RELATIVE FREQUENCY
Teacher Notes

References

Foundation	D5.3 Relative Frequency, Plus 17 Relative Frequency
Foundation Plus	D1.6 Relative Frequency
Higher	D3.5 Relative Frequency
Higher Plus	D3.3 Relative Frequency and Best Estimate

Introduction

This activity will help students understand the concept of relative frequency. Using dice and coin simulators, they will see relative frequency graphs being generated and experience how they converge towards an expected probability.

Resources

There are four TI-Nspire documents for use in this activity. The main document ***RelativeFrequency.tns*** simulates the throwing of dice and tossing of coins and is designed for use on the TI-Nspire computer software. The document generates many hundreds of data points and therefore runs much more quickly on the TI-Nspire computer software than the handheld. The three smaller documents ***RFreqOneDice.tns***, ***RFreqOneCoin.tns*** and ***RFreqTwoDice.tns*** will run on TI-Nspire handhelds and are identical to individual problems on the main document.
There are no student notes for this activity.

TI-Nspire skills students will need

Transferring a document to the handheld.
Opening a document on the handheld.

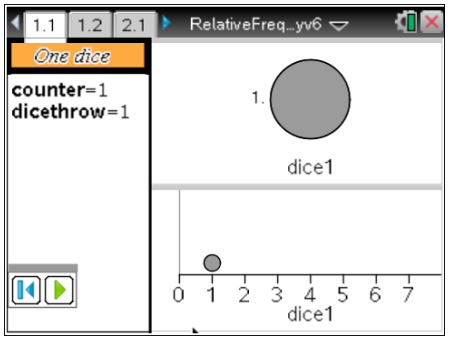
The activity

We suggest that this activity is best suited to a whole-class discussion around the projected images. Following this, students are able to produce their own version of the relative frequency graphs using their handhelds.

Below there is a section giving the instructions for running the simulators on TI-Nspire Teacher Software—you may wish to familiarise yourself with this before the lesson. This is followed by a suggested lesson outline.

How to use the simulators

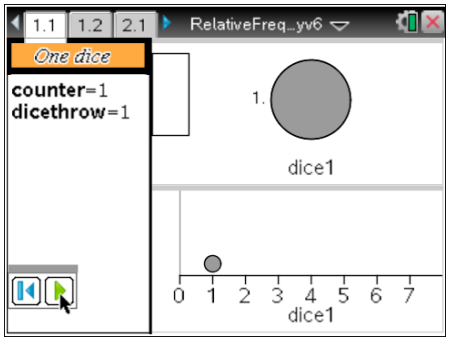
Load the file and if necessary open page 1.1. The screenshots below indicate what you will see using the Teacher Software with handheld view.



Page 1.1 simulates the throw of a standard six-sided dice and can be used to give students an understanding of relative frequency—whereas the dot plot shows *absolute* frequency the pie chart indicates the *relative* frequency of each outcome.

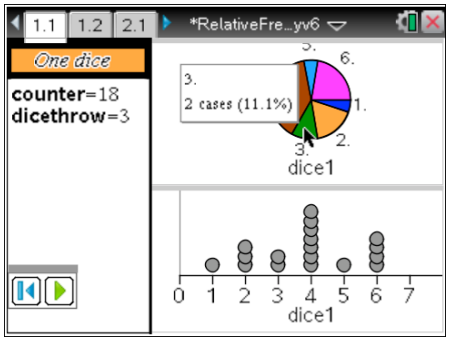
On the left hand side, the **counter** displays how many dice throws have occurred and **dicethrow** displays the number on the last dice that was thrown. In the screen shown on the left, the dice has been thrown once and that throw was a 1.

Note: If you should find that the number alongside **dicethrow** does not correspond to the throw shown in the graphs, this can be corrected by following the two steps given below to restart the simulation.



Use the mouse (or the Touchpad if using a handheld) to move the cursor over the box in the bottom left corner of the screen.

Clicking on the *Start animation* button will begin the dice throwing simulation. The counter will increase in steps of 1 and the simulated dice will be thrown.



As soon as the simulation begins *Start animation* is replaced by *Pause animation*.

