text{ x } \frac{1}{6} = \frac{1}{216}$ The probability of rolling three 4s in a row is $\frac{1}{216}$.

The rule is: When dealing with independent probability, to get the probability of an event happening *x* times in a row, find the probability of it happening once, then multiply that probability *x* times.

So, for a coin toss where the probability of getting heads is $\frac{1}{2}$, the probability of tossing heads in a row is:

2 heads in a row $\left(\frac{1}{2}\right)^2 \rightarrow \frac{1}{2} \text{ x } \frac{1}{2} = \frac{1}{4}$

3 heads in a row $\left(\frac{1}{2}\right)^3 \rightarrow \frac{1}{2} \text{ x } \frac{1}{2} \text{ x } \frac{1}{2} = \frac{1}{8}$

4 heads in a row $\left(\frac{1}{2}\right)^4 \rightarrow \frac{1}{2} \text{ x } \frac{1}{2} \text{ x } \frac{1}{2} \text{ x } \frac{1}{2} = \frac{1}{16}$

5 heads in a row $\left(\frac{1}{2}\right)^5 \rightarrow \frac{1}{2} \text{ x } \frac{1}{2} \text{ x } \frac{1}{2} \text{ x } \frac{1}{2} \text{ x } \frac{1}{2} = \frac{1}{32}$

6 heads in a row $\left(\frac{1}{2}\right)^6 \rightarrow \frac{1}{2} \text{ x } \frac{1}{2} \text{ x } \frac{1}{2} \text{ x } \frac{1}{2} \text{ x } \frac{1}{2} \text{ x } \frac{1}{2} = \frac{1}{64}$

12 heads in a row $\left(\frac{1}{2}\right)^{12} \rightarrow \frac{1}{2} \text{ x } \frac{1}{2} \text{ x } \frac{1}{2} \text{ x } \frac{1}{2} \text{ x } \frac{1}{2} \text{ x } \frac{1}{2} \text{ x } \frac{1}{2} \text{ x } \frac{1}{2} \text{ x } \frac{1}{2} \text{ x } \frac{1}{2} \text{ x } \frac{1}{2} \text{ x } \frac{1}{2} = \frac{1}{4096}$

NOTE – If you need a review of how to multiply fractions on the calculator, see Lesson 1 in the Algebra section of this website.

Example Four
What is the probability of flipping a coin 4 times and getting 4 heads in a row?

Calculate the probability of getting heads once.

$$\frac{\text{desired outcomes}}{\text{total outcomes}} \qquad \frac{\text{1 way to get heads}}{\text{2 total possible outcomes}} \rightarrow \frac{1}{2}$$

This is independent probability, so each of the 4 coin flips has the same probability, $\frac{1}{2}$, of landing on heads.
To get the probability of it happening 4 times in a row, multiply the probability of it happening once 4 times.

$$\frac{1}{2} \text{ x } \frac{1}{2} \text{ x } \frac{1}{2} \text{ x } \frac{1}{2} = \frac{1}{16}$$

Example Five
If the probability of rolling the color blue on a game cube is 50%, what is the probability of rolling blue 3 times in a row?
Each roll has a probability of 50%, or $\frac{1}{2}$, of landing on blue.
This is independent probability, so to get the probability of it happening 3 times in a row, multiply the probability of it happening once 3 times.

$$\frac{1}{2} \text{ x } \frac{1}{2} \text{ x } \frac{1}{2} = \frac{1}{8} = 0.125 = 12.5\%$$

NOTE – If the probability is given as a percent, you have to convert the percent to a decimal or fraction before doing the probability calculation.

> Convert 50% to a fraction by thinking of 50% as 50 out of 100, making a fraction with 50 on top and 100 on the bottom, and reducing the fraction on your calculator.
> $50\% = \frac{50}{100} = \frac{1}{2}$
>
> Convert 50% to a decimal by moving the decimal point 2 places to the left and dropping the % sign.
> $50\% = 0.50$

It may be helpful to memorize the following common conversions if you don't already know them.

