

MATHS



MODEL ANSWERS

RELATIVE FREQUENCY AGAINST TRIALS

SCORE	PERCENTAGE
/130	%

STEMUP

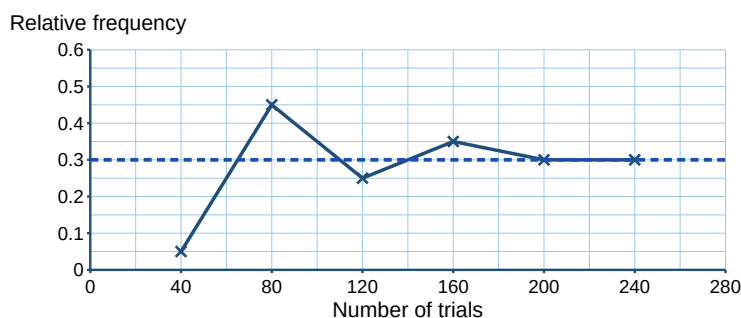
- 1 After 250 trials of an experiment, the relative frequency of success was 0.38.
Work out the number of successes.

$$\begin{aligned} \text{number of successes} &= \text{relative frequency} \times \\ \text{trials} &= 0.38 \times 250 = 95 \end{aligned}$$

95

1 / 1

- 2 Bethan flips a bottle top many times. The graph shows the relative frequency of the event "upright" as the number of trials increases.
Use the graph to estimate the probability of upright.



the points level off
(settle) at about 0.3
the best estimate is
0.3

0.3

1 / 1

- 3 Dylan drops a drawing pin 150 times and records the number of times it lands point up.
The table shows the results after different numbers of drops.
Complete the table. Give each relative frequency correct to 2 decimal places.

Number of drops	30	60	90	120	150
Number of times point up	10	23	36	46	57
Relative frequency	0.33	0.38	0.40	0.38	0.38

$$\begin{aligned} 10 \div 30 &= 0.3333 = 0.33 \\ 57 \div 150 &= 0.3800 = 0.38 \end{aligned}$$

1 / 1

- 4 After 100 trials of an experiment, the relative frequency of success was 0.28.
Work out the number of successes.

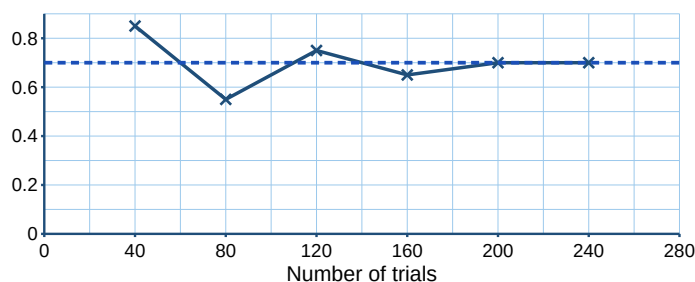
$$\begin{aligned} \text{number of successes} &= \text{relative frequency} \times \\ \text{trials} &= 0.28 \times 100 = 28 \end{aligned}$$

28

1 / 1

- 5 Owen takes many shots in basketball. The graph shows the relative frequency of the event "a score" as the number of trials increases.
Use the graph to estimate the probability that Owen scores with his next shot.

Relative frequency



*the points level off
(settle) at about 0.7
the best estimate is
0.7*

0.7

1 / 1

- 6 Owen takes 250 shots in basketball and records the number of times he scores.
The table shows the results after different numbers of shots.
Complete the table. Give each relative frequency correct to 2 decimal places.

Number of shots	50	100	150	200	250
Number of times scored	36	72	103	138	173
Relative frequency	0.72	0.72	0.69	0.69	0.69

$$\begin{aligned} 36 \div 50 &= 0.7200 = 0.72 \\ 72 \div 100 &= 0.7200 = 0.72 \end{aligned}$$

1 / 1

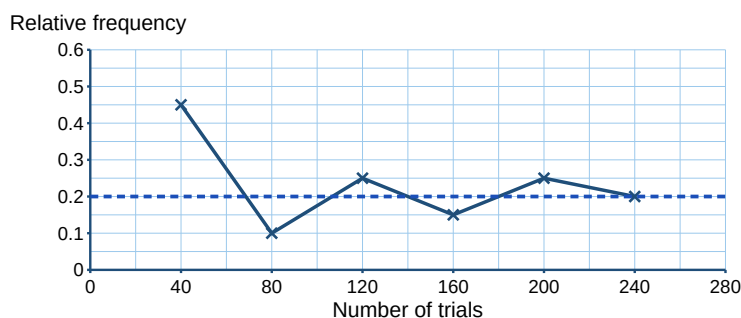
- 7 After 200 trials of an experiment, the relative frequency of success was 0.36.
Work out the number of successes.

$$\begin{aligned} \text{number of successes} &= \text{relative frequency} \times \\ \text{trials} &= 0.36 \times 200 = 72 \end{aligned}$$

72

1 / 1

- 8 Bethan flips a bottle top many times. The graph shows the relative frequency of the event "upright" as the number of trials increases.
Use the graph to estimate the probability of upright.



