

About the Lesson

In this activity, students will collect data on a 1 cent coin as it falls under its own volition after being placed on its edge 25 times. Students will then analyze the class' data using a scatter plot and determine the experimental probability of getting a head or a tail. As a result, students will:

• Perform operations on lists and calculate the probability that a coin will fall on a head or tail.

Vocabulary

- Probability
- Linear Regression
- Cumulative Sum
- Sequence

Teacher Preparation and Notes

- Students should know how to collect data, input that data into lists, create a scatter plot, calculate and graph a linear regression equation.
- Teachers may want to give more guidance when students are calculating the linear regression.

Activity Materials

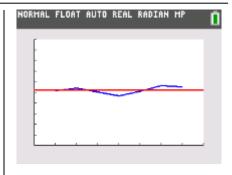
• Compatible TI Technologies:

TI-84 Plus*

TI-84 Plus Silver Edition*

⊕TI-84 Plus C Silver Edition

⊕TI-84 Plus CE



Tech Tips:

- This activity includes screen captures taken from the TI-84 Plus CE. It is also appropriate for use with the rest of the TI-84 Plus family. Slight variations to these directions may be required if using other calculator models.
- Watch for additional Tech Tips throughout the activity for the specific technology you are using.
- Access free tutorials at http://education.ti.com/calculator
 s/pd/US/Online-Learning/Tutorials
- Any required calculator files can be distributed to students via handheld-to-handheld transfer.

Lesson Files:

- The_1_Cent_Event_Student.pdf
- The_1_Cent_Event_Student.doc

^{*} with the latest operating system (2.55MP) featuring MathPrint [™] functionality.



Introduction

In this activity, students will collect data on a 1 cent coin as it falls under its own volition after being placed on its edge 25 times. They will then analyze the class' data using a scatter plot and determine the experimental probability of getting a head or a tail.

Students will need to find a level table top with a "sweet spot" where they can easily place their coin on edge. Instruct students to place the coin on its edge and wait until it falls. They should not hit the table or blow on it; just wait until it falls. They will record the result, Heads or Tails, and will then repeat the event for a total of 25 times. Students should tally their results as shown:

| HEADS | TAILS |
|-------|-------|
| | |

Collecting the Data

Find a level table top with a "sweet spot" where you can easily place your coin on its edge. Place the coin on its edge and wait until it <u>falls on its own</u>. Don't hit the table or blow on it. Just wait until it falls. Tally your result, Heads or Tails, and repeat the event for a total of 25 times.

| HEADS | TAILS |
|-------|-------|
| | |
| | |
| | |
| | |
| | |

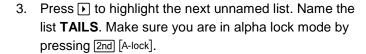
Entering the Data

- 1. Gather student data to compile a list for the "class data". Students will then enter the class data into their calculators.
- Clear all the lists on your calculator by 2nd [mem] select
 4:CIrAllLists and press enter.

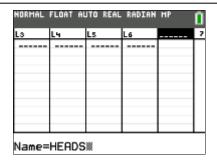


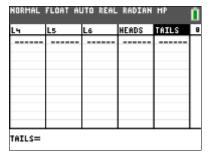


- Press stat enter. Name the list HEADS by pressing
 until you get to the very top of L1. Be sure to highlight
 the heading L1 and not just the first line in L1. Press
 then to get to an unnamed list. Name the list HEADS
 and press enter. Make sure you are in alpha lock mode
 by pressing 2nd [A-lock].
- 2. Enter the class **HEADS** data into the list.



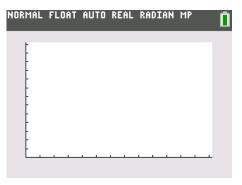






Analyzing the Data

- 1. What is the maximum number of heads of any one group?
- 2. How about the minimum number of tails?
- 3. Do you see any pattern?
- 4. What could you do if one student reported the number of heads but left the room before they told the number of tails?
- 5. If we plot the data with HEADS as the X-values and TAILS as the Y-values, what do you think the graph will look like? Sketch it here:





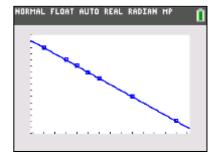
6. Now set up the plot. Press 2nd [stat plot] enter to set up Plot1. Press 2nd [list] and select HEADS for the Xlist and TAILS for the Ylist.



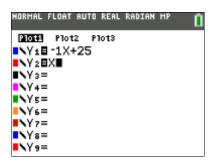
- 7. Press y= to make sure there are no equations in the Y= Editor. Press clear to erase any equations.
- 8. Set up your window by recalling the maximum and minimum values for **HEADS** and **TAILS**.



9. Press graph to see the plot of your data.



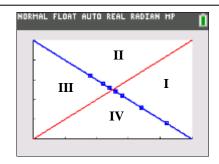
- 10. What pattern do you see? What does the graph mean?
- 11. Press y= to return to the Y= Editor and enter in the equation that models the pattern. If you need to you could do a regression. Look at the plot with the equation. Did you get it?
- 12. Let's compare this with the y=x equation. That is the number of **TAILS** = the number of **HEADS**. Press **y**= and go to **Y2** and enter **X**.





