Relative frequency

Starter

1.   A bag contains hundreds of glass marbles, each one coloured either red, orange, green or blue. There are more than 2 marbles of each colour.
        Marbles are drawn randomly from the bag, one at a time, and not replaced.
        How many marbles must be drawn from the bag in order to ensure that at least three marbles of the same colour are drawn?

2.   Discuss:
        (a)   How could we estimate the percentage of black cars that pass the school each day?
        (b)   How could we make our answer more accurate?

Notes
Relative frequency is a way of estimating probability *from real events*. It is also used to check whether a dice, for example, is biased.

We need to *carry out an experiment or collect data* before we can calculate the relative frequency of an event.

Let's conduct an experiment to illustrate what we mean.

Matchstick Experiment
A matchstick of length 4 cm is dropped onto a sheet of paper from a height of 30 cm. The sheet of paper has lines on with the distance between the lines being the length of the matchstick (i.e. 4 cm).

The question is: how often will the matchstick land on the page and touch one of the lines?

Estimate what the probability will be that the matchstick will be touching one of the lines.

To get an estimate of this probability (i.e. the *relative frequency*), we can carry out an experiment.

Spend 5 minutes dropping a 4 cm matchstick from a height of about 30 cm onto the page and record your data in a tally chart like the one below. Complete the final column at the end of the experiment

Touches the line	Does not touch the line	Number of trials

Using these data, how will we estimate the probability of the matchstick touching a line?

$$\text{Probability of touching the line} \approx \frac{\text{Number of times matchsrtick touches the line}}{\text{Total number of throws}}$$

The more trials we carry out, the more accurate the answer will be.

In actual fact, mathematics can prove that:

$$\text{Probability of touching the line} = \frac{2}{\pi} \approx 0.637$$

Video: Buffon's needle problem

No need to copy

Probability of touching the line $= \dfrac{2l}{\pi x}$ where l is the length of the matchstick

and x is the distance between the lines

In the American Civil War, a certain Captain Fox, while recovering from an injury, carried out the experiment 1100 times and estimated π to 2 decimal places.

Start copying again

Relative frequency of X happening $= \dfrac{\text{Number of ways X happened}}{\text{Number of trials}}$

N.B.   The more trials, the more accurate the value of relative frequency.

Relative frequency can be used to estimate probability and to check whether a dice is biased

E.g. 1 A factory makes shirts and wants to know how many of each size to make. It measures people in a town

Size	S	M	L	XL
Frequency	32	45	51	37

What is the relative frequency of size M?

E.g. 2 A dice is rolled 60 times and the frequency of rolls is below. Is the dice biased?

Number	1	2	3	4	5	6
Frequency	9	13	11	12	7	8

E.g. 3 The table shows the results of rolling a dice 200 times

Number	1	2	3	4	5	6
Frequency	54	12	38	9	61	26

(a)   What is the relative frequency of rolling an odd number? Give your answer as a decimal.
(b)   John says "If I roll the dice I am likely to get a 5." Criticise John's statement.

Video: **Relative frequency**

Solutions to Starter and E.g.s

Exercise
9-1 class textbook: p232 M8.1 Qu 1-3
A*-G class textbook: p202 M8.1 Qu 1-3
9-1 homework book: p77 M8.1 Qu 1-4
A*-G homework book: p56 M8.1 Qu 1-4

Summary
Relative frequency is a way of estimating probability *from real events*.

Relative frequency of X happening $= \dfrac{\text{Number of ways X happened}}{\text{Number of trials}}$

The more trials, the more accurate the value of relative frequency.