*the points level off
(settle) at about 0.2
the best estimate is
0.2*

0.2

1 / 1

- 9 Dylan drops a drawing pin 160 times and records the number of times it lands point up.
The table shows the results after different numbers of drops.
Complete the table. Give each relative frequency correct to 2 decimal places.

Number of drops	40	80	120	160
Number of times point up	20	44	72	95
Relative frequency	0.50	0.55	0.60	0.59

$$\begin{aligned} 20 \div 40 &= 0.5000 = 0.50 \\ 95 \div 160 &= 0.5938 = 0.59 \end{aligned}$$

1 / 1

- 10** After 250 trials of an experiment, the relative frequency of success was 0.28.
Work out the number of successes.

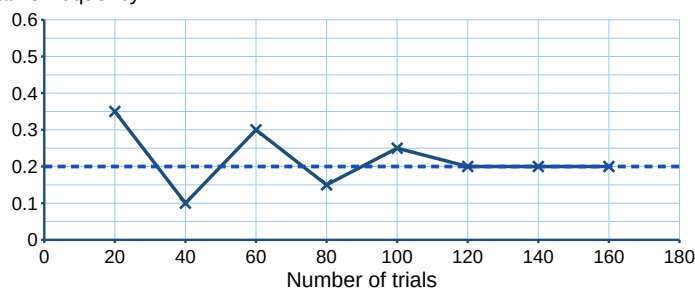
$$\begin{aligned} \text{number of successes} &= \text{relative frequency} \times \\ \text{trials} &= 0.28 \times 250 = 70 \end{aligned}$$

70

1 / 1

- 11** Dylan drops a drawing pin many times. The graph shows the relative frequency of the event "point up" as the number of trials increases.
Use the graph to estimate the probability of point up.

Relative frequency



*the points level off
(settle) at about 0.2
the best estimate is
0.2*

0.2

1 / 1

- 12** Dylan drops a drawing pin 250 times and records the number of times it lands point up.
The table shows the results after different numbers of drops.
Complete the table. Give each relative frequency correct to 2 decimal places.

Number of drops	50	100	150	200	250
Number of times point up	14	31	47	66	80
Relative frequency	0.28	0.31	0.31	0.33	0.32

$$\begin{aligned} 14 \div 50 &= 0.2800 = 0.28 \\ 66 \div 200 &= 0.3300 = 0.33 \end{aligned}$$

1 / 1

- 13 Tegan and Sion each do an experiment to estimate the probability that a basketball player scores with a free throw.

Tegan does 250 free throws and scores 125 times. Sion does 25 free throws and scores 15 times.

Whose results give the better estimate of the probability? Give a reason for your answer.

Tegan: $125 \div 250 = 0.5$

Sion: $15 \div 25 = 0.6$

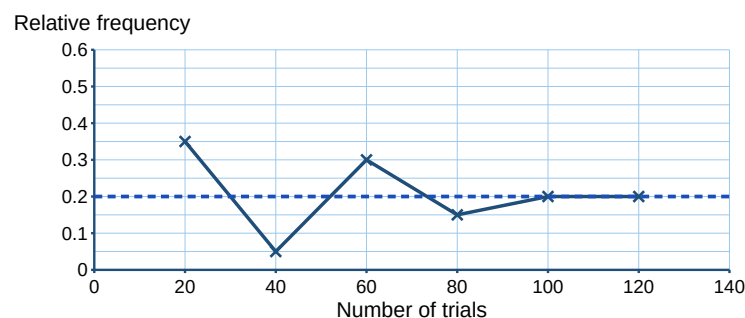
Tegan did more free throws so the estimate is more reliable

Tegan (more free throws)

2 / 2

- 14 Owen takes many shots in basketball. The graph shows the relative frequency of the event "a score" as the number of trials increases.

Use the graph to estimate the probability that Owen scores with his next shot.



*the points level off (settle) at about 0.2
the best estimate is 0.2*

0.2

1 / 1

- 15 Bethan flips a bottle top 120 times and records the number of times it lands upright.

The table shows the results after different numbers of flips.

Complete the table. Give each relative frequency correct to 2 decimal places.

Number of flips	30	60	90	120
Number of times upright	17	35	55	76
Relative frequency	<i>0.57</i>	<i>0.58</i>	<i>0.61</i>	0.63

$17 \div 30 = 0.5667 = 0.57$

$35 \div 60 = 0.5833 = 0.58$

$55 \div 90 = 0.6111 = 0.61$

2 / 2

- 16 Megan and Bethan each do an experiment to estimate the probability that a biased coin lands on heads.
- Megan does 50 throws and it lands on heads 24 times. Bethan does 500 throws and it lands on heads 200 times.
- Whose results give the better estimate of the probability? Give a reason for your answer.

