Year 9 Probability Workbook

Part 2: Experimenting

Name:



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Experiment 1 (at home)

When you drop a spoon, there are two ways the spoon can land. Either:



Spoon facing up

or



Spoon facing down

Problem

I wonder what the probability of the spoon landing facing up is?

Plan

1. Collect a spoon.
2. Find a piece of carpet where you can safely (and quietly) do the experiment.
3. Hold your arm out and drop the spoon.
4. Record whether it landed facing up or down on the tally chart below.
5. Repeat this a total of 50 times.
6. Clean the spoon and return it to the drawer.

Explain why it is important that you use the same method each time to drop the spoon.

Why is collecting 50 pieces of data a good thing to do? Why not do more or less?

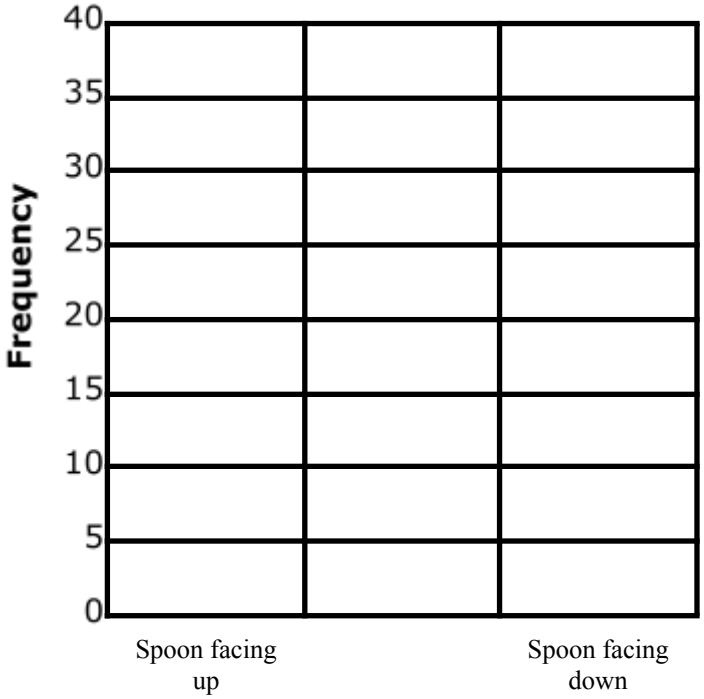
Data

Carry out your investigation and record your data below.

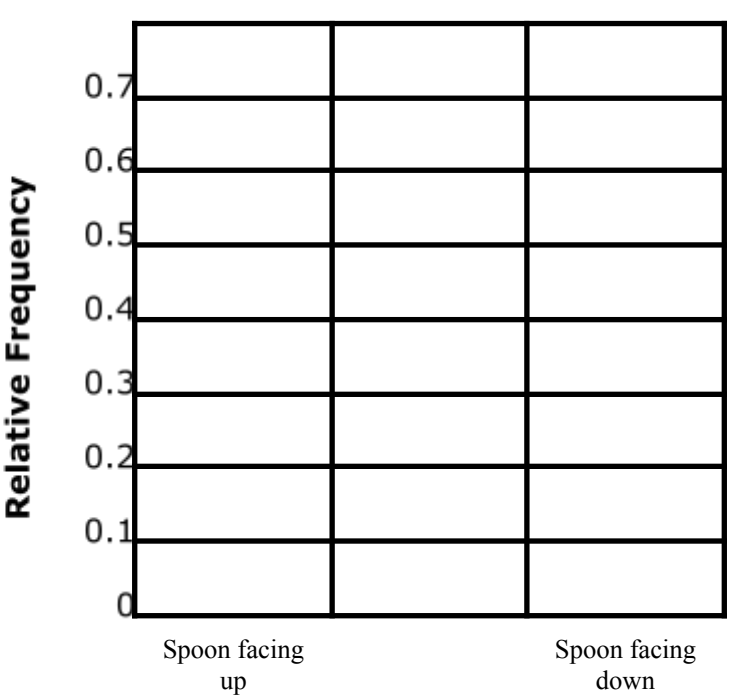
Outcome	Tally	Frequency	Relative Frequency
Spoon facing up			
Spoon facing down			

Draw both a frequency and relative frequency bar graph

Frequency graph



Relative frequency graph



Analysis

Mode =

I notice that the most common result is _____

Conclusion

From my experiment the estimated probability of the spoon landing facing up is _____ and the estimated probability of the spoon landing facing down is _____.

Experiment 1 (at school)

When you toss a drawing pin, there are two ways the pin can land. Either:



Pin up or



Pin down

Problem

I wonder what the probability of the pin landing pin up is?

Plan

Sample space: Pin up and Pin down.

Number of trials: 50

Instructions:

1. Collect a pin from your maths teacher.
2. Find a flat surface to safely do the experiment.
3. Hold your arm about 30 cm above the table and drop the pin.
4. Record whether it landed pin up on the tally chart below.
5. Repeat this a total of 50 times.
6. Return the pin to your teacher.

Explain why it is important that you use the same method each time to drop the spoon.

Why is collecting 50 pieces of data a good thing to do? Why not do more or less?

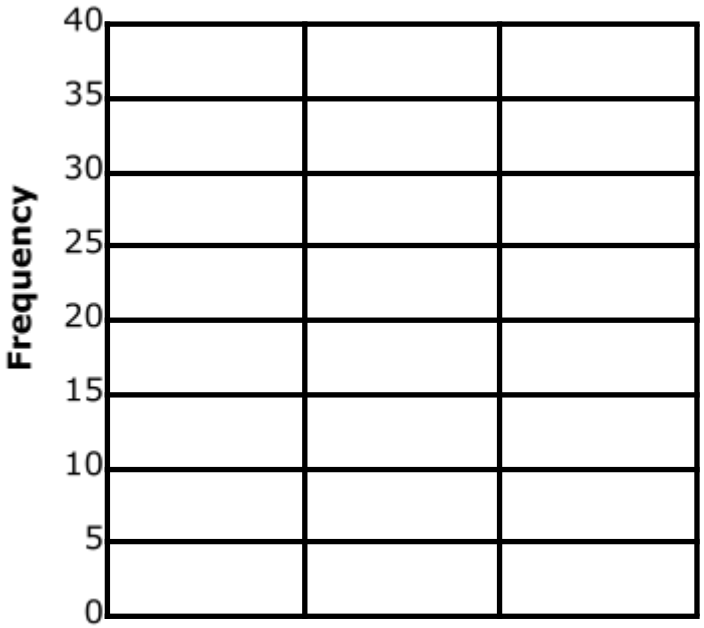
Data

Carry out your investigation and record your data below.