13. Return to the graph (press s) and explain what it means to be in the areas I, II, III, and IV.

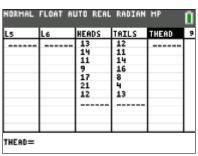
What does it mean to be on the lines?



You can just move around on the screen with your arrows

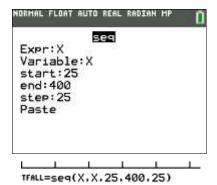
• • or press trace to follow on the lines. Press • to switch what you trace on.

- 14. Now we want to look at the probability that the coin will fall showing heads. Return to the **List Editor** by pressing stat 1. Move over to the third column and using the technique you used before name a list for the total number of heads **THEAD**.
- 15. While still in the header of the list get the cumulative sum operation. Press 2nd [list] 6:cumSum. Then tell the TI-84 which list you want to sum. Press 2nd [list] and find the HEADS list. Press enter to finish and find the sum.
- 16. Now we need the total numbers of falls. Make a fourth list named TFALL. Another way we can fill a list is with the sequence operation. This will work because we know the falls were 25, 50, 75, ... since everyone did this 25 times. To get the values, while you are still in the header of the TFALL list as shown, press 2nd [list] ▶ 5:seq(.The syntax for sequence is seq(variable, rule, start, end, step). So your need to know how many total falls you had in order to fill in the form. In the sample shown you have 400. seq(X,X,25,400,25).





| MORMAL FLOAT AUTO REAL RADIAN MP | | | | | | |
|----------------------------------|-------|-------|-------|-------|----|--|
| LG | HEADS | TAILS | THEAD | TFALL | 19 | |
| | 13 | 12 | 13 | | П | |
| | 14 | 11 | 27 | | 1 | |
| | 11 | 14 | 38 | | l | |
| | 9 | 16 | 47 | | l | |
| | 17 | 8 | 64 | | l | |
| | 21 | 4 | 85 | | l | |
| | 12 | 13 | 97 | | ı | |
| | | | | | _ | |





17. To get the probability we need to divide the total heads by the total falls. In the sample we have 13/25 = 0.52 or 52%. Create a new list named **PROB** to hold these values. While still in the header tell the computer to do this calculation; **LTHEAD/LTFALL**. Press [2nd] [list] to get the names of the lists.

| NORMAL FLOAT AUTO REAL RADIAN MP | | | | | |
|----------------------------------|------------------------------------|--|---|--|--|
| TAILS | THEAD | TFALL | PROB 🖴 | 11 | |
| 12 | 13 | 25 | 0.52 | Г | |
| 11 | 27 | 58 | 8.54 | ı | |
| 14 | 38 | 75 | 0.5067 | ı | |
| 16 | 47 | 188 | 8.47 | ı | |
| 8 | 64 | 125 | 0.512 | ı | |
| 4 | 85 | 150 | 8.5667 | ı | |
| 13 | 97 | 175 | 0.5543 | | |
| | TAILS 12 11 14 16 8 | TAILS THEAD 12 13 11 27 14 38 16 47 8 64 4 85 | TAILS THEAD TFALL 12 13 25 11 27 50 14 38 75 16 47 100 8 64 125 4 85 150 | TAILS THEAD TFALL PROB 6 12 13 25 0.52 11 27 50 0.54 14 38 75 0.5067 16 47 100 0.47 8 64 125 0.512 4 85 150 0.5667 | |

PROB= "LTHEAD/LTFALL"

18. Notice the numbers are all between 0 and 1. When you flip a coin you expect 50% of the time you will get heads.

How many of your data points are more than 50%? What does that mean?

19. Set up a plot of **PROB** vs. **TFALL** and see how the probability is revealing itself with repeated trials. Don't for get to turn off your **Y**= equations and to reset the window. Press [2nd] [stat plot] [1] to set up Plot1 as shown.



- 20. We will set up the window manually. Press window and enter the data as shown, with the exception of Xmax. This number will be determined by the total number of falls that your class had.
- WINDOW

 Xmin=0

 Xmax=400

 Xscl=25

 Ymin=0

 Ymax=1

 Yscl=0.1

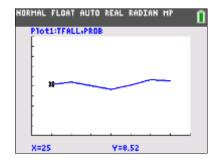
 Xres=

 aX=1.5151515151515

 TraceStep=3.03030303030303

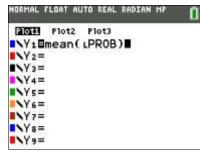
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21. Now look at the plot by pressing trace.
What do you think the probability is tending toward?



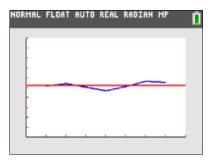


22. Look at the average of the probabilities to help. Press y= and move to a free line. Key in the key word for average by pressing 2nd [list] 4 3. Now select the list you want the mean of by pressing 2nd [list] and find the PROB list. Change the color of the line by pressing 4 to highlight the line properties and press enter. Use the arrows to select the color you like then arrow down to OK and press enter.





23. Press graph and see the Truth.



24. Finally, examine your coin with a magnifying device. Do you notice anything that might cause your coin to fall over one way more often than the other? Ask your teacher (or use the web) to understand the concept of *center of mass*. Explain your findings.