Megan: $24 \div 50 = 0.48$

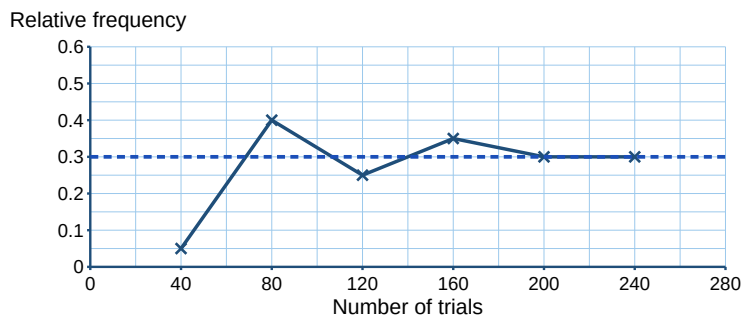
Bethan: $200 \div 500 = 0.4$

Bethan did more throws so the estimate is more reliable

Bethan (more throws)

2 / 2

- 17 The graph shows the relative frequency of the number 4 after different numbers of spins of a spinner with 4 equal sections numbered 1 to 4.
- Use the graph to estimate the probability of getting the number 4.



*the points level off (settle) at about 0.3
the best estimate is 0.3*

0.3

2 / 2

- 18 The relative frequency after 10 throws of a coin was 0.7. Explain why this is not a reliable estimate of the probability of heads.

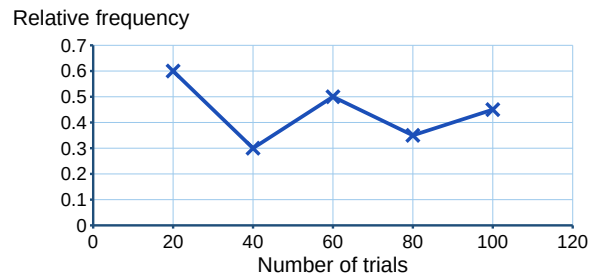
*Only 10 throws is too few, so by chance the result can be far from the true probability
More trials give a more reliable estimate*

Too few trials

2 / 2

- 19 The table shows the relative frequency of blue after different numbers of spins of a spinner with 5 equal sections, 2 of them blue.
- (a) Plot the relative frequencies on the grid and join the points with straight lines.
- (b) Write down the best estimate of the probability of blue.

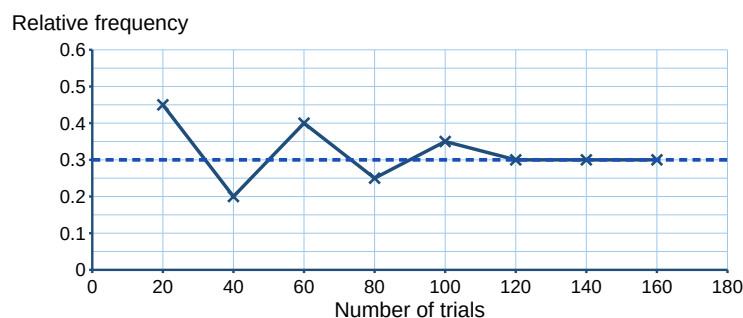
Spins	Relative frequency
20	0.6
40	0.3
60	0.5
80	0.35
100	0.45



(b) 0.45

2 / 2

- 20 Owen takes many shots in basketball. The graph shows the relative frequency of the event "a score" as the number of trials increases.
- Use the graph to estimate the probability that Owen scores with his next shot.



*the points level off
(settle) at about 0.3
the best estimate is
0.3*

0.3

2 / 2

- 21 A graph shows relative frequency against number of trials. What would you expect to happen to the relative frequency if the number of trials increased to a very large number?

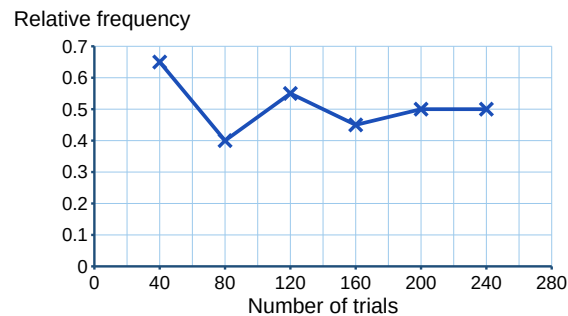
It would settle (get closer and closer) to a fixed value, which is close to the true probability

It settles at the probability

2 / 2

- 22 The table shows the relative frequency of heads after different numbers of throws of a coin.
- (a) Plot the relative frequencies on the grid and join the points with straight lines.
- (b) Write down the best estimate of the probability of a head.

