The 1 Cent Event

Student Activity

Name _____

Class _____

Introduction

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

You will tally your results as shown here.

HEADS	TAILS
|||	||||

Objectives

In this activity, you will:

- Enter the data into your handheld.
- Examine the data from the collective class and discuss patterns revealed in the data.
- Set up a Scatter Plot of the data.
- Identify the mathematical relationship in the plot.
- Explore what we have discovered in relation to the y=x function.

You'll Need

- TI-84 Plus CE
- One penny

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 falls on its own. 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.

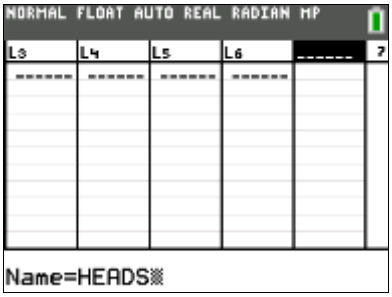
HEADS	TAILS

Entering the Data

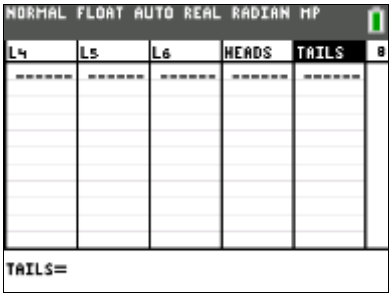
1. Share your results with your teacher, so he or she can compile a list for the "class data".

2. Clear all the lists on your calculator by [2nd] [mem] select **4:ClrAllLists** and press [enter].

3. 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].
4. Enter the class **HEADS** data into the list.



5. Press ▶ to highlight the next unnamed list. Name the list **TAILS**. Make sure you are in alpha lock mode by pressing 2nd [A-lock].
6. Enter the class **TAILS** data into the list.



Analyzing the Data

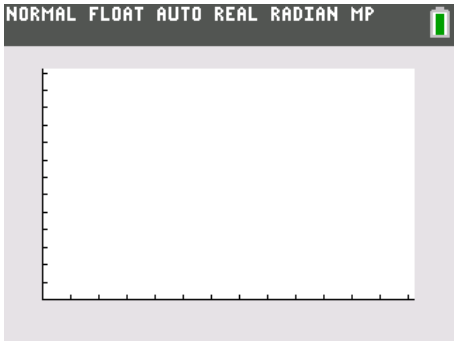
1. What is the maximum number of heads of any one group?

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?

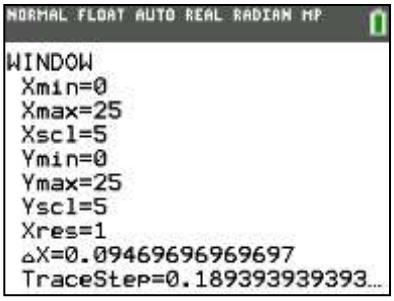
5. If we plot the data with **HEADS** as the **X**-values and **TAILS** as the **Y**-values, what do you think the graph will look like? Sketch it here:



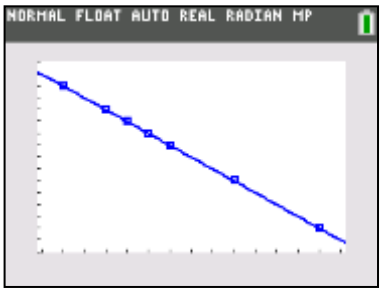
6. Now set up the plot. Press [2nd] [stat plot] [enter] to set up **Plot1**. Press [2nd] [list] and select **HEADS** for the **Xlist** and **TAILS** for the **Ylist**.

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**.



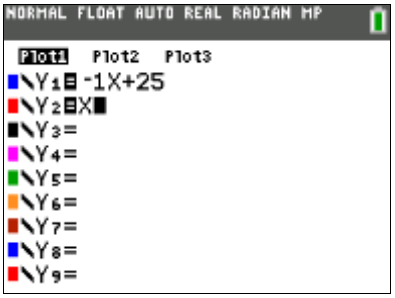
9. Press [graph] to see the plot of your data.



10. What pattern do you see? What does the graph mean?

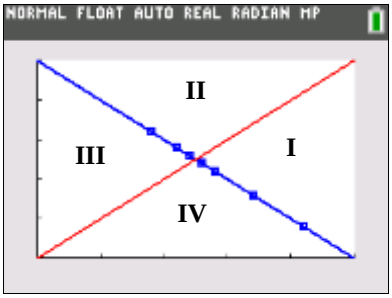
11. Press [y=] to return to the **Y= Editor** and enter in the equation that models the pattern. If you need to you could do a regression. Look at the plot with the equation. Did you get it?

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**.