$\frac{1}{2} = 0.5 = 50\%$

$\frac{1}{4} = 0.25 = 25\%$

$\frac{3}{4} = 0.75 = 75\%$

Practice Two *Answers – p. 14*

CAREFUL – Be sure to read carefully to determine if you are asked to calculate the probability of 1 independent event after other independent events have already taken place, or the probability of several independent events happening in a row. Review Examples 2 and 3 above to be sure you understand this difference.

1. A spinner is divided into 8 even segments numbered 1 – 8, and the first spin lands on 4. What is the probability that the second spin will land on 4?

A. $\frac{1}{16}$ B. $\frac{1}{64}$ C. $\frac{1}{8}$ D. $\frac{1}{4}$ E. $\frac{1}{2}$

2. A 6-sided number cube numbered 1 – 6 is rolled three times resulting in rolls of 2, 5, and 5. What is the probability that a fourth roll will be a 2?

A. $\frac{1}{6}$ B. $\frac{1}{4}$ C. $\frac{1}{16}$ D. $\frac{1}{36}$ E. $\frac{2}{3}$

3. A coin is flipped 2 times and lands on tails both times. What is the probability of a third coin flip landing on tails?

A. $\frac{1}{8}$ B. $\frac{1}{6}$ C. $\frac{1}{3}$ D. $\frac{1}{2}$ E. $\frac{2}{3}$

4. If a coin is flipped 3 times, what is the probability of getting 3 tails in a row?

A. 2 B. 4 C. $\frac{1}{16}$ D. $\frac{1}{8}$ E. $\frac{1}{4}$

5. When spinning a spinner, the probability of landing on a red section is 50%. What is the probability of landing on a red section 5 spins in a row?

A. $\frac{1}{2}$ B. $\frac{1}{10}$ C. $\frac{1}{16}$ D. $\frac{1}{5}$ E. $\frac{1}{32}$

6. There are 15 green balls and 15 blue balls in a bag. After each random selection, the ball selected is put back in the bag before the next pick. What is the probability of picking a green ball 2 times in a row?

A. 50% B. 25% C. 15% D. 30% E. 7.5%

7. The probability of landing on a white section on a spinner is 25%. What is the probability of landing on a white section 3 times in a row?

A. $\frac{1}{25}$ B. $\frac{3}{25}$ C. $\frac{1}{64}$ D. $\frac{1}{12}$ E. $\frac{25}{3}$

8. A 6-sided number cube numbered 1 – 6 is rolled twice. If the first roll lands on 5, what is the probability of the second roll landing on 5.

A. $\frac{1}{6}$ B. $\frac{1}{12}$ C. $\frac{1}{3}$ D. $\frac{1}{36}$ E. $\frac{2}{3}$

9. A 6-sided number cube numbered 1 – 6 is rolled twice. What is the probability of rolling a 5 both times?

A. $\frac{1}{6}$ B. $\frac{1}{12}$ C. $\frac{1}{3}$ D. $\frac{1}{36}$ E. $\frac{2}{3}$

ANSWER KEY   Lesson 2 Dependent & Independent Probability

Practice One

1. A bag of coins contains 6 dimes, 10 nickels, and 5 pennies. If a dime is randomly picked from the bag, and not returned to the bag, what is the probability that the next random selection will be another dime?

A. $\frac{5}{21}$ B. $\frac{3}{10}$ C. $\frac{1}{5}$ D. $\frac{3}{4}$ E. $\frac{1}{4}$

Before First Pick	**After First Pick**
6 dimes	5 dimes
10 nickels	10 nickels
5 pennies	5 pennies
21 total	20 total

After 1 dime is picked, there are now 20 total coins and 5 dimes.

$$\frac{\text{desired outcomes}}{\text{total outcomes}} \quad \frac{\text{5 dimes}}{\text{20 total coins}} \rightarrow \frac{5}{20} = \frac{1}{4}$$

Answer: E. $\frac{1}{4}$

2. A drawer contains 12 white socks, 13 black socks, 14 striped socks, and 5 green socks. If the first 2 socks removed at random, with no replacement, are white and black, what is the probability that the third sock picked will be black?