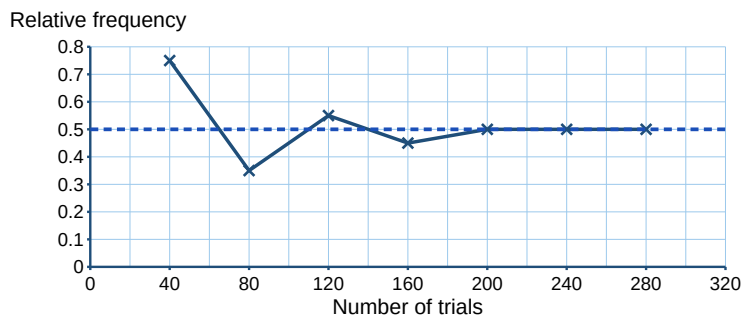
Throws	Relative frequency
40	0.65
80	0.4
120	0.55
160	0.45
200	0.5
240	0.5



(b) 0.5

2 / 2

- 23 Aled throws a fair coin many times. The graph shows the relative frequency of heads.
- (a) Draw a horizontal line on the graph to show the theoretical probability of heads.
- (b) What happens to the relative frequency as the number of throws increases?



(a) theoretical probability = 0.5
draw a line across at 0.5

(b) the relative frequency settles close to the theoretical probability 0.5

(b) It gets closer to (settles at) 0.5

3 / 3

- 24 On a graph of relative frequency against number of trials, the points on the left are spread out and the points on the right are close together. Explain why.

With few trials, one result changes the relative frequency a lot

With many trials, each extra result changes it very little, so it becomes stable

More trials, less change

2 / 2

- 25 A spinner was tested in 4 batches of 25 spins. The table shows the number of successes (when it lands on 4) in each batch.

Batch	1	2	3	4
Number of successes	12	10	11	13

(a) $12 + 10 + 11 = 33$

$33 \div 75 = 0.44$

(b) total = 46

$46 \div 100 = 0.46$

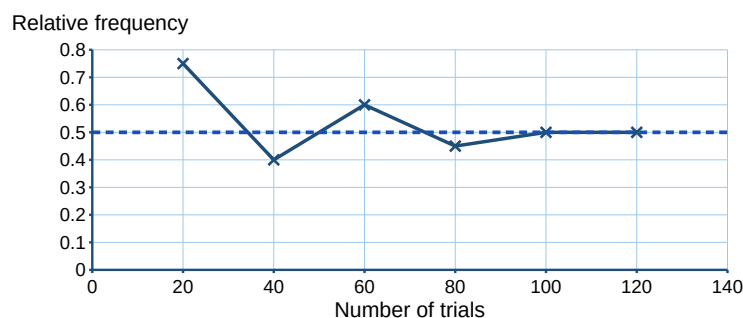
(a) 0.44 (b) 0.46

3 / 3

- 26 Gareth throws a fair coin many times. The graph shows the relative frequency of heads.

(a) Draw a horizontal line on the graph to show the theoretical probability of heads.

(b) What happens to the relative frequency as the number of throws increases?



(a) theoretical probability = 0.5
draw a line across at 0.5

(b) the relative frequency settles close to the theoretical probability 0.5

(b) It gets closer to (settles at) 0.5

3 / 3

- 27 After 300 spins of a spinner the relative frequency of red is 0.4. Sam says, "The probability of red must be exactly 0.4." Is Sam correct? Give a reason.

A relative frequency is only an estimate of the probability

Another 300 spins could give a different value

No: only an estimate

2 / 2

- 28 A bottle top was tested in 5 batches of 20 flips. The table shows the number of successes (when it lands upright) in each batch.
- (a) Work out the relative frequency of success after the first 60 flips.
- (b) Work out the relative frequency of success after all 100 flips.

Batch	1	2	3	4	5
Number of successes	10	7	13	10	13

(a) $10 + 7 + 13 = 30$

$30 \div 60 = 0.5$

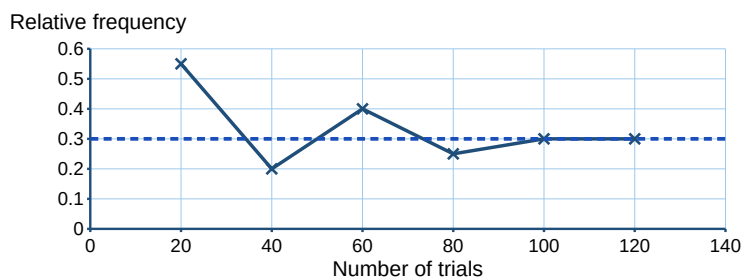
(b) total = 53

$53 \div 100 = 0.53$

(a) 0.5 (b) 0.53

3 / 3

- 29 A fair spinner has 10 equal sections, 3 of them red. Haf spins it many times. The graph shows the relative frequency of red.
- (a) Draw a horizontal line on the graph to show the theoretical probability of red.
- (b) What happens to the relative frequency as the number of spins increases?