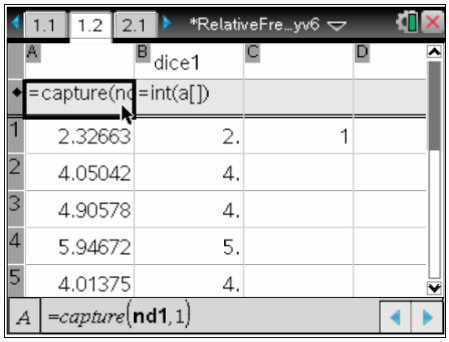
Notice that, when the animation has been paused you can click and hold on sectors of the pie chart to see information like that shown on the left. Here there were two cases of a three being thrown out of a total of 18 throws—i.e. 11.1%,

To remove the highlight from that sector, click outside the pie chart.

Notice also that as more dice are thrown the vertical scale of the dot plot automatically changes, resizing the columns of dots.

To **restart the simulation** two steps are needed.

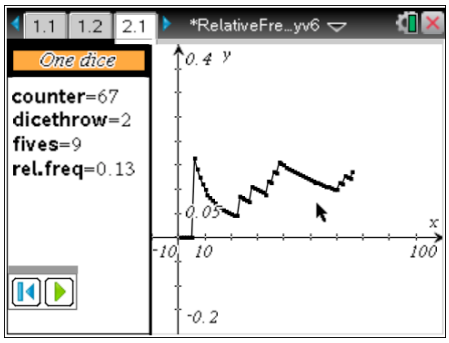
a) Click on the *Reset animation* button on the left to set the counter back to 1.



b) To clear the dot plot and the pie chart you need to move to page 1.2 — click on 1.2 at the top of the screen. (Press ctrl ▶ on the handheld.)

This spreadsheet page is where the data for the graphs have been generated. Click on the cell shown on the left: it is outlined in black. Then choose Clear Data from the data menu. (Press menu 3 4 on the handheld.)

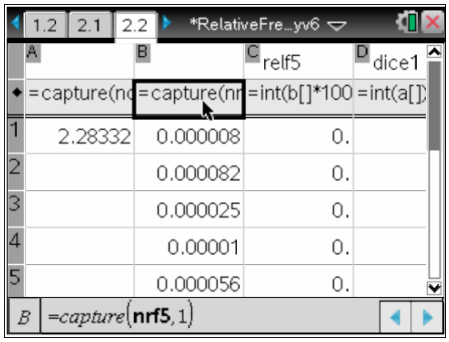
Click on page 1.1 to return to that page.
(Press ctrl ◀ on the handheld.)



On page 2.1 is a similar dice-throw simulator, which this time counts the number of fives that have been thrown and displays the current relative frequency on the left of the page.

On the right the relative frequency values are plotted against the values of the counter, showing how the relative frequency gradually settles down as the number of dice throws increases.

This simulator works in a similar way to the one on page 1.1. However, notice that in order to restart the simulation it is necessary to Clear Data from columns A and B on page 2.4.



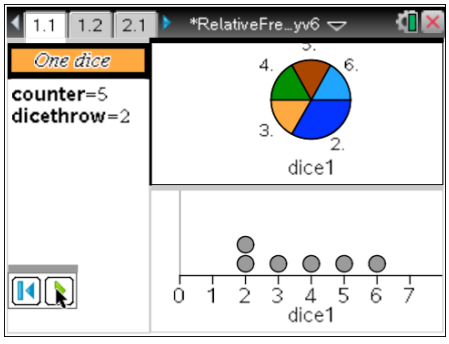
Pages 3.1 and 4.1 have simulators that toss a coin and record the number of heads.

Pages 5.1 and 6.1 have simulators that throw two dice and record the number of times a total of 5 occurs.

Suggested lesson: introducing relative frequency

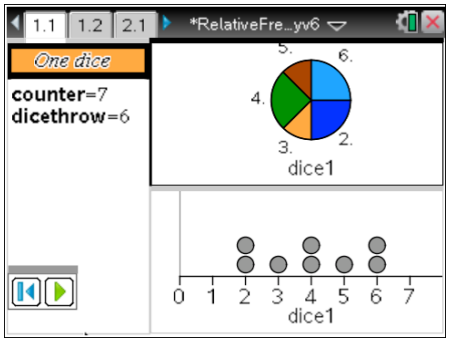
a) 100 throws of the dice

Begin by running the simulation on page 1.1 and then almost immediately stopping it again. Explain that the throws of a single dice are being simulated. Ask questions of the class to promote thinking about what the information on the screen represents.



How many times has the dice been thrown?
What were the scores?
How would the pie chart change if the next number were a 1, or another 2, or a 3?
Ask students to sketch their predictions.