A. 31%   B. 30%   C. 3.1%   D. 2.9%   E. 29%

The term "with no replacement" means that after a sock is removed from the drawer it is not put back into the drawer.

Before Any Picks	**After Picking 1 White and 1 Black**
12 white	11 white
13 black	12 black
14 striped	14 striped
5 green	5 green
44 total	42 total

After 1 white sock and 1 black sock are removed, there are now 42 total socks and 12 black socks.

$$\frac{\text{desired outcomes}}{\text{total outcomes}} \quad \frac{\text{12 black socks}}{\text{42 total socks}} \rightarrow \frac{12}{42} = 12 \div 42 = 0.29 = 29\%$$

Answer: E. 29%

3. A class of 20 students is divided into Team A and Team B by each student picking at random from a bag with 10 Team A tickets and 10 Team B tickets. If the first 2 students both pick Team A tickets, what is the probability that the next student will pick a Team B ticket?
A. 56% B. 5.6% C. 65% D. 1.8% E. 0.56%

After 2 Team A tickets are removed, there are now 18 total tickets and there are still 10 Team B tickets.

$$\frac{\text{desired outcomes}}{\text{total outcomes}} \quad \frac{\text{10 Team B tickets}}{\text{18 total tickets}} \rightarrow \frac{10}{18} = 10 \div 18 = 0.56 = 56\%$$

Answer: A. 56%

NOTE – The problem doesn't say "with no replacement," but it is clear from the situation that the tickets will not be put back into the bag.

4. A bag contains 3 white chocolate truffles, 3 milk chocolate truffles, and 3 dark chocolate truffles. After you eat your first random pick of a milk chocolate truffle, what is the probability that your second random pick will be a dark chocolate truffle?
A. 2.67 B. 375 C. 0.45 D. 0.375 E. 0.5

After 1 milk chocolate is removed, there are now 8 total truffles and there are still 3 dark chocolate truffles.

$$\frac{\text{desired outcomes}}{\text{total outcomes}} \quad \frac{\text{3 dark}}{\text{8 total}} \rightarrow \frac{3}{8} = 3 \div 8 = 0.375$$

Answer: D. 0.375

5. A teacher is handing out pencils by picking at random from a bag that contains 10 yellow pencils, 15 red pencils, and 12 black pencils. If the first pencil she picks is yellow, what is the probability that the next pencil she picks will be red?
A. 39% B. 4.2% C. 42% D. 40% E. 3.9%

After 1 yellow pencil is removed, there are now 36 total pencils and there are still 15 red pencils.

$$\frac{\text{desired outcomes}}{\text{total outcomes}} \quad \frac{\text{15 red pencils}}{\text{36 total pencils}} \rightarrow \frac{15}{36} = 15 \div 36 = 0.42 = 42\%$$

Answer: C. 42%

NOTE – The problem doesn't say "with no replacement," but it is clear from the situation that the pencils will not be put back into the bag.

6. A group of 30 volunteers is planning a bake sale to raise money. Each person will bake 2 items, and will choose at random from a bag with slips of paper to determine which 2 items they will bake. The bag contains 10 cake slips, 20 cookies slips, 14 pie slips, and 16 brownies slips. The random picks of the first 6 people were 1 cake, 3 cookies, 3 pie, and 5 brownies. If the 7th person picks a cake and a pie slip, what is the probability that the first pick of the 8th person will be a cookies slip?