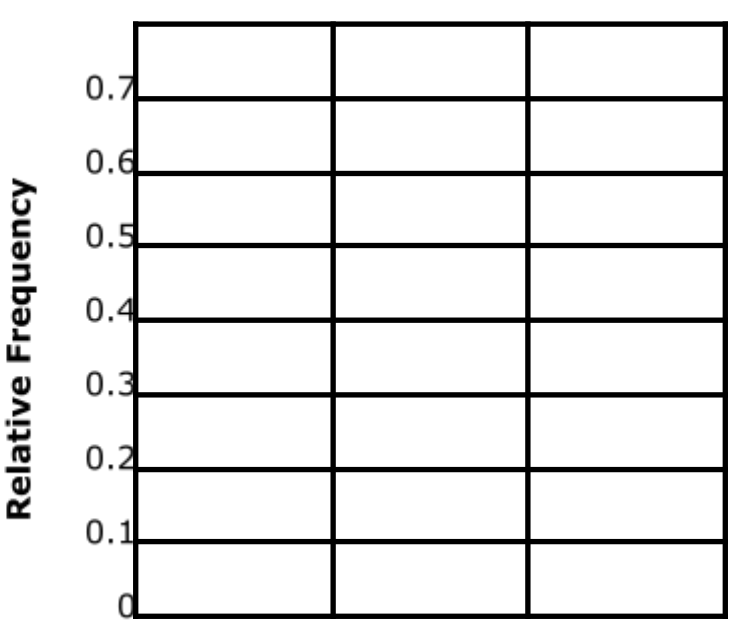
Outcome	Tally	Frequency	Relative Frequency
Spoon facing up			
Spoon facing down			

Draw both a frequency and relative frequency bar graph

Frequency graph



Relative frequency graph



Spoon facing up	Spoon facing down	Spoon facing up	Spoon facing down

Analysis

Mode =

I notice that the most common result is _____

Conclusion

From my experiment the estimated probability of the spoon landing facing up is _____ and the estimated probability of the spoon landing facing down is _____.

Experiment 2 (How random are you?)

Problem

I wonder whether a student is as good as making random numbers as a spinner, my calculator and a random number table ?

Plan

Sample space: Random numbers = 1, 2, 3, 4, 5, 6, 7, 8, 9, 10.

Number of trials: 50

Instructions:

1. Get a student to generate 50 random numbers between 1 and 10,
2. Record all the results in the matching table below.
3. Generate 50 random numbers between 1 and 10 using a spinner,
4. Record all the results in the matching table below.
5. Generate 50 random numbers between 1 and 10 using a calculator
6. Record all the results in the matching table below.
7. Generate 50 random numbers between 1 and 10 using a random number table.
8. Record all the results in the matching table below.

Data

Student:

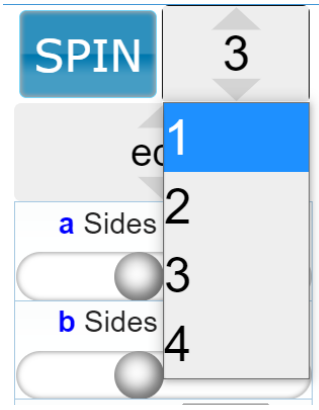
Write down 50 numbers between 1 and 10:

Spinner:

Step 1: Click here to go to the website

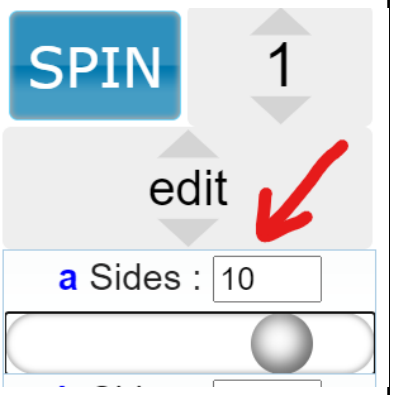
Step 2:

Click on the **3** button, and choose **1** spinner



Step 3:

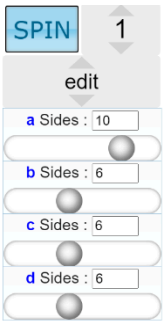
Change the number of sides to **10**



Step 4:

Click on the **Spin** button



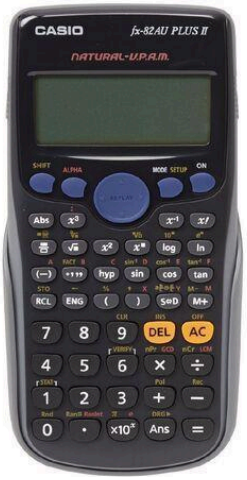


Step 5:

Write your result in the table below and repeat until you have all your data.

Calculator:

Step 1: Turn on your calculator (click here to go a website if you don't have one).



Step 2: We want to enter the formula **RanInt#(1,10)**. To do this press the following sequence of buttons:

ALPHA • 1 SHIFT) 10) =

Each time you press = another random number will be displayed.

RanInt#(1,10)
9

Step 4: Write your result in the table below and repeat until you have 50 values.

Table of random numbers:

1) Choose a random starting point on the random number table.
2) Break the numbers into single digit numbers.
   E.g. 36518 becomes 3 6 5 1 8
3) If the number is a 0, we will make this equal to a random number of 10.
4) Write these numbers down below.

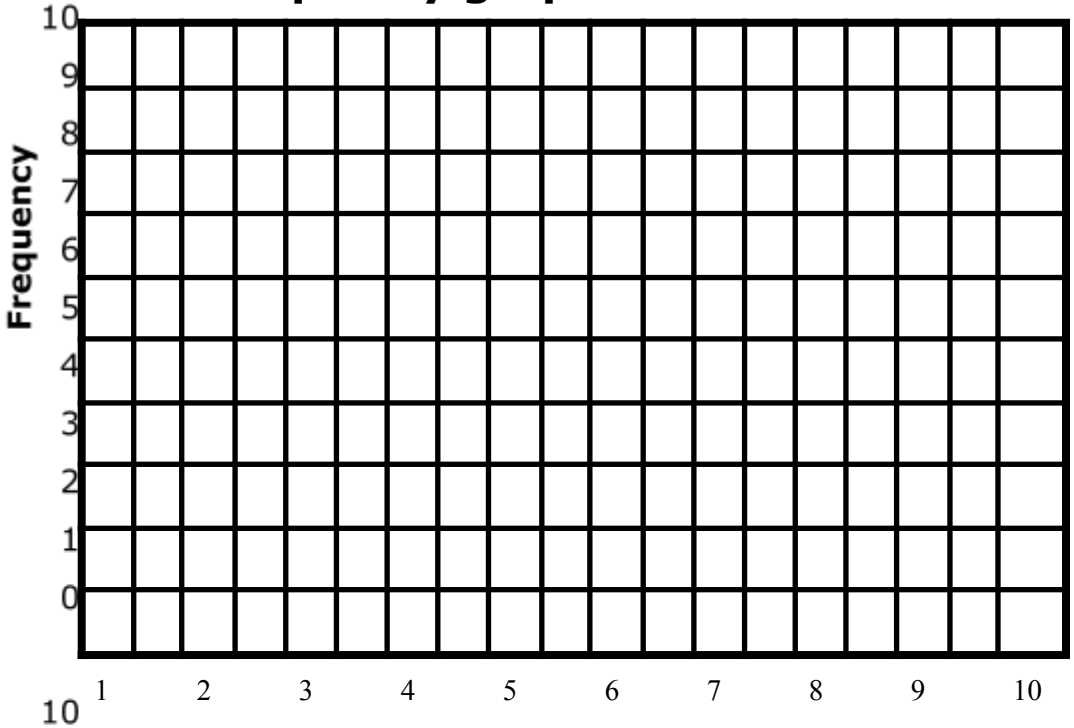
36518	36777	89116	05542	29705	83775
46132	81380	75635	19428	88048	08747
31841	77367	40791	97402	27569	90184
84180	93793	64953	51472	65358	23701
78435	37586	07015	98729	76703	16224
41859	94198	37182	61345	88857	53204
13019	07274	51068	93129	40386	51731
82448	72430	29041	59208	95266	33978
25432	96593	83112	96997	55340	80312
69226	38655	03811	08342	47863	02743

