

Simple Probability

You probably already have an intuitive idea of what probability is. In this lesson we look at some simple examples in order to start studying probability from a mathematical point of view.

If we flip a coin, the chance, or **probability**, of getting "heads" is $1/2$, and the chance of getting "tails" is also $1/2$. The "heads" and "tails" are the two possible **outcomes** when you toss a coin, and they are equally likely.

When rolling a six-sided number cube (a die), you have six possible **outcomes**: you can roll either 1, 2, 3, 4, 5, or 6. These are all equally likely (assuming the die is fair).

The probability of rolling five is $1/6$. The probability of rolling three is also $1/6$.

In fact, the probability of each outcome is $1/6$.

The probability of rolling an even number is $3/6$ or $1/2$, because of the six possible outcomes, three are even numbers.

Simple probability has to do with situations where **each possible outcome is equally likely**.

The **probability** of an event is the fraction
$$\frac{\text{number of favorable outcomes}}{\text{number of possible outcomes}}$$

Favorable outcomes are those where the event you're looking at occurs. Examples will make this clear.

Probability is always at least 0 and at most 1. In symbols: $0 \leq P(\text{event}) \leq 1$.

Example 1. What is the probability of getting a number that is less than 6, when tossing a fair die?

COUNT how many of the outcomes are "favorable", in other words, less than 6. There are five such outcomes: if you roll either 1, 2, 3, 4, or 5.

COUNT all of the possible outcomes. There are six.

Therefore, the probability is $5/6$. We can write this using "P" for probability, and writing the event in parenthesis:

$$P(\text{less than } 6) = 5/6$$

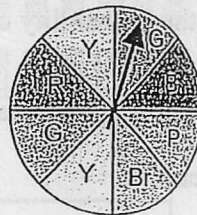
Example 2. On this spinner there are eight equally likely outcomes.

What is the probability of spinning yellow?

How many favorable outcomes (yellow areas)? There are two.

How many possible outcomes? There are eight.

$$P(\text{yellow}) = 2/8 = 1/4.$$



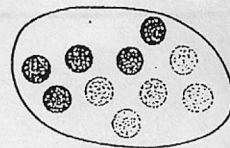
Example 3. What is the probability of rolling 8 on a die?

This is an impossible event. Its probability is zero.

Example 4. What is the probability of rolling a whole number on a die?

This is a sure event! Its probability is one.

1. There are three red marbles, two dark blue marbles, and five light green marbles in Michelle's bag. She chooses one marble at random. What is the probability that...



- the marble is blue?
 - the marble is not red?
 - the marble is neither blue nor green?
2. There are three possible outcomes if you choose one marble randomly from Michelle's bag. List those possible outcomes.

3. You choose one letter randomly from the word "PROBABILITY". Find the probabilities:

- $P(B)$
- $P(A \text{ or } I)$
- $P(\text{consonant})$

4. List all the possible outcomes if you choose one letter randomly from the word "PROBABILITY".

Note: You do not need to calculate probabilities.

Probability of "not"

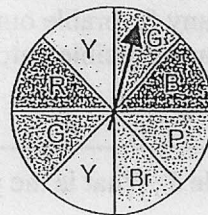
Let's say the probability of some event is a . Then, the probability that the event does NOT happen is $1 - a$.

5. The weatherman says that the chance of rain for tomorrow is $1/10$. What is the probability of it not raining?

6. The probability that Helen wears a pink outfit on any day is $3/13$. What is the probability of her not wearing it?

7. The spinner is spun once. Find the probabilities as simplified fractions.

- $P(\text{green})$
- $P(\text{not green})$
- $P(\text{not pink})$
- $P(\text{black})$
- $P(\text{not black})$



8. You roll a number cube with numbers 1, 2, 3, 4, 5, and 6 printed on the faces. Find the probabilities as fractions.

- $P(\text{not } 5)$
- $P(\text{not } 7)$
- $P(\text{less than } 9)$
- $P(2 \text{ or } 6)$
- $P(\text{not } 2 \text{ nor } 5)$
- $P(\text{less than } 5)$

Probabilities are often given as **percents** or decimals, instead of fractions.

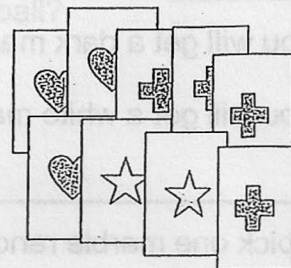
Example. Kimberly's sock bin contains 7 brown socks, 9 white socks, and 5 red socks. She picks one without looking. What is the probability that she gets a white sock?

There are 9 white socks, and 21 socks in all. The probability is $9/21 = 3/7$. To write that as a decimal, divide 3 by 7 (long division) or use a calculator:

$3 \div 7 \approx 0.42857 = 0.429$. As a percent, this is 42.9%.