(a) theoretical probability = 0.3

draw a line across at 0.3

(b) the relative frequency settles close to the theoretical probability 0.3

(b) It gets closer to (settles at) 0.3

3 / 3

- 30 Ffion carries out an experiment. After 80 trials the event had happened 38 times. After 200 trials the relative frequency of the event was 0.35. How many times did the event happen in the last 120 trials?

total after 200 trials = $0.35 \times 200 = 70$

$70 - 38 = 32$

32

3 / 3

- 31 A basketball player was tested in 4 batches of 20 shots. The table shows the number of successes (when it scores) in each batch.
- (a) Work out the relative frequency of success after the first 60 shots.
- (b) Work out the relative frequency of success after all 80 shots.

Batch	1	2	3	4
Number of successes	8	8	11	9

(a) $8 + 8 + 11 = 27$

$27 \div 60 = 0.45$

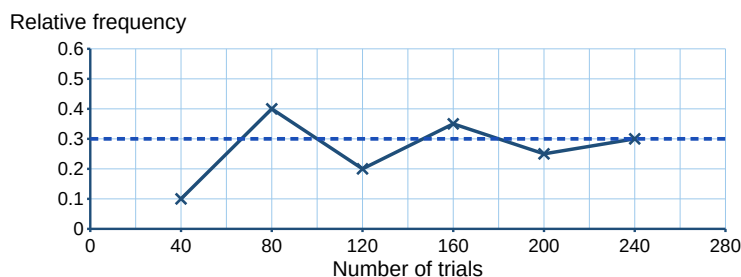
(b) total = 36

$36 \div 80 = 0.45$

(a) 0.45 (b) 0.45

3 / 3

- 32 A fair spinner has 10 equal sections, 3 of them red. Iwan spins it many times. The graph shows the relative frequency of red.
- (a) Draw a horizontal line on the graph to show the theoretical probability of red.
- (b) What happens to the relative frequency as the number of spins increases?



(a) theoretical probability = 0.3

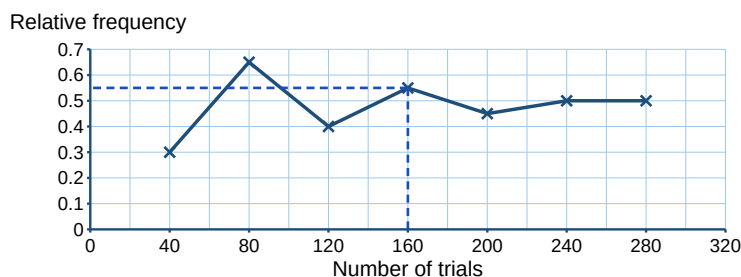
draw a line across at 0.3

(b) the relative frequency settles close to the theoretical probability 0.3

(b) It gets closer to (settles at) 0.3

3 / 3

- 33 The graph shows the relative frequency of the event that the spinner lands on red, after different numbers of spins.
- (a) Write down the relative frequency after 160 spins.
- (b) Work out the number of times that this event happened in the first 160 spins.



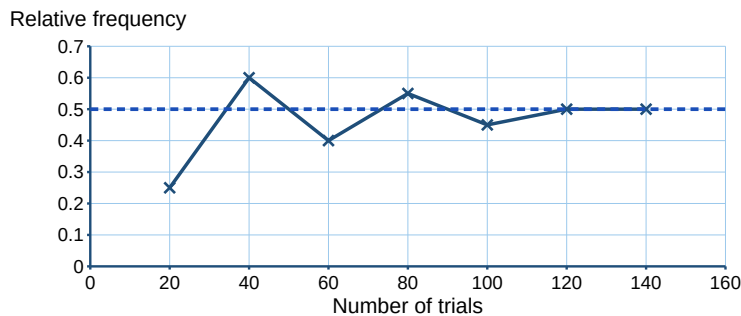
(a) read up from 160 to the graph then across: 0.55

(b) number = relative frequency $\times$ trials = $0.55 \times 160 = 88$

(a) 0.55 (b) 88

3 / 3

- 34 Gareth says that a coin is fair. He throws the coin many times. The graph shows the relative frequency of heads. Use the graph to decide whether Gareth is likely to be correct. Give a reason for your answer.