Write down 50 numbers between 1 and 10:

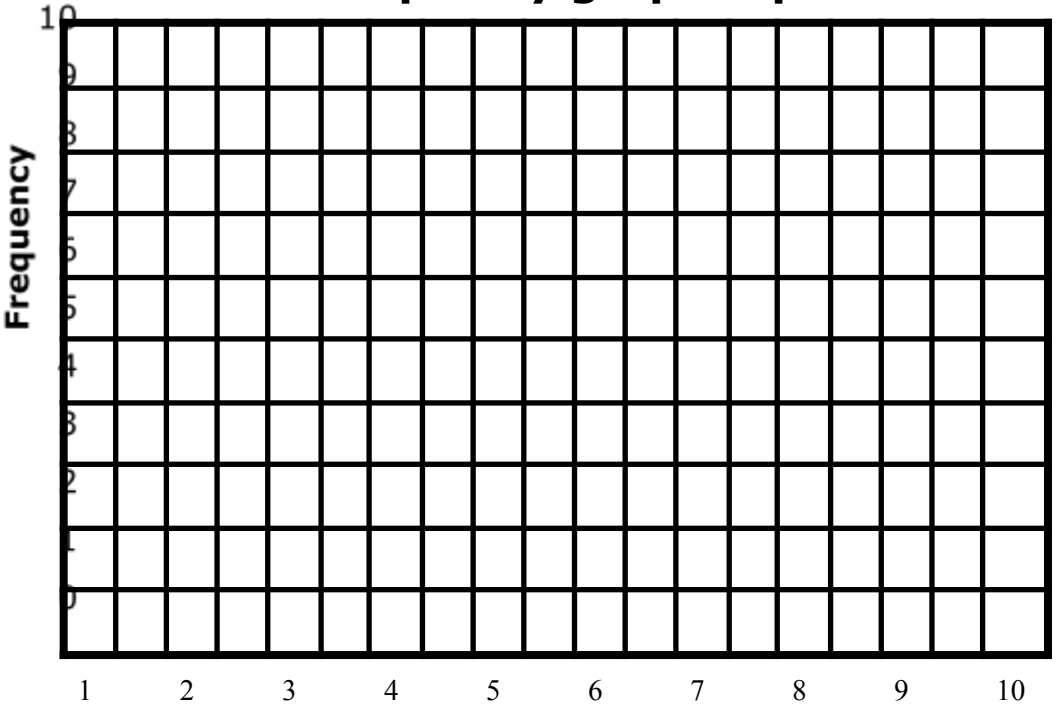
	Student			Spinner			Calculator			Table		
Outcome	**Tally**	**Frequency**	**Relative Frequency**	**Tally**	**Frequency**	**Relative Frequency**	**Tally**	**Frequency**	**Relative Frequency**	**Tally**	**Frequency**	**Relative Frequency**
0												
1												
2												
3												
4												
5												
6												
7												
8												
9												