A. $\frac{17}{48}$ B. $\frac{17}{46}$ C. $\frac{8}{23}$ D. $\frac{17}{60}$ E. $\frac{1}{3}$

Before Any Picks	**After 12 Picks From First 6 People**	**After 2 Picks From 7th Person**
10 cake	9 cake	8 cake
20 cookies	17 cookies	17 cookies
14 pie	11 pie	10 pie
16 brownies	11 brownies	11 brownies
60 total	48 total	46 total

After 7 people have made their 2 picks, there are now 46 total slips and 17 cookies slips.

$$\frac{\text{desired outcomes}}{\text{total outcomes}} \quad \frac{\text{17 cookies}}{\text{46 total slips}} \rightarrow \frac{17}{46}$$

Answer: B. $\mathbf{\frac{17}{46}}$

NOTE – The problem doesn't say "with no replacement," but it is clear from the situation that the slips of paper will not be put back into the bag.

7. A chocolate assortment has 6 nougat filled, 6 caramel filled, 8 mint filled, and 12 cherry filled candies. All the candies look the same on the outside, so when 5 friends picked candies, the type of filling was chosen at random. On the first pick 1 nougat, 2 cherry, and 2 caramel were chosen. What is the probability that on the next round of picks, the third person to choose will get a caramel, if the first two people both pick mint?

A. $\frac{4}{25}$ B. $\frac{4}{27}$ C. $\frac{1}{5}$ D. $\frac{6}{25}$ E. $\frac{1}{6}$

Before Any Picks	**After All 5 Have Had Their First Pick**	**After First 2 Have Had Their Second Pick**
6 nougat	5 nougat	5 nougat
6 caramel	4 caramel	4 caramel
8 mint	8 mint	6 mint
12 cherry	10 cherry	10 cherry
32 total	27 total	25 total

After the first 2 have had their second pick, there are now 4 caramel and 25 total.

$$\frac{\text{desired outcomes}}{\text{total outcomes}} \quad \frac{\text{4 caramel}}{\text{25 total}} \rightarrow \frac{4}{25}$$

Answer: A. $\mathbf{\frac{4}{25}}$

8. An art class of 10 students is doing a project using colored felt. Each student can pick 3 pieces of whatever color felt they want from a box containing 20 red, 20 black, 20 white, 20 yellow, 20 blue, and 20 purple pieces of felt. The first 7 students choose 5 red, 3 black, 2 white, 4 yellow, 3 blue, and 4 purple pieces of felt. The next student to choose decides to close their eyes and randomly pick their pieces of felt. If this student's first pick is white, what is the probability that the second pick will be purple?

A. $\frac{15}{98}$ B. $\frac{1}{6}$ C. $\frac{16}{99}$ D. $\frac{8}{49}$ E. $\frac{10}{49}$

Before Any Picks	After 21 Picks From First 7 Students	After First Pick From 8th Student
20 red	15 red	15 red
20 black	17 black	17 black
20 white	18 white	17 white
20 yellow	16 yellow	16 yellow
20 blue	17 blue	17 blue
20 purple	16 purple	16 purple
120 total	99 total	98 total

After 21 picks from the first 7 students and 1 pick from the 8th student, there are now 98 total pieces of felt, and 16 purple pieces.

$$\frac{\text{desired outcomes}}{\text{total outcomes}} \quad \frac{\text{16 purple}}{\text{98 total}} \rightarrow \frac{16}{98} = \frac{8}{49}$$

Answer: D. $\mathbf{\frac{8}{49}}$

NOTE – The problem doesn't say "with no replacement," but it is clear from the situation that the pieces of felt will not be put back into the box.

Practice Two

1. A spinner is divided into 8 even segments numbered 1 – 8, and the first spin lands on 4. What is the probability that the second spin will land on 4?

A. $\frac{1}{16}$ B. $\frac{1}{64}$ C. $\frac{1}{8}$ D. $\frac{1}{4}$ E. $\frac{1}{2}$

Before First Spin	**After First Spin**
1 way to spin a 1	1 way to spin a 1
1 way to spin a 2	1 way to spin a 2
1 way to spin a 3	1 way to spin a 3
1 way to spin a 4	1 way to spin a 4
1 way to spin a 5	1 way to spin a 5
1 way to spin a 6	1 way to spin a 6
1 way to spin a 7	1 way to spin a 7
1 way to spin a 8	1 way to spin a 8
8 possible outcomes	8 possible outcomes

The desired outcomes and total possible outcomes do not change after each spin. For the second spin, there are still 8 possible outcomes and 1 desired outcome.

$$\frac{\text{desired outcomes}}{\text{total outcomes}} \quad \frac{\text{1 way to spin a 4}}{\text{8 total possible outcomes}} \rightarrow \frac{1}{8}$$

Answer: C. $\frac{1}{8}$

NOTE – We are not calculating the probability of spinning two 4s in a row. The first spin has already happened, and the result is stated in the problem. We are calculating the probability of one thing happening, getting a 4 on the second spin.

