Experimental probability

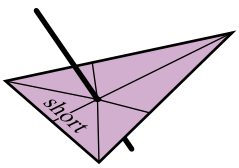
- Using experimental data to estimate probabilities
- Understanding the effect of repeating an experiment many times
- Comparing theoretical and experimental probabilities

Keywords

You should know

explanation 1a | explanation 1b | explanation 1c | online

1 John cut an isosceles triangle from thin card.
He found the centre by joining each corner to the midpoint of the opposite side.



He pushed a short stick through the centre to form a spinner.

a John spins the spinner 20 times to see what happens.
He records whether it lands on the short side or on one of the longer sides.
What is the likelihood of the spinner landing on the short side?

Short	Long
|||	𝍸 𝍸 𝍸 ||

b John decides to estimate the probability that the spinner lands on the short side.
He spins it forty times.
Find the relative frequency of it landing on the short side as a decimal.

Event	Short	Long
Frequency	8	32

c To check his results John spins the spinner 55 times and then spins it 120 times.

Event	Short	Long
Frequency	11	44

Event	Short	Long
Frequency	28	92

Find the relative frequency of landing on the short side for each set of data to 3 decimal places.

d Use the set of data you think will be most reliable to find the best estimate for the probability of the spinner coming to rest on the shortest side.

2 Design your own spinner and investigate the probability that it lands on a particular side.

3 Simon flipped a coin 5 times and got 3 heads.
He then flipped it another 5 times and got another 3 heads.
After another 5 goes he got 2 more heads.
He recorded his data in a table.

Number of trials	5	10	15	20	25	30
Number of heads	3	6	8			
Relative frequency	$\frac{3}{5} = 0.6$	$\frac{6}{10} = 0.6$	$\frac{8}{15} = 0.533$			

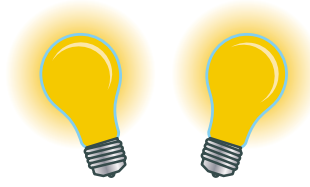
a Use a coin to complete a table like Simon's.

b Comment on the relative frequency of getting a head.

c What is your experimental probability of getting a head?

4 The lifetimes of 500 light bulbs are given in the table.

Lifetime	Frequency
0–99 hours	150
100–199 hours	300
200–299 hours	50



Estimate the probability that a similar bulb will last at least 200 hours.

5 A teacher puts 20 discs in a bag, some are red and some are blue. He writes three possible numbers for the red and blue discs on the board. One pupil takes a disc at random from the bag and the result is recorded. The disc is replaced and the next pupil picks a disc.

How many red and blue discs are in the bag?

Possibilities
A 7 red and 13 blue
B 5 red and 15 blue
C 3 red and 17 blue

Results:
B B B R B B B B
R B B B B B R B
B R B B B B B B
B B R B B R B B

a Write down the theoretical probabilities, as decimals, of getting a red disc and getting a blue disc for each of the possible combinations A, B and C

b Find the relative frequency of getting each colour based on the data collected in the class and compare them to theoretical probabilities.

c How many red and blue discs do you think the teacher had in the bag? How certain are you?

6 Choose possibility A, B or C from question **5**. Put the correct number of red and blue cubes in a box. Ask a partner to select a random cube from the box and record the result before replacing it. Repeat this forty times and then compare the relative frequencies with the theoretical probabilities.

Could your partner predict how many blue and red cubes there were?

7 The table shows the results in the Premiership at one stage in the football season.

Home wins	24
Away wins	9
Draws	5

a Use these results to estimate the probability of these outcomes in a randomly chosen match the next week. Give your answers as fractions.

i home win **ii** away win **iii** draw.

These were the results much later in the season.

Home wins	182
Away wins	100
Draws	98

b What is the probability of each outcome in part **a** based on this table?

c Will your answers to part **a** or part **b** be more reliable? Why?

8 In a set of thirty cards some are marked with a cross and the others left blank. The number of cards marked with a cross is a multiple of 4. The cards are shuffled then a card is chosen at random. Its marking is recorded, 'X' for a cross and 'B' for blank. Then it is returned and the cards are shuffled again. These are the results.

XBXBXXXBXBBBXBBXXXBBXXXBB

a How many trials were carried out?

b Summarise the data in a table.

c Find the relative frequency of getting a cross.

d What is the experimental probability of getting a cross?

e Compare the experimental probability with the possible theoretical probabilities.

f How many cards out of thirty does this suggest were marked with a cross?

9 Make a set of ten blank cards and mark either 3, 6 or 9 cards with a cross. See if your partner can use experimental probability to find out how many are marked with a cross.

10 Every week for one year Kevin's grandma put either a 50p or a £2 coin into his moneybox, which has only one opening at the top for money.
He shakes the moneybox and then turns it upside down and shakes again until a coin falls out.
He records which coin fell out then puts the coin back in.
He does this 20 times with these results.

50p, £2, £2, 50p, £2, 50p, £2, 50p, £2, 50p, £2, £2, 50p, £2, £2, £2, 50p, £2, 50p, £2

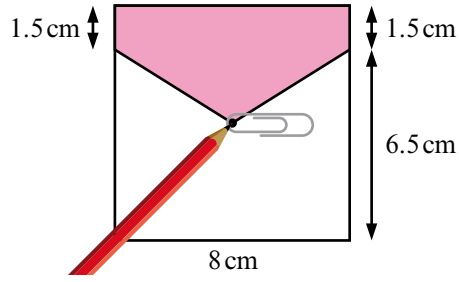
a Summarise his results in a table.

b Calculate the relative frequency of each coin.

c Estimate the probability of getting each coin.

d Explain how Kevin could estimate how much money he has in his moneybox.

11 Use a paper clip and a pencil to make this spinner. Spin the paper clip round the pencil point and record where the middle of the clip lands.



a Decide how many times to spin the paper clip. Do the experiment and record your results in a table.

b Use your results to estimate the probability of the paper clip landing in the shaded region.

c Measure the angle at the centre of the shaded region and calculate the theoretical probability of the clip landing in this region.

d Compare the theoretical and experimental probabilities.

e How could you improve the reliability of the experimental probability?