10												

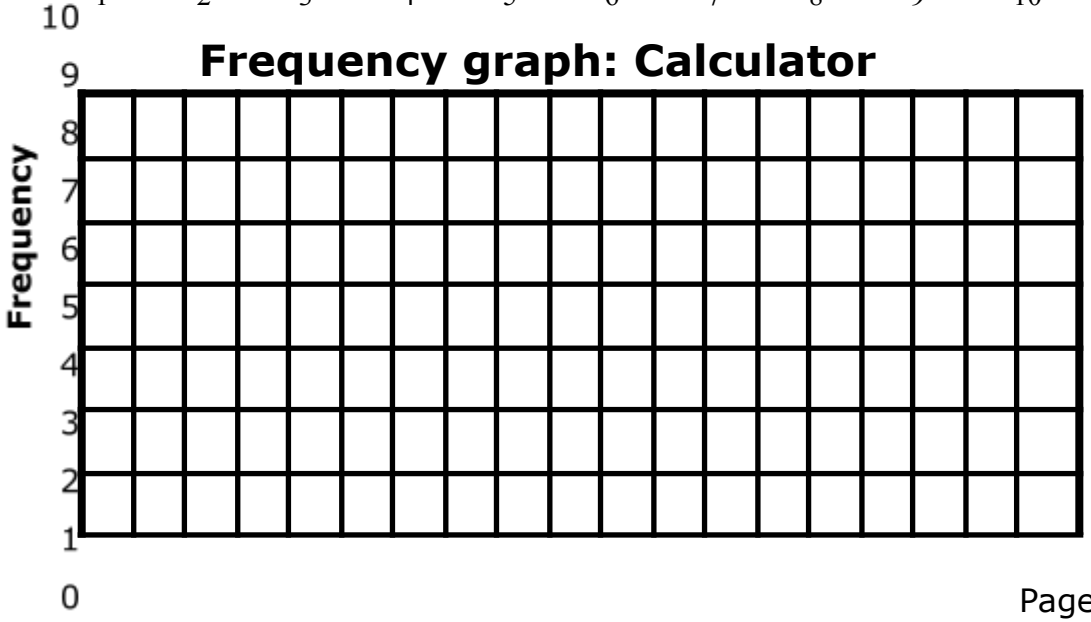
Frequency graph: Student



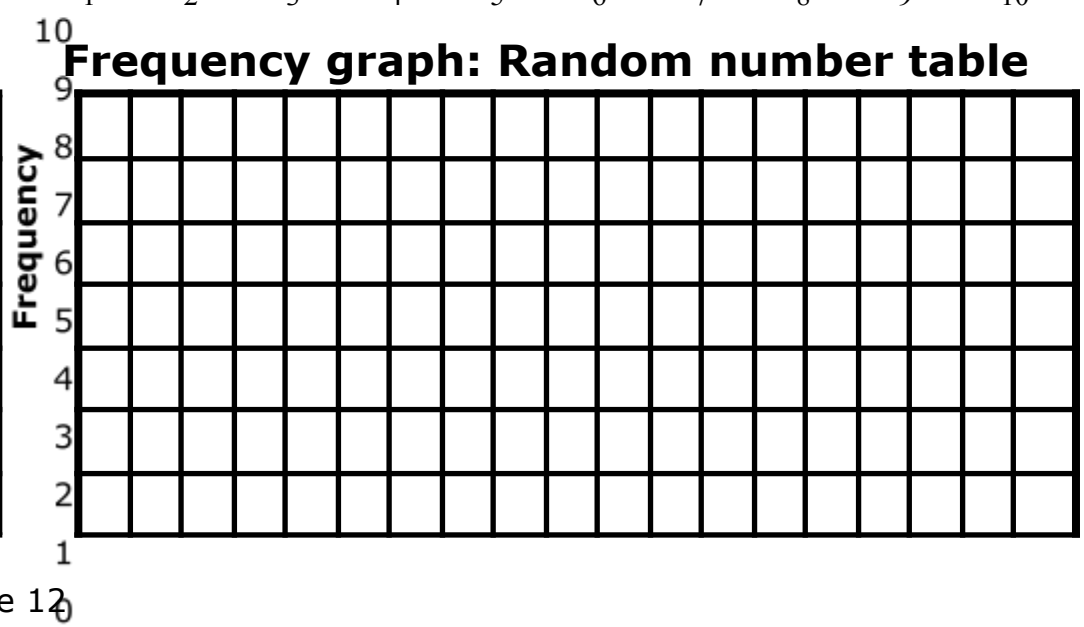
Frequency graph: Spinner

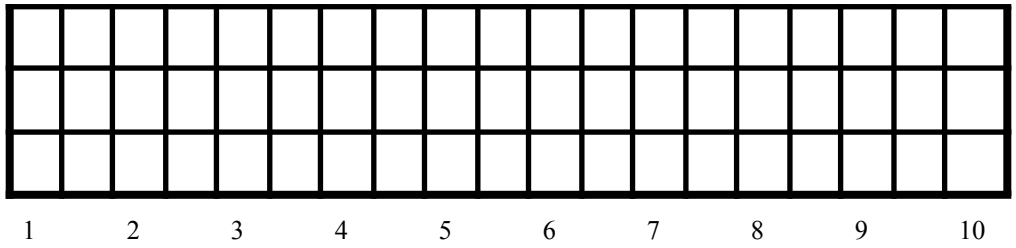


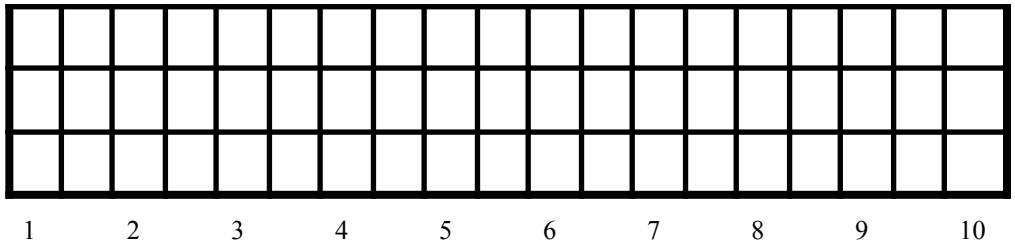
Frequency graph: Calculator



Frequency graph: Random number table




1 2 3 4 5 6 7 8 9 10


1 2 3 4 5 6 7 8 9 10

Analysis

Find the mode for each tool and write in the table below.

Mode:

Student	Spinner	Calculator	Table

Describe the modes for each tool.

What else do you notice about the 4 tools? Think about the probabilities, the shape, and any other features. Discuss the similarities and differences.

Conclusion

Compare how random each of the tools are. Do you think they are all good at generating random numbers, or are any of the tools biased? Explain your reasons.

Which is the most random? Explain your reasons.

Experiment 3 (Dice)

Problem

I wonder whether the probability of getting each number on the die is equally likely?

Plan

Write a plan for how you can carry out this experiment. Each trial needs to be carried out in exactly the same conditions.

Sample space:

Number of trials: 60

Instructions:

1)

Data

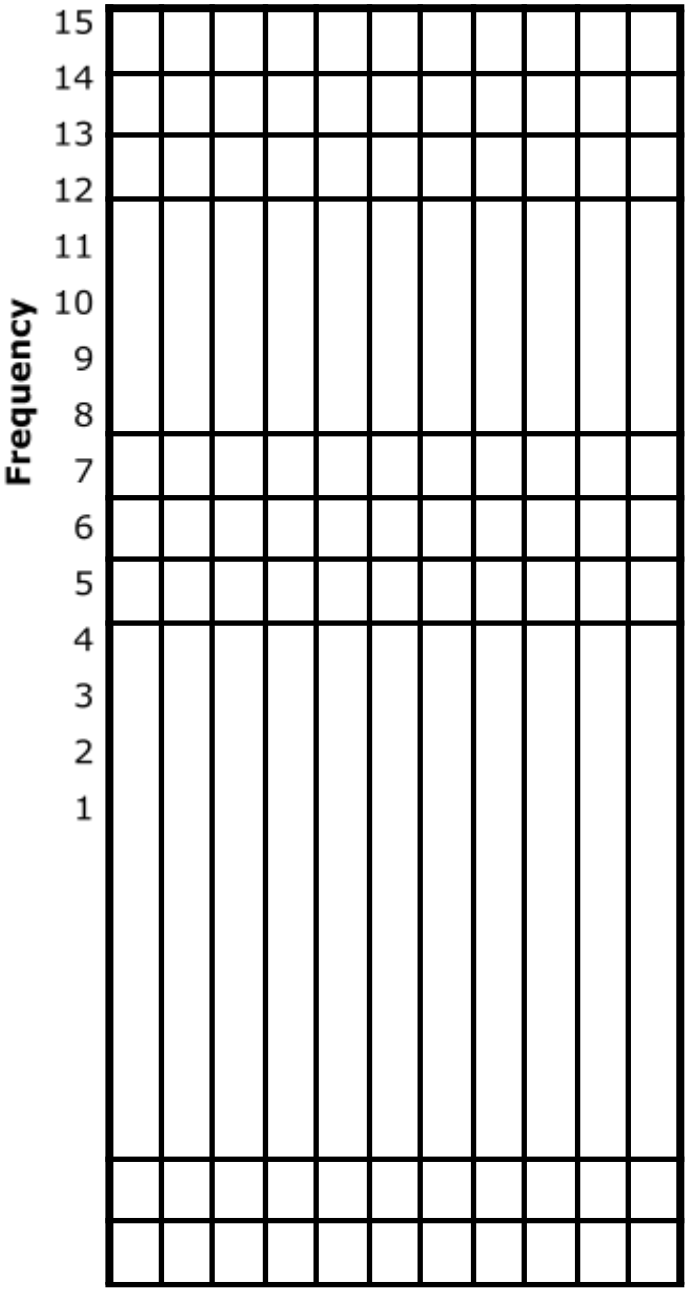
Carry out your experiment and record your data.

Analysis

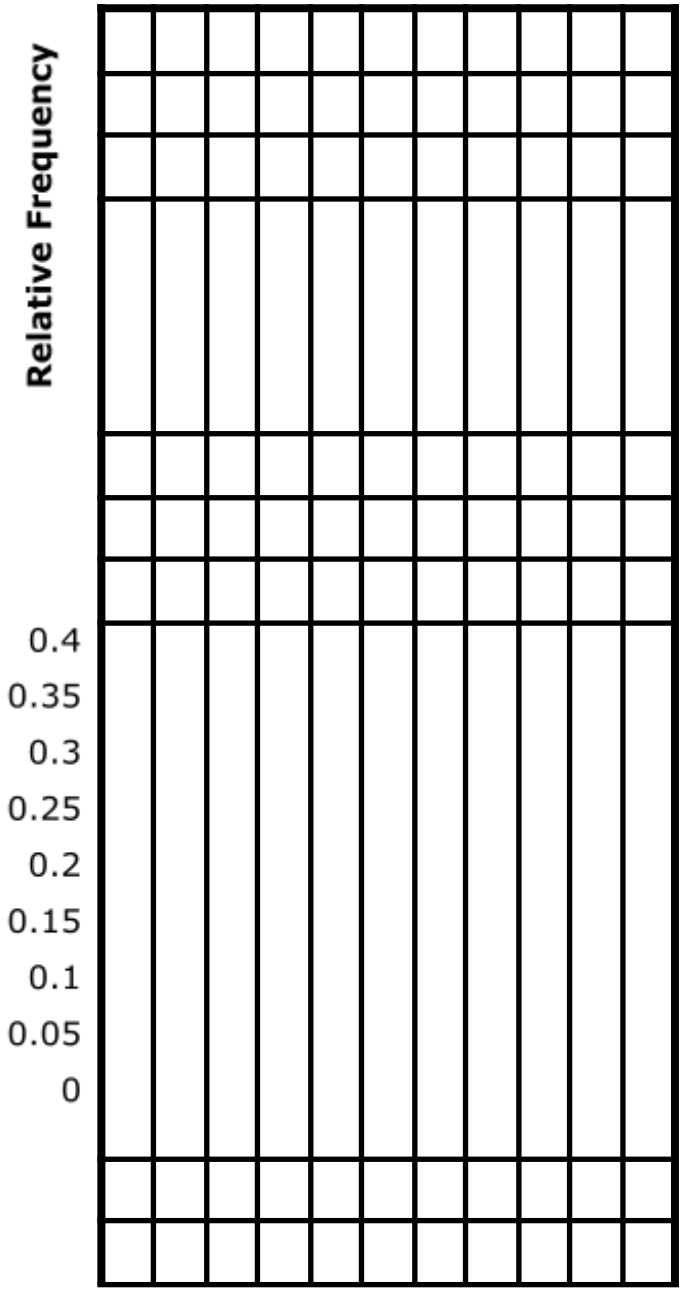
Complete the tally table and graphs below.

