

## Probability words

Note on spelling: *The plural of die is dice in the same way that the plural of mouse is mice. However, textbooks and even exam papers now use the word 'dice' even for one so I'm doing the same here.*

## Fair and biased

A coin is fair if both faces have an equal chance of being seen when you toss the coin.

A biased coin has been tampered with in some way to make one face more likely.

If you toss a coin 10 times, you won't be too surprised to get 7 heads.

If you toss a coin 10 000 times and got 7 000 heads, you might be suspicious about the coin!

## Outcomes and events

Suppose you roll a fair dice. The dice can land with 1, 2, 3, 4, 5 or a 6 uppermost.

Those numbers (actually usually patterns of dots) are called the **outcomes** of rolling the dice.

One event could be 'roll a dice and get a 6' another event could be 'roll a dice and get a number larger than 2'.

The first event has one outcome that fits, seeing the 6 on the dice.

The second event fits with four possible outcomes, 3, 4, 5 and 6 on the dice.

## Probability

**The probability of an event is the fraction of the time you would expect the event to occur.**

**Example:** Toss a fair coin. Half the time you get a head, so the probability of getting a head is  $\frac{1}{2}$

Your turn: What is the probability of getting a 5 when you roll a fair dice?

## Experimental probability

**The experimental probability of an event is the fraction of times you see the event based on your actual observations of a limited number of trials.**

**Experimental probability is usually given as a decimal. It is very similar to probability. Don't get it mixed up with Expected Frequency.**

**Example:** I toss a coin 10 times and see 7 heads. The experimental probability of getting a head is 0.7 based on my limited number of observations.

**Your turn:** Toss a coin 10 times and see how many heads you get. Collate your results with the other students. As you collect more results, does the experimental probability look like it is getting closer to 0.5?

## Likelihood words

You can also describe the likelihood of events in a less precise way using the words...

**impossible; unlikely; evens; likely and certain.**

An impossible event has probability zero and a certain event has probability 1.

- An event that has a probability less than half is unlikely to happen.
- An event that has a probability more than half is likely to happen.
- An event with a probability of exactly half is described as 'evens'.

**Example:** It is unlikely that you will get a 2 when you roll a fair dice.

**Your turn:** Toss *two* coins. What is the likelihood of getting *at least* one head?

## Expected frequency (making predictions)

**The expected value is just the value of the probability fraction of the total number of trials.**

**Example:** Suppose you toss a fair coin 500 times. You might expect to see a head about 250 times (half of 500).

**Your turn:** You roll a fair dice 600 times. What is the expected frequency of getting less than 3?

## Mutually exclusive events (add, OR)

Events are mutually exclusive if they can't happen together

**The probability of a set of mutually exclusive events must add up to 1**

**Example:** 3 red counters, 4 blue counters and 8 yellow counters in a bag and you pick one counter. You can't get a counter that is both red and blue. These outcomes are mutually exclusive.

**Your turn:** write down the probabilities of getting a counter of each colour. Check they add up to 1.

## Independent events (multiply, AND)

**When one event has no influence on another event the events are called independent**

**You can multiply the probabilities of independent events to work out the probability of the combined event.**

**Example:** Suppose you roll two fair dice of different colours. The outcome on the first dice is not correlated at all with the outcome of the second dice. The probability of rolling 6 on first dice AND

rolling a 6 on the second dice is  $\frac{1}{6} \times \frac{1}{6} = \frac{1}{36}$

**Your turn:** work out the probability of getting three heads in a row when you toss a fair coin