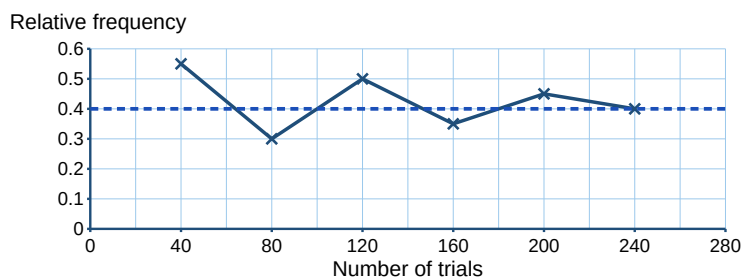


*the graph settles at about 0.5
the theoretical probability of a head is 0.5
these are close, so it is likely to be fair*

Yes; settles near 0.5

4 / 4

- 35 A fair spinner has 5 equal sections, 2 of them blue. Rhian spins it many times. The graph shows the relative frequency of blue.
- (a) Draw a horizontal line on the graph to show the theoretical probability of blue.
- (b) What happens to the relative frequency as the number of spins increases?

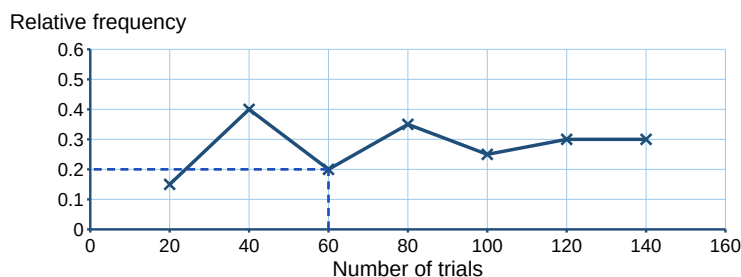


*(a) theoretical probability = 0.4
draw a line across at 0.4
(b) the relative frequency settles close to the theoretical probability 0.4*

(b) It gets closer to (settles at) 0.4

3 / 3

- 36 The graph shows the relative frequency of the event that the drawing pin lands point up, after different numbers of drops.
- (a) Write down the relative frequency after 60 drops.
- (b) Work out the number of times that this event happened in the first 60 drops.

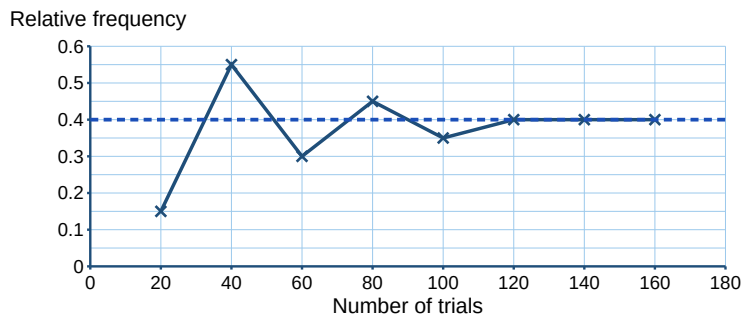


*(a) read up from 60 to the graph then across: 0.2
(b) number = relative frequency $\times$ trials = $0.2 \times 60 = 12$*

(a) 0.2 (b) 12

3 / 3

- 37 A spinner has 5 equal sections, 2 of them blue. Mari spins it many times. The graph shows the relative frequency of blue.
- Is the spinner likely to be fair? Use the graph to give a reason for your answer.



*the graph settles at about 0.4
the theoretical probability of blue is 0.4
these are close, so it is likely to be fair*

Yes: settles near 0.4

4 / 4

- 38 Elin throws a coin 100 times and gets 64 heads.
- Elin says the coin is not fair. Is Elin likely to be correct?
- Work out the relative frequency and compare it with the theoretical probability to give a reason.

relative frequency = $64 \div 100 = 0.64$

theoretical probability = 0.5

the difference is large

The relative frequency is 0.64, which is far from the theoretical probability 0.5, so it is probably not fair

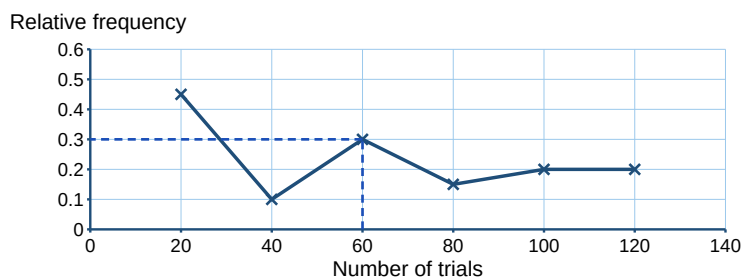
Yes: 0.64 is far from 0.5

4 / 4

- 39 The graph shows the relative frequency of the event that the drawing pin lands point up, after different numbers of drops.

(a) Write down the relative frequency after 60 drops.

(b) Work out the number of times that this event happened in the first 60 drops.