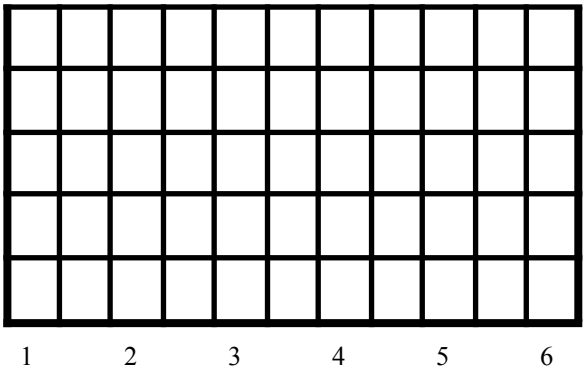
Outcomes	Tally	Frequency	Relative frequency

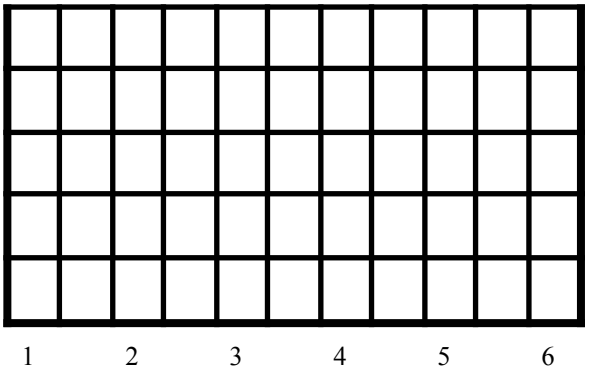
Frequency graph



Relative Frequency graph





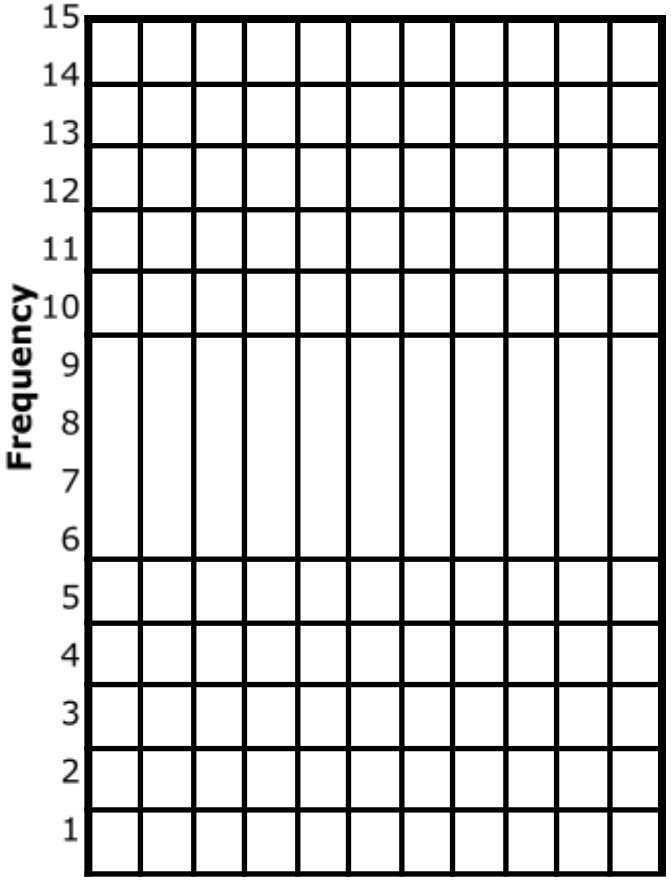


Identify the mode and probabilities and describe these below in context.

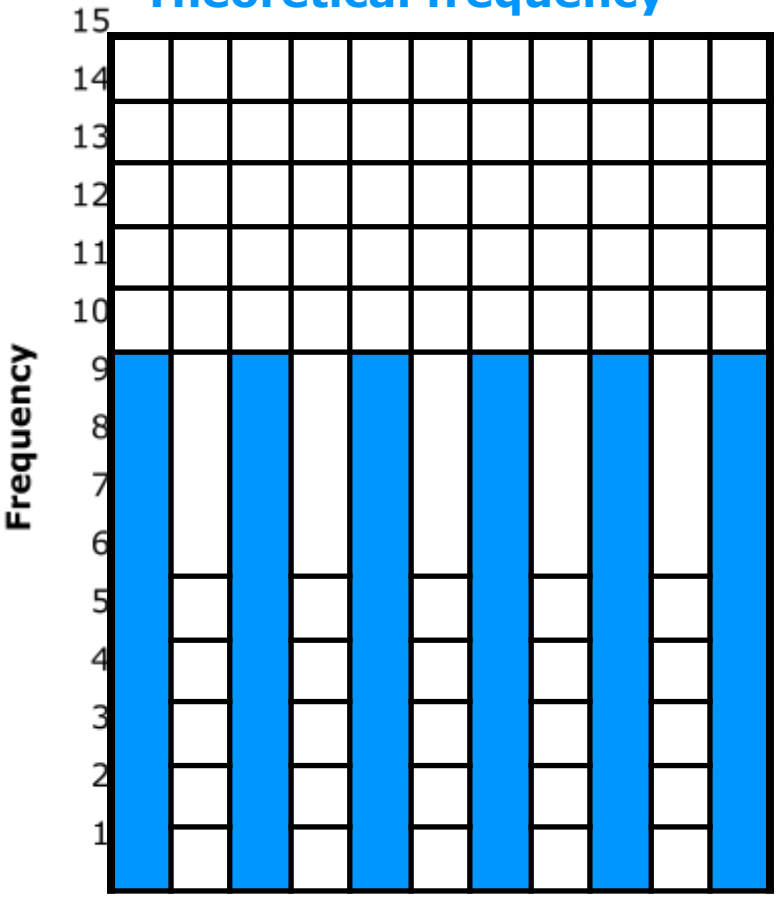
Comparing experimental and theoretical

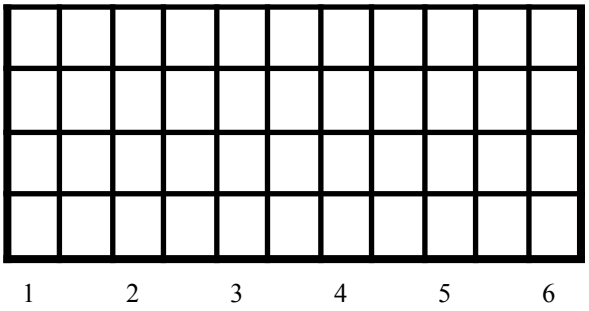
Now let's compare your **experimental result** with the **theoretical distribution**. I have drawn the **theoretical distribution** for you. Redraw your **frequency** graph on the left-hand side of the grid below.