2. A 6-sided number cube numbered 1 – 6 is rolled three times resulting in rolls of 2, 5, and 5. What is the probability that a fourth roll will be a 2?

A. $\frac{1}{6}$ B. $\frac{1}{4}$ C. $\frac{1}{16}$ D. $\frac{1}{36}$ E. $\frac{2}{3}$

The desired and total outcomes don't change when a number cube is rolled, so the results of the first three rolls do not affect the probability of getting a 2 on the fourth roll. There are still 6 possible outcomes, and 1 way to get the desired outcome.

$$\frac{\text{desired outcomes}}{\text{total outcomes}} \quad \frac{\text{1 way to roll a 2}}{\text{6 total possible outcomes}} \rightarrow \frac{1}{6}$$

Answer: A. $\frac{1}{6}$

NOTE – We are not calculating the probability of rolling a 2, then a 5, then a 5, and then a 2 again. The first three rolls have already happened, and the results are stated in the problem. We are calculating the probability of one thing happening, getting a 2 on the fourth roll.

3. A coin is flipped 2 times and lands on tails both times. What is the probability of a third coin flip landing on tails?

A. $\frac{1}{8}$ B. $\frac{1}{6}$ C. $\frac{1}{3}$ D. $\frac{1}{2}$ E. $\frac{2}{3}$

The desired and total outcomes don't change when a coin is flipped, so the results of the first 2 flips do not affect the probability of getting tails on the third flip. There are still 2 possible outcomes, and 1 way to get the desired outcome.

$$\frac{\text{desired outcomes}}{\text{total outcomes}} \quad \frac{\text{1 way to get tails}}{\text{2 total possible outcomes}} \rightarrow \frac{1}{2}$$

Answer: D. $\frac{1}{2}$

NOTE – We are not calculating the probability of 3 coin flips in a row landing on tails. The first two flips have already happened, and the results are stated in the problem. We are calculating the probability of one thing happening, getting tails on the third flip.

4. If a coin is flipped 3 times, what is the probability of getting 3 tails in a row?

A. 2 B. 4 C. $\frac{1}{16}$ D. $\frac{1}{8}$ E. $\frac{1}{4}$

Calculate the probability of getting tails once.

$$\frac{\text{desired outcomes}}{\text{total outcomes}} \quad \frac{\text{1 way to get tails}}{\text{2 total possible outcomes}} \rightarrow \frac{1}{2}$$

This is independent probability, so each of the 3 coin flips has the same probability, $\frac{1}{2}$, of landing on tails.

To get the probability of it happening 3 times in a row, multiply the probability of it happening once 3 times.

$$\frac{1}{2} \text{ x } \frac{1}{2} \text{ x } \frac{1}{2} = \frac{1}{8}$$

Answer: D. $\frac{1}{8}$

5. When spinning a spinner, the probability of landing on a red section is 50%. What is the probability of landing on a red section 5 spins in a row?

A. $\frac{1}{2}$ B. $\frac{1}{10}$ C. $\frac{1}{16}$ D. $\frac{1}{5}$ E. $\frac{1}{32}$

The probability of landing on a red section once is 50%, or $\frac{1}{2}$.