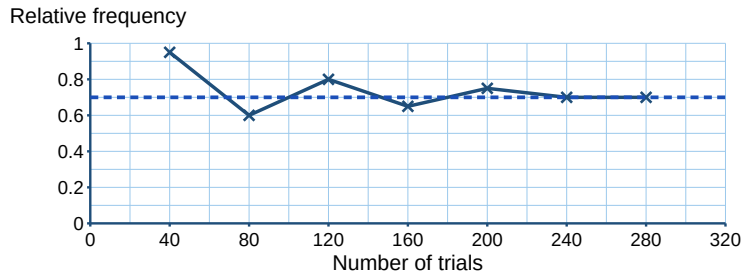


*(a) read up from 60 to the graph then across: 0.3
(b) number = relative frequency $\times$ trials = $0.3 \times 60 = 18$*

(a) 0.3 (b) 18

3 / 3

- 40 Elin flips a bottle top many times. The graph shows the relative frequency of the event "the bottle top lands upright".
- (a) Use the graph to estimate the probability that the bottle top lands upright.
- (b) Use your answer to (a) to estimate how many times this would happen in 200 flips.



(a) the graph levels off at about 0.7
 (b) expected number
 $= 0.7 \times 200 = 140$

(a) 0.7 (b) 140

5 / 5

- 41 Bethan rolls a dice 600 times and gets 178 sixes.
 Bethan says the dice is not fair. Is Bethan likely to be correct?
 Work out the relative frequency and compare it with the theoretical probability to give a reason.

relative frequency $= 178 \div 600 = 0.297$

theoretical probability $= \frac{1}{6}$

the difference is large

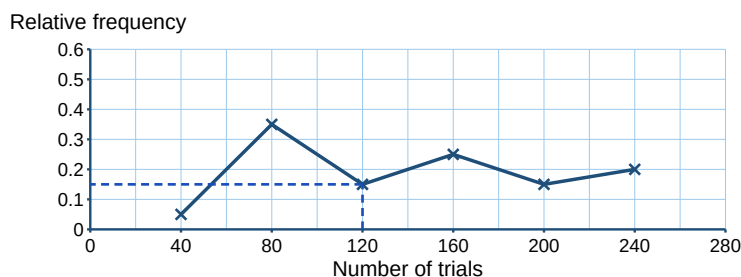
The relative frequency is 0.297, which is far from the theoretical probability $\frac{1}{6}$, so it is

probably not fair

Yes: 0.297 is far from $\frac{1}{6}$

4 / 4

- 42 The graph shows the relative frequency of the event that the bottle top lands upright, after different numbers of flips.
- (a) Write down the relative frequency after 120 flips.
- (b) Work out the number of times that this event happened in the first 120 flips.

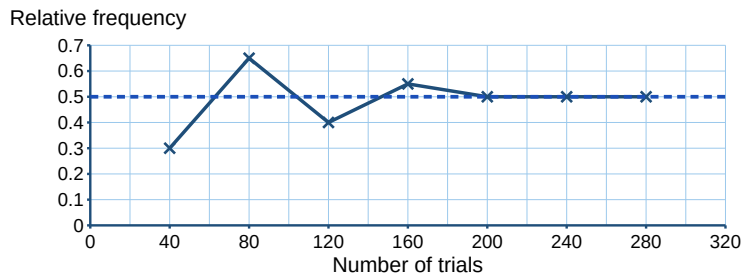


(a) read up from 120 to the graph then across: 0.15
 (b) number = relative frequency $\times$ trials =
 $0.15 \times 120 = 18$

(a) 0.15 (b) 18

3 / 3

- 43 Emyr drops a drawing pin many times. The graph shows the relative frequency of the event "the drawing pin lands point up".
- (a) Use the graph to estimate the probability that the drawing pin lands point up.
- (b) Use your answer to (a) to estimate how many times this would happen in 500 drops.



(a) the graph levels off at about 0.5
 (b) expected number = $0.5 \times 500 = 250$

(a) 0.5 (b) 250

5 / 5

- 44 Owen rolls a dice 600 times and gets 106 sixes.
- Owen says the dice is not fair. Is Owen likely to be correct?
- Work out the relative frequency and compare it with the theoretical probability to give a reason.

relative frequency = $106 \div 600 = 0.177$

theoretical probability = $\frac{1}{6}$

the difference is small

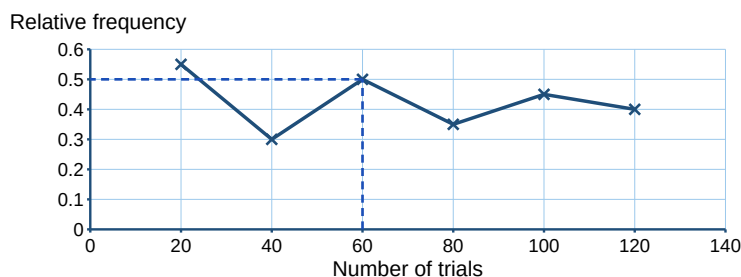
The relative frequency is 0.177, which is close to the theoretical probability $\frac{1}{6}$, so there is no

evidence it is unfair

No: 0.177 is close to $\frac{1}{6}$

4 / 4

- 45 The graph shows the relative frequency of the event that the drawing pin lands point up, after different numbers of drops.
- (a) Write down the relative frequency after 60 drops.
- (b) Work out the number of times that this event happened in the first 60 drops.