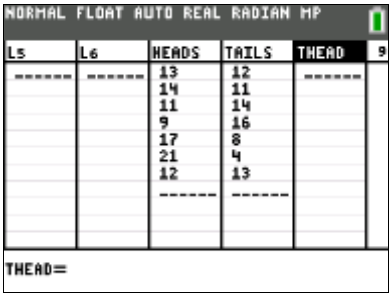
13. Return to the graph (press [graph]) and explain what it means to be in the areas I, II, III, and IV.

    What does it mean to be on the lines?

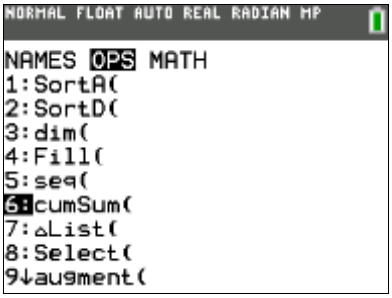


    You can just move around on the screen with your arrows [◄] [►] [▲] [▼] or press [trace] to follow on the lines. Press [▼] [▲] to switch what you trace on.

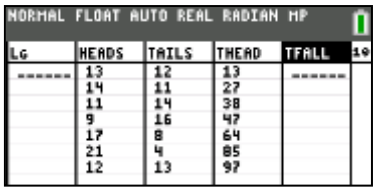
14. Now we want to look at the probability that the coin will fall showing heads. Return to the **List Editor** by pressing [stat] [1]. Move over to the third column and using the technique you used before name a list for the total number of heads – **THEAD**.

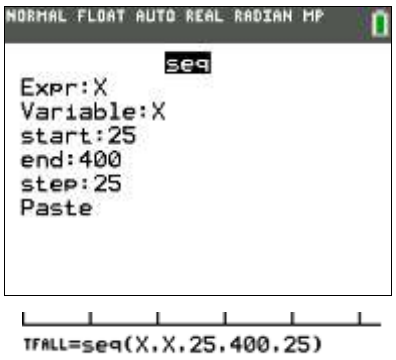


15. While still in the header of the list get the cumulative sum operation. Press [2nd] [list] [►] **6:cumSum**. Then tell the TI-84 which list you want to sum. Press [2nd] [list] and find the **HEADS** list. Press [enter] to finish and find the sum.



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).**





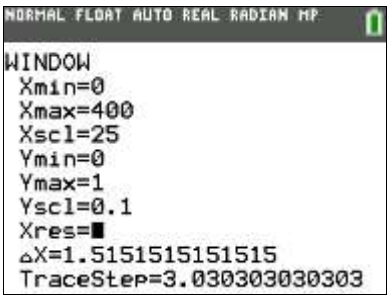
17. To get the probability we need to divide the total heads by the total falls. In the sample we have 13/25 = 0.52 or 52%. Create a new list named **PROB** to hold these values. While still in the header tell the computer to do this calculation; **LTHEAD/LTFALL**. Press 2nd [list] to get the names of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

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?

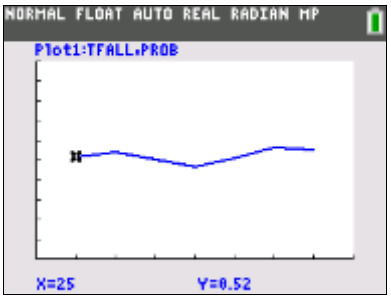
19. Set up a plot of **PROB** vs. **TFALL** and see how the probability is revealing itself with repeated trials. Don't for get to turn off your **Y=** equations and to reset the window. Press 2nd [stat plot] 1 to set up Plot1 as shown.

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.

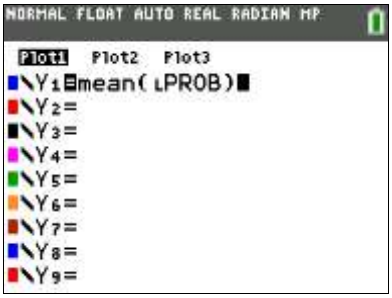


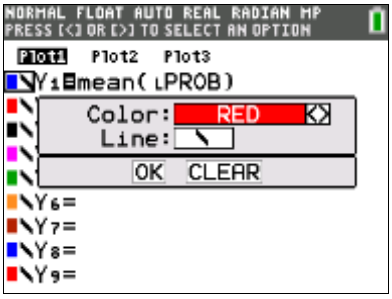
21. Now look at the plot by pressing trace.

    What do you think the probability is tending toward?

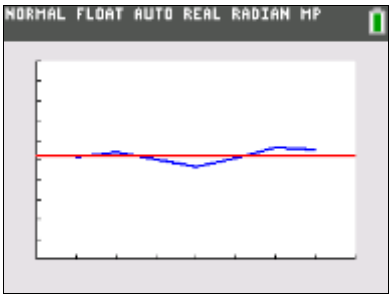


22. Look at the average of the probabilities to help. Press y= and move to a free line. Key in the key word for average by pressing 2nd [list] ◀ 3. Now select the list you want the mean of by pressing 2nd [list] and find the **PROB** list. Change the color of the line by pressing ◀ to highlight the line 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.