

Probability Models and Chance Experiments

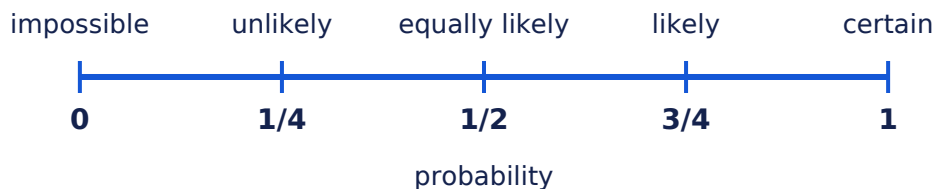
Grade 7 math · Lesson · Standards: 7.SP.C.5, 7.SP.C.6, 7.SP.C.7

Quick answer: Probability is a number from 0 to 1 that measures how likely an event is. Theoretical probability is favorable outcomes divided by total outcomes. Experimental probability is the fraction of trials where the event happened. In a uniform model all outcomes are equally likely; in a non-uniform model they are not.

Standards: 7.SP.C.5, 7.SP.C.6, 7.SP.C.7 · **Level:** Grade 7

How is probability measured?

Probability is a number from 0 to 1 that tells how likely an event is. A probability near 0 means the event is unlikely, near $1/2$ means it is about as likely as not, and near 1 means it is likely.



Probability is a number from 0 to 1.

Key terms

- **Theoretical probability:** favorable outcomes $\div$ total outcomes, when all outcomes are equally likely.
- **Experimental probability:** the number of times the event happened $\div$ the number of trials.
- **Uniform model:** every outcome has the same probability.
- **Non-uniform model:** some outcomes are more likely than others.

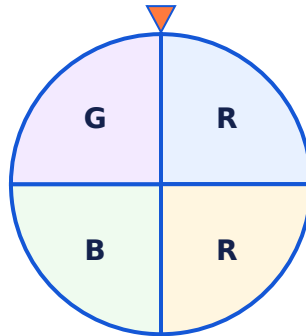
How do you find a theoretical probability?

Count the outcomes that match the event and divide by the number of all outcomes. A bag has 5 red, 3 blue and 2 green marbles, so there are 10 outcomes. The probability of drawing blue is $\frac{3}{10} = 0.3$. The probability of an event that does not happen is 1 minus its probability, so $P(\text{not blue}) = 0.7$.

Probability formulas

$$P(\text{event}) = \frac{(\text{favorable outcomes})}{(\text{total outcomes})}$$

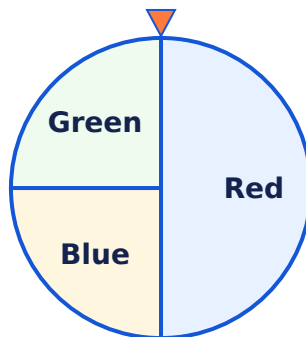
All the probabilities in a model add to 1.



A spinner with 4 equal sections.

What is a non-uniform probability model?

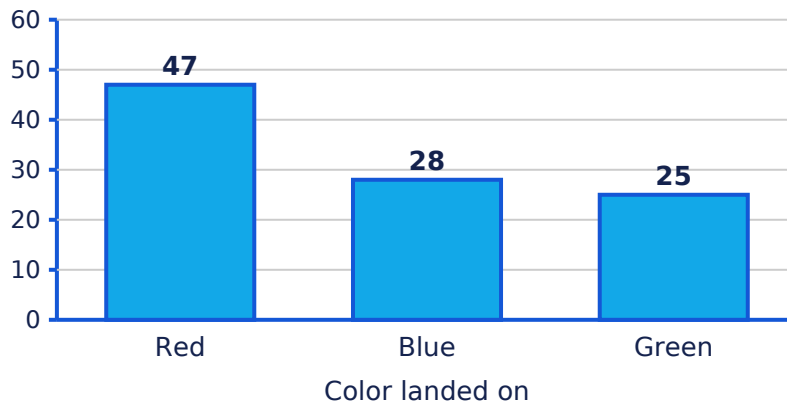
In a probability model, each possible outcome is listed with its probability. When the outcomes are not equally likely, the model is non-uniform. The spinner below lands on red half the time, so the model is $P(\text{red}) = 0.5$, $P(\text{blue}) = 0.25$ and $P(\text{green}) = 0.25$.



Red covers half; blue and green cover one quarter each.

How do experimental results compare with predictions?

Spin 100 times and you expect about 50 reds. The observed results usually differ a little, because chance varies. The more trials you run, the closer the experimental probability tends to get to the theoretical one.



Results of 100 spins of the spinner with red covering half.

Worked example

In 100 spins, red came up 47 times. The experimental probability of red is $47 \div 100 = 0.47$. The model predicts $0.5 \times 100 = 50$ reds. The gap of 3 is small, so the data support the model.

Common mistake

Expecting results to match the prediction exactly. Probability describes what happens in the long run, not every short run.

Mathbot's tip

To predict how many times an event will happen, multiply its probability by the number of trials:
 $\text{expected count} = \text{probability} \times \text{trials}$.

Key points to remember

- 0 is impossible, 1 is certain, $1/2$ is equally likely.
- Theoretical probability = $\text{favorable} \div \text{total outcomes}$.
- Experimental probability = $\text{times it happened} \div \text{trials}$.
- The probabilities of all outcomes add to 1.
- Expected count = $\text{probability} \times \text{number of trials}$.

Probability Models and Chance Experiments: frequently asked questions

Can a probability be greater than 1?

No. Probability is always between 0 and 1, including 0 and 1. A value above 1 or below 0 means there was a mistake in the counting.

What is the difference between theoretical and experimental probability?

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Theoretical probability comes from counting equally likely outcomes. Experimental probability comes from actual trials. The two usually differ a little, and they tend to get closer as the number of trials grows.

What is a probability model?

A probability model lists all possible outcomes of a chance process and gives the probability of each one. The probabilities must add up to 1.

How do I know if a model is uniform?

A model is uniform when every outcome has the same probability, like a fair die with six equal faces. If one outcome is more likely, such as a spinner with one huge section, the model is non-uniform.

If my results do not match the prediction, was the model wrong?

Not necessarily. Small differences are normal because of chance. If the observed counts are far from the predicted counts after many trials, the model may not describe the situation well.