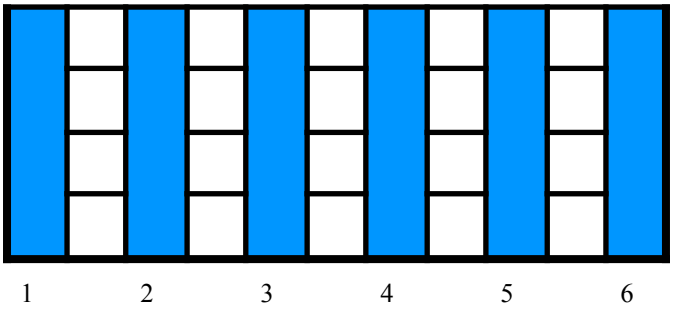
Experimental frequency



Theoretical frequency







Conclusion

Draw a conclusion about your experimental results (answer your investigation question).

Compare the graphs of your experimental data with the theoretical data. Are all the bars in your **experimental graph** the same height as the **theoretical model**? Are they identical? Why/why not? Explain your reasons.

Experiment 4 (Two Coins)

You will need two coins (or click on this link to go to an online coin tossing website. Click on the settings cog to select 2 coins, then click on the coins and it will do a toss).

Problem

When I toss **two coins**, I wonder whether the probability of getting one Head is the same as getting two Tails?

Plan

Write a plan for how you can carry out this experiment. Each trial needs to be carried out in exactly the same conditions, and you want to do at least 50 trials.

Sample space:

Number of trials:

Definition of one trial: one trial is when I toss ____ coins

Instructions:

1)

Data

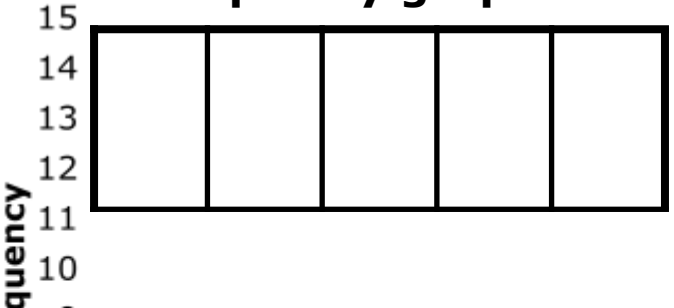
Carry out your experiment and record your data.

Analysis

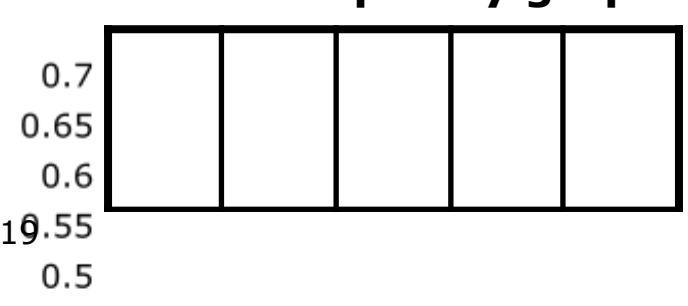
Complete the tally table and graphs below.

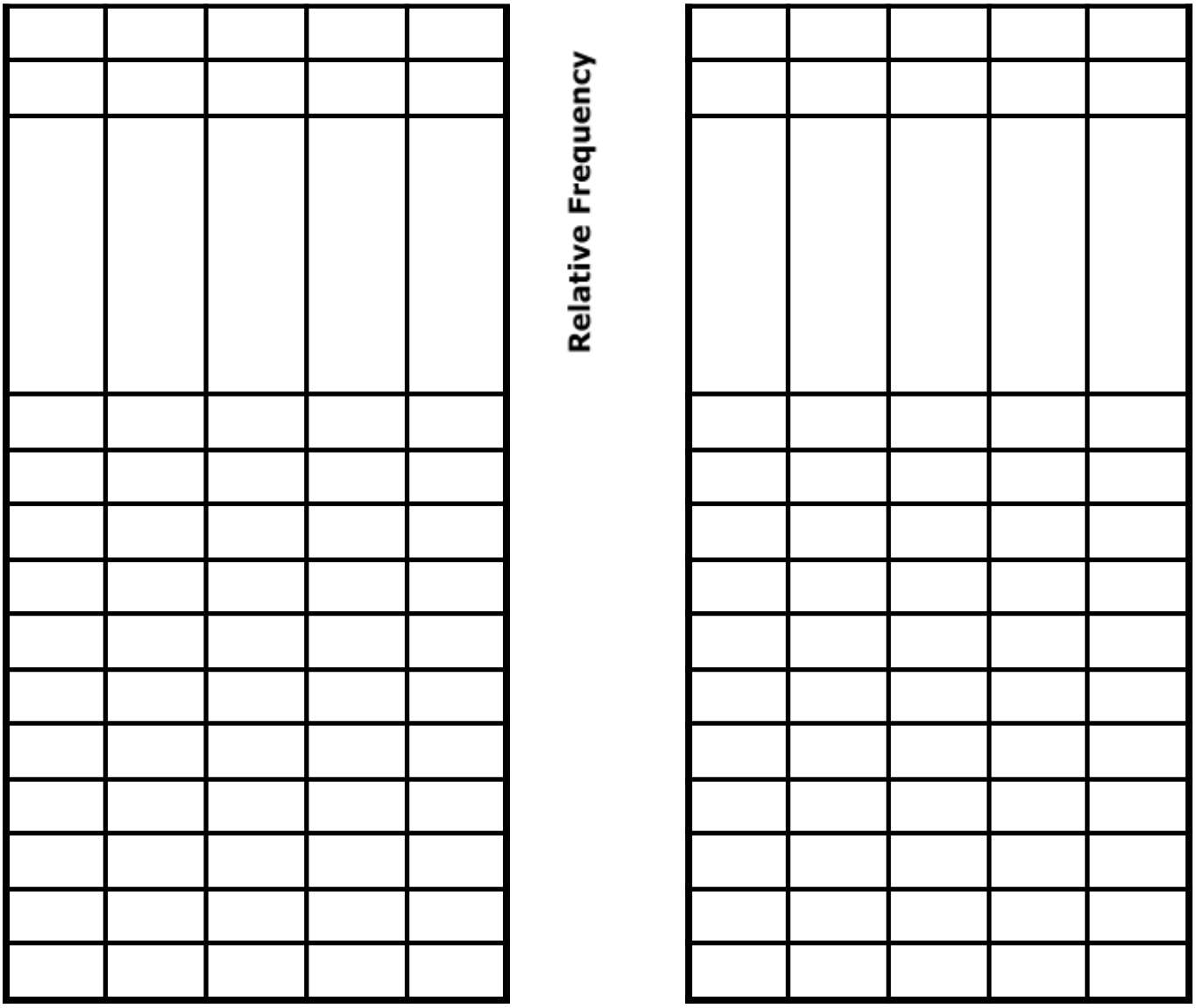
Outcomes	Tally	Frequency	Relative frequency
Two heads			
One head			
No heads			

Frequency graph



Relative Frequency graph

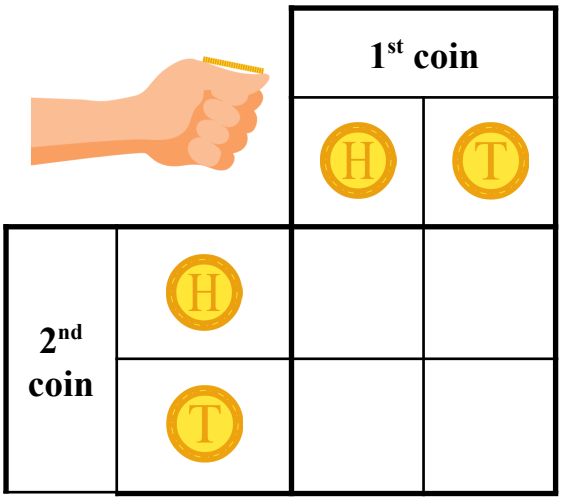




Identify the mode and probabilities and describe these below in context.

