Activity 9: Coins, marbles and dice — Teacher's notes

KS 3 Framework ref: Page 283-5

Strand: Handling Data
Topic: Probability
Pupils should be taught to: Collect and record experimental data and estimate probabliities based on data
Year group: 8
Objectives: Estimate probabilities from experimental data. Understand that increasing the number of times and experiment is repeated generally leads to better estimates of probability. Compare experimental and theoretical probabilities in different contexts.
Key Vocabulary: Experimental, theoretical, experiment, outcome
Resources required: Class set of calculators plus Viewscreenor TI-SmartView emulator

This activity uses the software called ***Prob Sim****-- a probability simulator that is one of the standard "Apps" supplied with TI calculators.*

Summary

The aim of te activity is to estimate the theoretical probability from the experimental probability and to form a view of the extent to which the experimental is a good indicator of the theoretical. Note particularly that, however many trials, the experimental probabilities of the outcomes are very unlikely be exactly equal to the theoretical probabilities!

To make this activity meaningful for students, it is best to start the lesson (or devote the preceding lesson) to practical hands-on experiments with real dice, spinners etc. Students should be encouraged to sketch bar charts showing the outcomes of these experiments, so that they realise the power of being able to quick produce accurate charts from a large number of trials, something that the software does well.

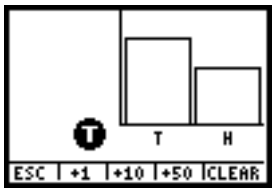
Instructions for the teacher

Using the demo calculator, set up the application and show how it works. You can follow the procedure in Activities 1 and 2 of Handout 1.

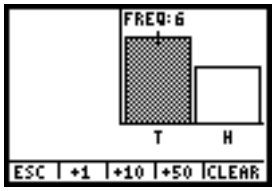
Make a table on the board as shown. Repeat single coin tosses and fill in the table.

Toss	Outcome	Fraction of heads	Fraction of tails
1	H	1/1	0/1
2	H	2/2	2/2
3	T	2/3	1/3
4	H	3/4	1/4

Continue up to 10 single coin tosses.

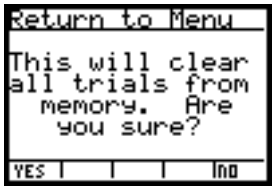


Increase the number of coin tosses by 10 by pressing [ZOOM] (below **+10**) and then by 50 by pressing [TRACE] (below **+50**).
Fill in the table with the new values. Notice that the handouts ask students to use approximate fractions.(e.g *a bit more than half.)* However you may prefer to show students to use the actual fractions.
You can use the cursor key [▶] to see the frequencies of tails and heads.



Questions:
"What do you notice about the probabilities of getting a head or a tail" – *they get closer to half as we toss the coin more*
"Are there ever exactly half heads or tails?" – *Well, the chances of that aree very low*

Now repeat this experiment with other types of trials, e.g. dice, pick marbles and spinner.
Press [Y=] (below **ESC**)
Press [Y=] (below **ESC** again)
Press [Y=] (below **YES**)
This returns you to the main menu, where you can choose a different simulation.



In each standard case, the theoretical probabilities of each outcome are equal. However, in the **Pick Marbles** simulation, it is possible to modify the composition to make the outcomes different, and this is explored in Activity 8 on Handout 3.

1) First load the probability simulation:

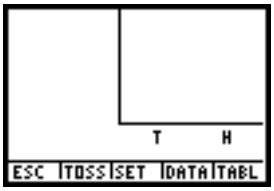
On your calculator press [APPS]
Use the cursor [▼] to place the highlight beside the application **Prob Sim** like this.
Press [ENTER]

Press any key

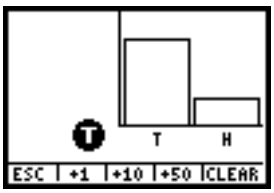
2) Try using the simulation

Press **1** to choose **Toss Coins.**

Notice the boxes at the bottom of the screen. If you want to enter TOSS you press the key below it marked [WINDOW].



Do this and see what happens.
Try pressing [WINDOW] (below **+1**) a few times.
Try pressing [ZOOM] (below **+10**)
and [TRACE] (below **+50**)



To start again press [GRAPH] (below **CLEAR**)
and press [Y=] (below **YES**)

3) Draw up a table

Make a copy of this table in your exercise book. It will need about 20 rows.

Toss number	Outcome	Fraction of heads	Fraction of tails

On the calculator press [WINDOW] (below **+1**) to toss the coin.
Fill in the fraction of heads and tails you have got so far.
Throw again and fill in your table.
Keep going until you have made 10 coin tosses and filled up 10 rows.

4) Lots more coin tosses

Press [ZOOM] (below **+10)** and watch 10 more coin tosses all in one go!
Fill in the table: remember this is now 20 coin tosses in total.
Now you can probably only write an approximate fraction.
For example write either *a bit more than __*
or *a bit less than __*
or *exactly __*

Use **+10** again. Fill in your table. Do this 5 more times.

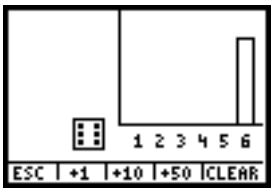
Press [TRACE] (below **+50**) and watch 50 more coin tosses.
Fill in the table. Remember to add an extra 50 coin tosses to the total.

Repeat with **+50** until your whole table is filled up.

Answer these questions in your exercise book:
What do you notice about the probabilities of getting a head or a tail?
Are there ever exactly half heads or tails?

5) A table for dice

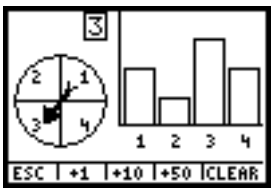
Use **ESC** to return to the main **Prob Sim** menu.
Repeat the experiment using option **2: Roll Dice**
Use a table like this:



Roll number	Outcome	Fraction of 1's	Fraction of 6's

6) Spinning

Use **ESC** to return to the main **Prob Sim** menu.
Repeat the experiment s using option **4: Spin spinner**
Use a table like this:



Spin number	Outcome	Fraction of 1's	Fraction of 4's

7) A marbles table

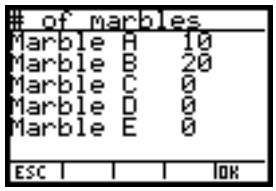
Use **ESC** to return to the main **Prob Sim** menu.
Repeat the experiment using option **3: Pick marbles**.
Use a table like this:

Pick number	Outcome	Fraction of A's	Fraction of B's

8) More marbles

Return to the main **Prob Sim** menu.
Choose option **3: Pick marbles** again.
Press ZOOM (below **SET**).

Press WINDOW (below **ADV**).
Enter 10 A's, 20 B's and no others as shown here.



Return to the simulation by pressing GRAPH (below **OK**) twice.

Now repeat the experiment with the same table as above.

(a) What is the probability of drawing an A?
(remember there are 30 marbles in the bag).
(b) What is the probability of drawing a B?
(c) What do you notice about the probabilities of getting marble A or B?

9) Even more marbles

Repeat the experiment with different numbers of marbles, for example:

10 A's, 10 B's, 30 C's, 50 D's, 100 E's.

Answer the same questions as for Activity 8.