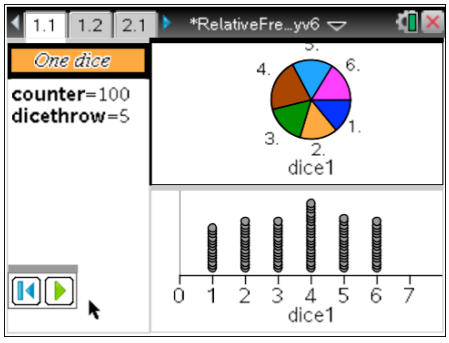
Draw out the key feature of the dot plot: it allows you to see the actual number of times (*the frequency*) that a five has been thrown. Compare this with the pie chart, which shows you the share of all the throws that were fives (*the relative frequency*).



Run the animation again and immediately stop it, so that only one or two more throws take place.

Has the pie chart changed in the way that you predicted?

Now ask students to imagine what the pie chart and dot plot might look like after 100 throws. What sort of proportions might they expect each sector of the pie chart to have?



Now run the simulation until counter=100.

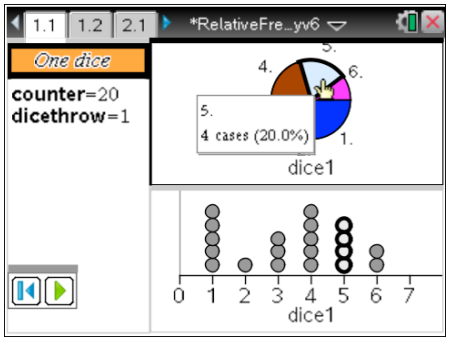
How similar is the result to what you expected?

What would happen if we run the simulation beyond 100?

b) How many fives?

Reset the counter and clear the data as explained above.

Explain that you are going to run the simulation again, but this time the class will focus on the sector in the pie chart that represents the proportion of fives that have been thrown. Regularly pause the animation and ask students to consider what proportion of the throws have been fives so far and how that proportion might change with the next throw.



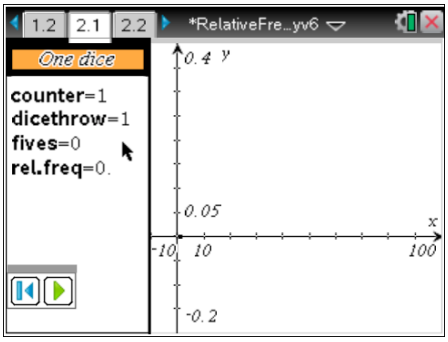
Click and hold on the relevant sector of the pie chart as described above,

For example, in this simulation, there have been 20 throws so far and 4 of them have been fives.
The proportion, or relative frequency, of fives is therefore 4/20 or 0.2 or 20%.

What would happen if the next number were a 5? Would the sector representing the proportion of fives get larger or smaller? By how much?

What if the next number were not a five?

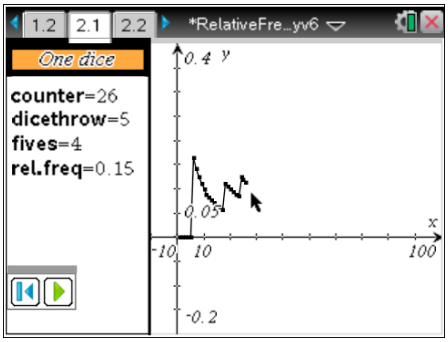
c) Exploring relative frequency graphs



Move on to page 2.1 and explain that this dice simulation will plot a 'live' relative frequency graph as the dice is thrown.

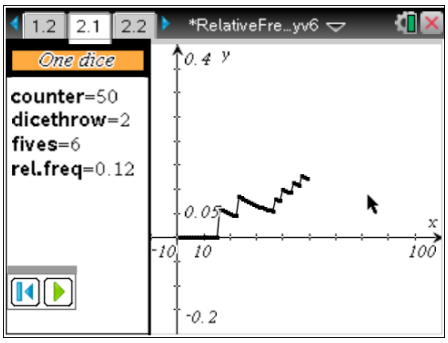
Stress that *fives* represents the number of fives that have been thrown and *rel.freq* represents the relative frequency of fives shown as a decimal number.

Run the simulation and stop it again after a few throws.



On the left it can be seen that the graph began at zero, then rose sharply to a value of 0.33. It then began coming down in smaller and smaller steps.