Comparing experimental and theoretical

Complete the sample space table and calculate the **theoretical probabilities**.



$P(2\ heads) =$
$P(1\ head) =$
$P(0\ heads) =$

Now let's compare your **experiment result** with the **theoretical distribution**.
Redraw your **relative frequency** graph on the left-hand grid below.

Experiment Relative freq.

Theoretical Relative freq.

Conclusion

Draw a conclusion about your experimental results (answer your investigation question).

Then compare the graphs of your experimental data with the theoretical data.

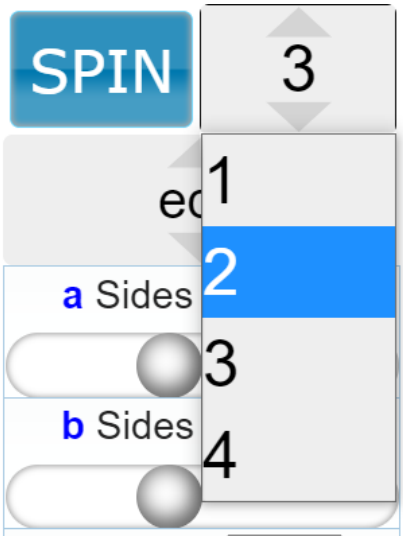
Experiment 5 (Two spinners)

Setting up:

Step 1: Click here to go to the website

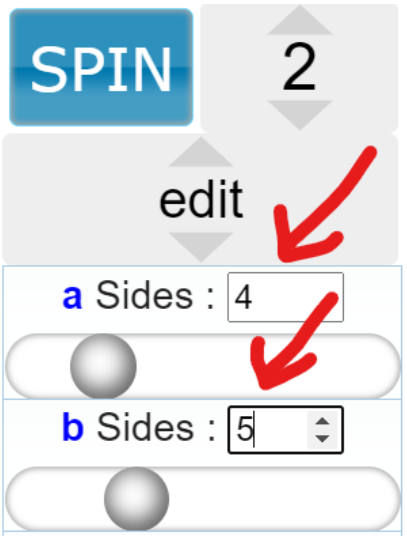
Step 2:

Click on the **3** button, and choose **2** spinners



Step 3:

Change the number of sides to **4** for spinner **a** and **5** for spinner **b**.

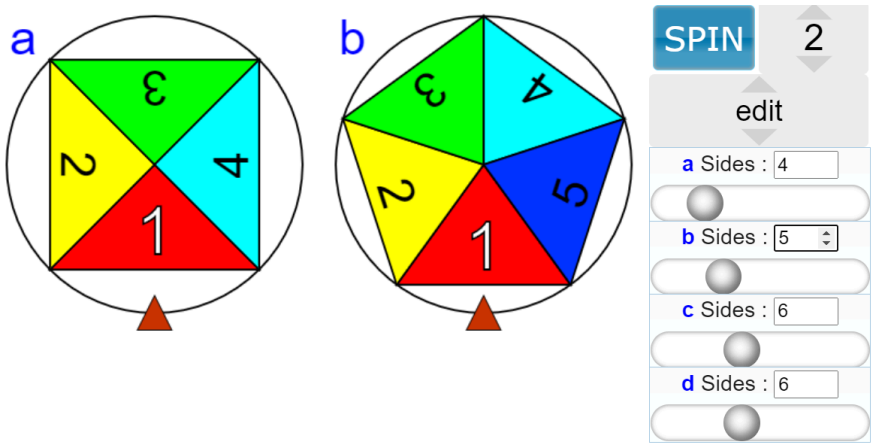


Step 4:

Click on the **Spin** button

Step 5:

Add the two numbers on the spinners together to find the total score.



Step 6:

Write your result in the table below and repeat until you have enough data.

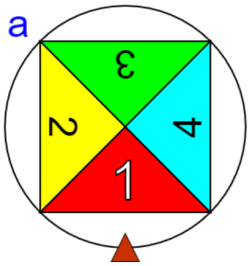
Problem

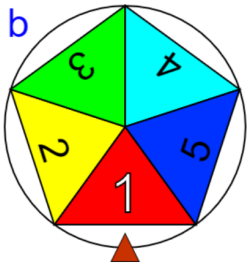
When I spin the two spinners above, I wonder what the probability of the total numbers are (when I add them both together)?

Plan

Write a plan for how you can carry out this experiment. Each trial needs to be carried out in exactly the same conditions, and you want to do at least 50 trials.

Sample space:





		1st spinner				
2nd spinner						

Number of trials:

Definition of one trial: one trial is …

Instructions:

1)

Data

Carry out your experiment and record your data.

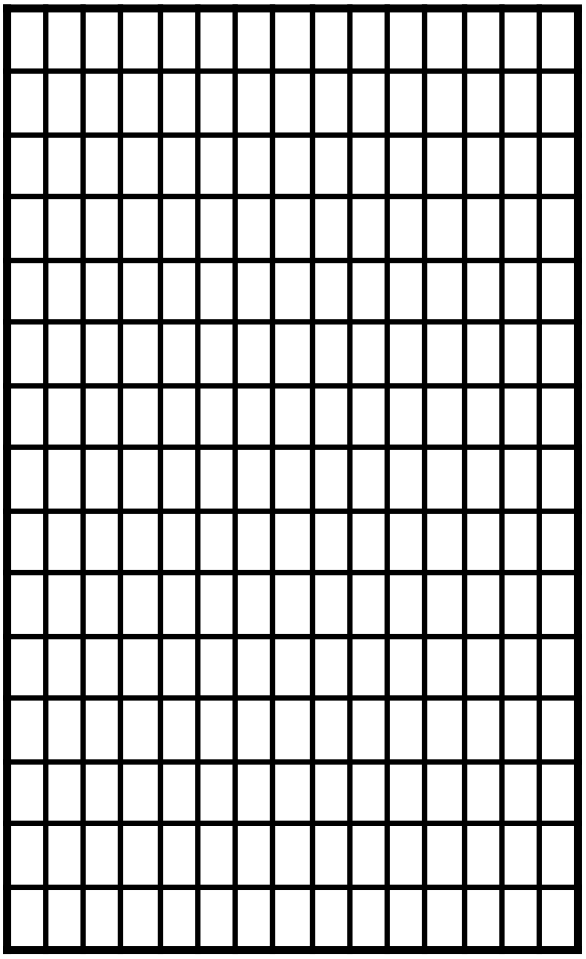
Analysis

Summarise your data below.