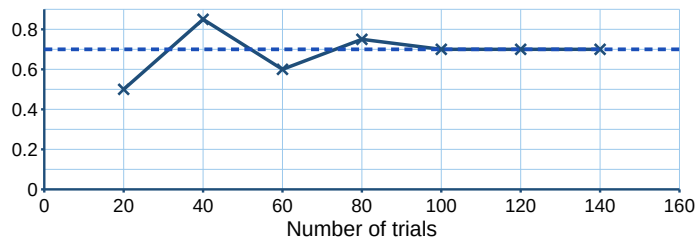
(a) read up from 60 to the graph then across: 0.5
 (b) number = relative frequency $\times$ trials = $0.5 \times 60 = 30$

(a) 0.5 (b) 30

3 / 3

- 46 Elin drops a drawing pin many times. The graph shows the relative frequency of the event "the drawing pin lands point up".
- (a) Use the graph to estimate the probability that the drawing pin lands point up.
- (b) Use your answer to (a) to estimate how many times this would happen in 100 drops.

Relative frequency



(a) the graph levels off at about 0.7
 (b) expected number
 $= 0.7 \times 100 = 70$

(a) 0.7 (b) 70

5 / 5

- 47 A spinner has 10 equal sections, 3 of them red. Sion spins it 300 times and gets red 120 times. Sion says the spinner is not fair. Is Sion likely to be correct? Work out the relative frequency and compare it with the theoretical probability to give a reason.

$$\text{relative frequency} = 120 \div 300 = 0.4$$

$$\text{theoretical probability} = 0.3$$

the difference is large

The relative frequency is 0.4, which is far from the theoretical probability 0.3, so it is probably not fair

Yes: 0.4 is far from 0.3

4 / 4

- 48 A spinner has 4 equal sections numbered 1 to 4. Aled spins it 300 times and gets the number 4 69 times. Aled says the spinner is not fair. Is Aled likely to be correct? Work out the relative frequency and compare it with the theoretical probability to give a reason.

$$\text{relative frequency} = 69 \div 300 = 0.23$$

$$\text{theoretical probability} = 0.25$$

the difference is small

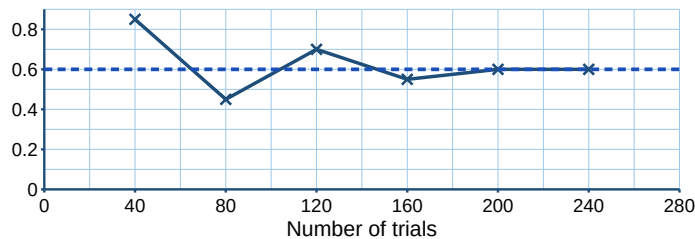
The relative frequency is 0.23, which is close to the theoretical probability 0.25, so there is no evidence it is unfair

No: 0.23 is close to 0.25

4 / 4

- 49 Gareth flips a bottle top many times. The graph shows the relative frequency of the event "the bottle top lands upright".
- (a) Use the graph to estimate the probability that the bottle top lands upright.
- (b) Use your answer to (a) to estimate how many times this would happen in 1000 flips.

Relative frequency



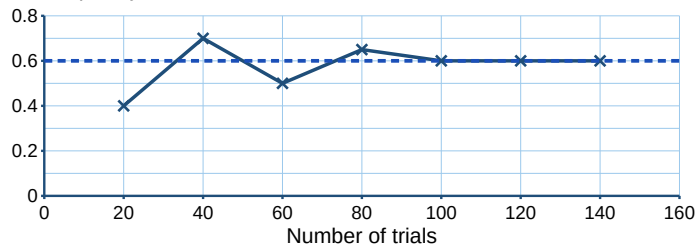
(a) the graph levels off at about 0.6
(b) expected number
 $= 0.6 \times 1000 = 600$

(a) 0.6 (b) 600

5 / 5

- 50 Rhian drops a drawing pin many times. The graph shows the relative frequency of the event "the drawing pin lands point up".
- (a) Use the graph to estimate the probability that the drawing pin lands point up.
- (b) Use your answer to (a) to estimate how many times this would happen in 200 drops.

Relative frequency



(a) the graph levels off at about 0.6
(b) expected number
 $= 0.6 \times 200 = 120$

(a) 0.6 (b) 120

5 / 5