9. You draw one card. List the possible outcomes, and their probabilities as fractions and percents.

Possible outcomes	Probability (fraction)	Probability (percent)

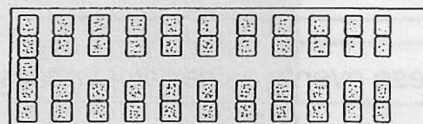


10. This "rainbow spinner" is spun once. Find the probabilities as percents.

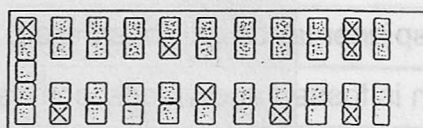


- a. P(yellow) b. P(blue or green)
c. P(not orange) d. P(not red and not purple)

11. a. An empty bus has 45 seats, and 22 of them are window seats. If you get a seat assigned at random, what is the probability (as a percent) that you get a window seat?



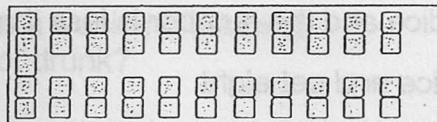
- b. Now some seats are already occupied (marked with an "x"). If you choose a seat randomly, what is the probability (as a percent) that you get a window seat?



Puzzle Corner

Fifteen seats in the bus are already occupied. You come in and choose a seat randomly. The bus driver tells you that the probability of getting a window seat is less than 25%.

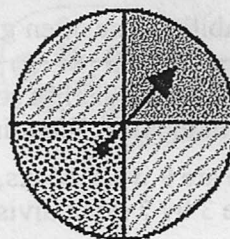
How many window seats are occupied, at least?



Probability

1. a. What is the probability that the spinner will land on dark gray?

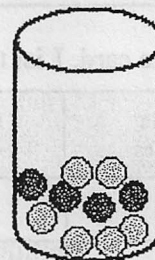
b. What is the probability that the spinner will land on the faint striped areas?



2. You pick one marble randomly from the jar. What is the probability that

a. you will get a dark marble

b. you will get a white marble

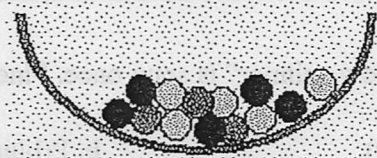


3. You pick one marble randomly from the bowl. What is the probability that

a. You will pick a white marble

b. you will pick a gray marble

c. you will pick a black marble



4. A jar has seven yellow blocks and thirteen red ones. You pick one block randomly. What is the probability that you will pick a yellow block?

5. Label these events as *certain*, *impossible*, or *possible*.

a. This spinner lands on gray.

b. This spinner lands on dotted area.

c. A coin is tossed and 'heads' comes up.

d. The spinner in exercise 1 lands on black.

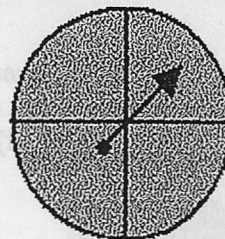
e. You pick a white marble from the bowl in exercise 3.

f. You pick a dotted marble from the bowl in exercise 3.

g. You roll a die and it gives you 6.

h. You roll a dice and the number is less than seven.

i. You roll a dice and get eight.



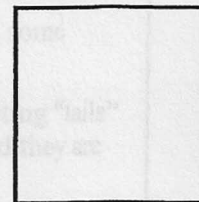
Probability

1. A bag contains 8 pairs of good socks, and 3 pairs of worn-out socks with holes. You pick one pair randomly. What is the probability that...

- a. you will get good socks? b. you will *not* get good socks?

2. The box has 4 blue, 7 red, and 5 white balls. Draw them in the box. You pick one randomly. What is the probability that...

- a. you get a blue ball? b. you get a red ball?
c. you get a white ball? d. you *don't* get a white ball?
e. you get a blue *or* a red ball? f. you get a white *or* a red ball?



3. Of the 20 students, 12 are girls (and the rest are boys). One of them is picked randomly for a job. What is the probability that the one picked is a boy?

4. You put your lottery ticket into the drawing - and there are 261 others. What is your chance to win?

5. They say 1 in 8 women gets breast cancer. What is a woman's theoretical chance of *not* getting it?

6. Rolling a die! What is the probability of these events?

Event	Probability	Event	Probability	Event	Probability
You roll 1		You don't get 1		You get 7	
You roll 2		You don't get 5		You get a number < 8	
You roll 3		You don't get 6		You get a number > 5	
You roll 4		You get 1 <i>or</i> 6		You get a number > 4	
You roll 5		You get 2 <i>or</i> 3		You get a number < 5	
You roll 6		You get 4 <i>or</i> 5		You get a number < 2	

On any given weekend evening, one in 10 drivers on America's roads has been drinking. - Firsteagle.com

7. If you pick a random driver from America's roads on a weekend evening, what is the probability that the driver is drunk? Is not drunk?