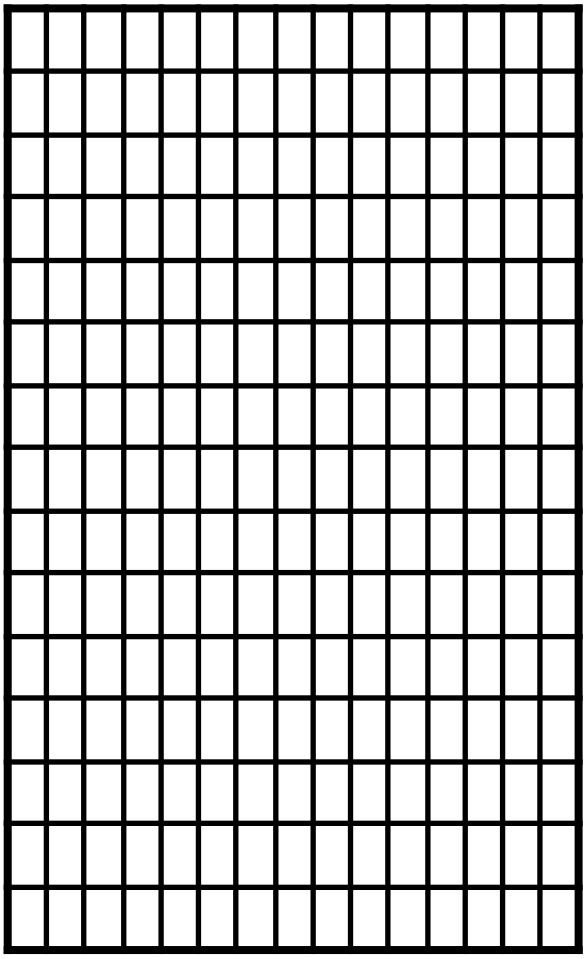
Outcomes	Tally	Frequency	Relative frequency

Draw the graphs of your data below.

Frequency graph



Relative Frequency graph



Identify the mode and probabilities and describe these below in context.

Comparing experimental and theoretical

Use the sample space table you created previously to calculate the **theoretical probabilities**.

$P(Total\ of\ ____) =$

$P(Total\ of\ ____) =$

$P(Total\ of\ ____) =$

$P(Total\ of\ ____) =$

$P(Total\ of\ ____) =$

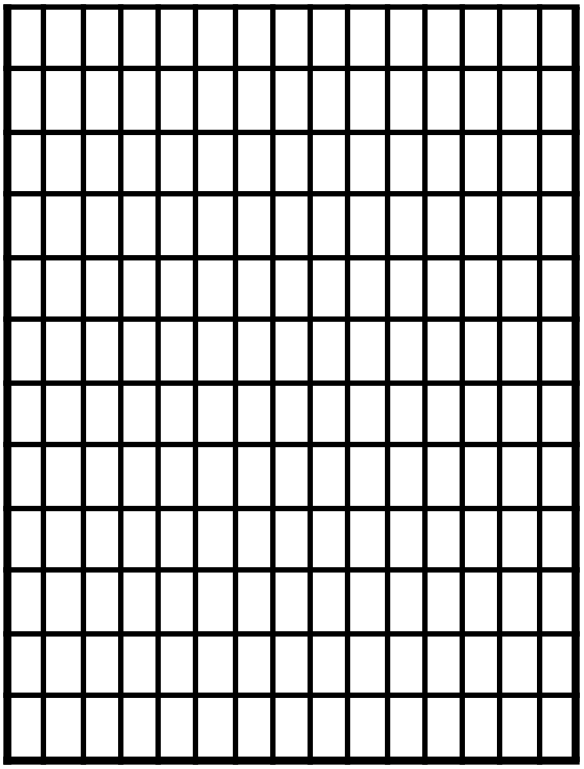
$P(Total\ of\ ____) =$

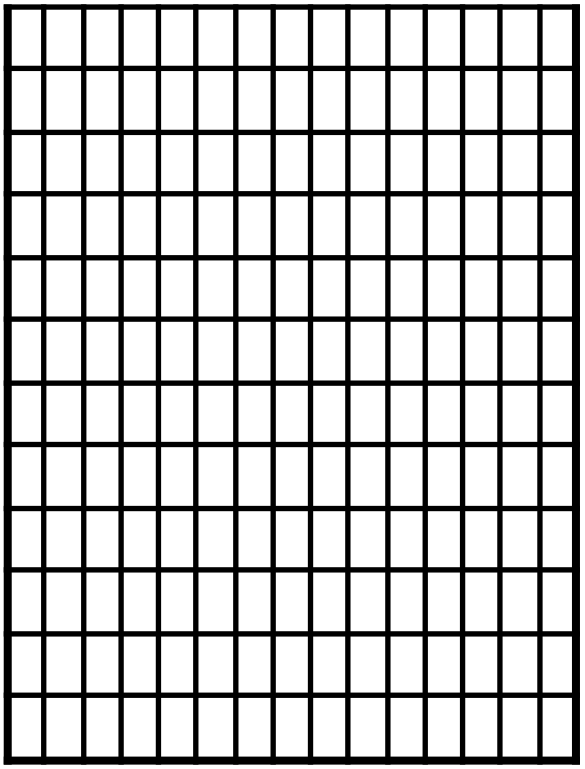
$P(Total\ of\ ____) =$

Draw your **relative frequency** graph for both the **experiment result** and the **theoretical distribution**.

Experiment Relative freq.

Theoretical Relative freq.





Conclusion

Draw a conclusion about your experimental results (answer your investigation question).

Then compare the graphs of your experimental data with the theoretical data.

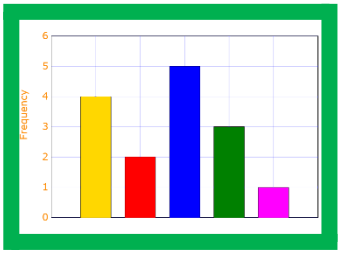
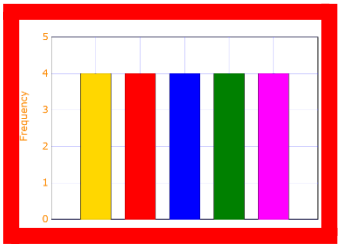
Key ideas:

In each experiment there are some key ideas I want students to identify.

Experiment 1

- How to carry out an experimental investigation using the **PPDAC cycle**.
- Knowing that sometimes we will have a situation where we **don't know what the theoretical probabilities are**, so we collect data and run experiments to estimate the probability.
- Making sure students know that the **number of trials** (or sample size) has to be **at least 50**.
- Making students think about using a **consistent method** to collect data in order to **control** the amount of **variation**.

Experiment 2

- Understanding that **random** should look like this,  and not this. 
- Use **probability tools**: spinner, random number table, calculator random number generator
- **Comparison** of different methods (leading towards comparing experimental and theoretical probabilities in later experiments).
- Students see that even when generating random numbers there is **ALWAYS variation in data**.

Experiment 3

- Learning to **write** their own **instructions** to collect data (and thinking about how to **control variation**).
- **Comparing experimental results with theoretical model**.

Experiment 4

- Students learning to **define** what **one trial** is.
- **Calculate** theoretical probabilities and **compare** to experimental results.

Experiment 5

- Two **different** spinners and **adding outcomes** together to form a total. Then plotting the **distribution of the total**.
- **Full comparison** of experimental versus theoretical models.