This is independent probability, so each of the 5 spins has the same probability, $\frac{1}{2}$, of landing on red. To get the probability of spinning red 5 times in a row, multiply the probability of it happening once 5 times.

$$\frac{1}{2} \text{ x } \frac{1}{2} \text{ x } \frac{1}{2} \text{ x } \frac{1}{2} \text{ x } \frac{1}{2} = \frac{1}{32}$$

Answer: E. $\frac{1}{32}$

NOTE – When a probability is stated as a percent, convert to a decimal or fraction before doing the probability calculation that is needed for the problem.

6. There are 15 green balls and 15 blue balls in a bag. After each random selection, the ball selected is put back in the bag before the next pick. What is the probability of picking a green ball 2 times in a row?

A. 50% B. 25% C. 15% D. 30% E. 7.5%

Calculate the probability of picking a green ball once.

$$\frac{\text{desired outcomes}}{\text{total outcomes}} \quad \frac{\text{15 green balls}}{\text{30 total balls}} \rightarrow \frac{15}{30} \rightarrow \frac{1}{2}$$

Since the selected ball is put back in the bag after the first pick, the desired and total outcomes don't change for the second pick, so this is independent probability. To get the probability of picking green 2 times in a row, multiply the probability of it happening once 2 times.

$$\frac{1}{2} \text{ x } \frac{1}{2} = \frac{1}{4} = 1 \div 4 = 0.25 = 25\%$$

Answer: B. 25%

7. The probability of landing on a white section on a spinner is 25%. What is the probability of landing on a white section 3 times in a row?

A. $\frac{1}{25}$ B. $\frac{3}{25}$ C. $\frac{1}{64}$ D. $\frac{1}{12}$ E. $\frac{25}{3}$

The probability of landing on a white section once is 25%, or $\frac{1}{4}$.

This is independent probability, so to get the probability of landing on white 3 times in a row, multiply the probability of it happening once 3 times.

$$\frac{1}{4} \text{ x } \frac{1}{4} \text{ x } \frac{1}{4} = \frac{1}{64}$$

Answer: C. $\mathbf{\frac{1}{64}}$

NOTE – To convert 25% to a fraction, think of 25% as 25 out of 100, form a fraction, and reduce. 25% = $\frac{25}{100} \rightarrow \frac{1}{4}$

8. A 6-sided number cube numbered 1 – 6 is rolled twice. If the first roll lands on 5, what is the probability of the second roll landing on 5.

A. $\frac{1}{6}$ B. $\frac{1}{12}$ C. $\frac{1}{3}$ D. $\frac{1}{36}$ E. $\frac{2}{3}$

The desired and total outcomes don't change when a number cube is rolled, so the result of the first roll does not affect the probability of getting a 5 on the second roll. There are still 6 possible outcomes, and 1 way to get the desired outcome.

$$\frac{\text{desired outcomes}}{\text{total outcomes}} \quad \frac{\text{1 way to roll a 5}}{\text{6 total possible outcomes}} \rightarrow \frac{1}{6}$$

Answer: A. $\mathbf{\frac{1}{6}}$

NOTE – We are not calculating the probability of rolling two 5s in a row. The first roll has already happened, and the result is stated in the problem. We are calculating the probability of one thing happening, getting a 5 on the second roll.

9. A 6-sided number cube numbered 1 – 6 is rolled twice. What is the probability of rolling a 5 both times?

A. $\frac{1}{6}$ B. $\frac{1}{12}$ C. $\frac{1}{3}$ D. $\frac{1}{36}$ E. $\frac{2}{3}$

Calculate the probability of rolling a 5 once.

$$\frac{\text{desired outcomes}}{\text{total outcomes}} \quad \frac{\text{1 way to roll a 5}}{\text{6 total possible outcomes}} \rightarrow \frac{1}{6}$$

This is independent probability, so to get the probability of rolling 5 two times in a row, multiply the probability of it happening once 2 times. $\frac{1}{6} \text{ x } \frac{1}{6} = \frac{1}{36}$

Answer: D. $\mathbf{\frac{1}{36}}$

NOTE – Look at the difference between this problem and #8 above. In this problem, we are calculating the probability of 2 independent events happening in a row. In #8, we are calculating the probability of 1 independent happening after another independent event has already taken place.