

1 What is Probability?

Probability is the chance that something will happen. Probability can be defined by a qualitative characteristic (certain, likely, unlikely, impossible) or quantitative characteristic (0.25, $1/4$). Probability is often expressed as a fraction in which the numerator (the number on top) is the number of instances of the scenario happening and the denominator (the number at the bottom) is the number of instances that can happen in total.

There are 2 main types of probability questions: ones that involve independent events, and ones that involve dependent events.

In independent events, the probability of one event does not affect the probability of another event. For example, the probability of picking 2 apples from a mix of 12 apples and 12 bananas with replacement. This means that the chance of picking the first apple is $1/2$, and then if you replace the first apple and then pick another apple, the chance is again $1/2$, which makes the probability of picking 2 apples $1/4$. (Hint: The keyword "and" usually indicates to multiply the probabilities of 2 events.)

In dependent events, the probability of one event affects the probability of another event. For example, the probability of picking 2 apples from a mix of 12 apples and 12 bananas, without replacement. This means that the chance of picking the first apple is $1/2$, but since you are not replacing the first apple you picked into the basket, the probability of picking a second apple is $11/23$, which makes the probability of picking 2 apples $11/46$.

Solve these basic probability questions. Simplify all answers.

1. What is the probability of Kelly eating a green apple if there are 6 green apples, 27 red apples, and 6 brown apples?
2. In a survey of 202 math nerds...
 - 45 worship Pythagoras
 - 42 love to eat pi
 - 40 count sheep in order to stay awake
 - 25 worship Pythagoras and eat pi
 - 19 worship Pythagoras and count sheep
 - 22 eat pi and count sheep
 - 9 are not typical math nerds and do none of the 3

If a math nerd is randomly picked, what is the probability that she/he:

- (a) only worships Pythagoras
- (b) worships Pythagoras and/or eats pi but falls asleep when counting sheep
- (c) should be given the award for best math nerd (by doing all three things)

3. Marie is getting married tomorrow at an outdoor ceremony in the desert. In recent years, it has rained only 5 days each year. Unfortunately, the weatherman has predicted rain for tomorrow. When it actually rains, the weatherman correctly forecasts rain 90 percent of the time. When it doesn't rain, he incorrectly forecasts rain 10 percent of the time. What is the probability that it will rain on the day of Marie's wedding?
4. 35 mathemagicians meet up to share math jokes and practice their arithmetic together. What is the probability that 2 or more mathemagicians have the same birthday (not including year)? Assume that all years have 365 days each (ignore leap years).

Let's break this problem down first:

- (a) The probability of an event plus the probability of its complementary event is always 1. For example, if there is a $1/3$ chance that it will rain tomorrow, then there is a $2/3$ chance that it will not rain tomorrow (this is the complementary event). $1/3 + 2/3 = 3/3$ or 1, because the probability of it either raining or not raining tomorrow is 1.

What is the complementary event in this situation?

- (b) Logically, if we can find the probability of the complementary event occurring, we can subtract that value from 1 to find the probability of the original event.

How would you find the probability of the complementary event? (Remember: You can always ask a lecturer for help or a calculator.)

- (c) Now that you know the probability of the complementary event, what is the probability of the main event?