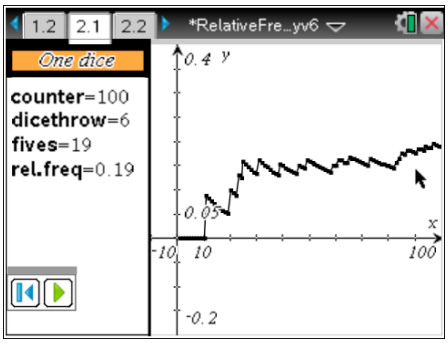
Why is rel.freq=0.15?
What made the graph suddenly jump up?
Why do the downward steps get smaller and smaller?
What are the next two possible values for the relative frequency of fives?
Which of these would result in the larger change?



In this example, the counter has been stopped at 50 throws. Six of these have been fives. Can they be seen on the graph?

Each time a five is the outcome the graph jumps upward. How does the size of these jumps change and why?

Every time that a five is not thrown the graph steps downward. How do the sizes of these steps change?



Here the counter has been stopped at 100 throws.

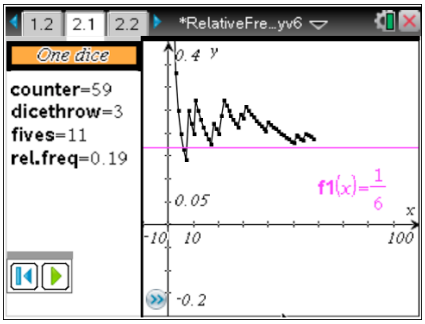
Is there a trend to the graph?

What value might we expect the graph to be converging to? Why?

Start a new simulation (remember to Clear Data in columns A and B on page 2.2) and see what happens this time. Is it similar in any ways to what happened before?

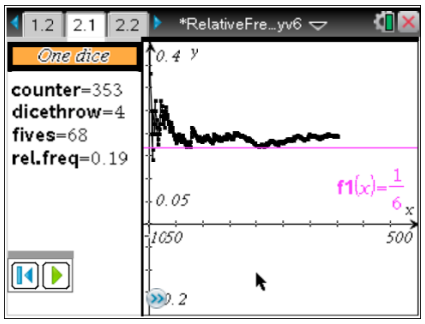
This simulation is also available in the document ***RFreqOneDice.tns*** and this will run easily on the handheld. You may wish students to each run a simulation so as to be able to compare a broad range of relative frequency graphs.

d) Possible extensions



It is possible, if you wish, to superimpose a graph of y=1/6 on the relative frequency graph. This represents the theoretical probability—the value that we might expect the graph to converge towards. An example is shown on the left. Remember that the expected does not always occur!

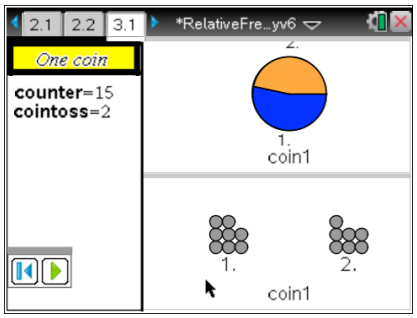
To add this line, click on the double arrow at the bottom of the screen, just left of the y-axis.
Alongside f1(x)= enter 1/6.



What might happen if the simulation were continued?

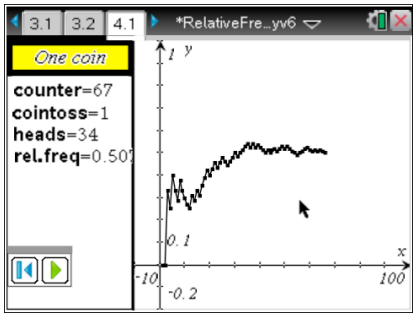
You can continue throwing the dice and in order to continue drawing the relative frequency graph, click twice on the value '100' on the x-axis and edit it to a larger number. The axes will re-scale and you can continue the experiment.

e) A coin and two dice



Two more simulators are included in the main TI-Nspire document and you may also wish to project these for whole-class discussion. Alternatively students can draw their own relative frequency graphs on handhelds.

Pages 3.1 and 4.1 provide simulations of tossing a coin—the outcomes are shown as 1 and 2, representing heads and tails respectively.



The relative frequency of getting heads is plotted on page 4.1. This simulation is also available in the document ***RFreqOneCoin.tns*** and this will run easily on the handheld.

Pages 5.1 and 6.1 (shown below) provide simulations of tossing two dice and getting a total score of 5.

The simulation from page 6.1 is also available for handheld use in the document ***RFreqTwoDice.tns***.