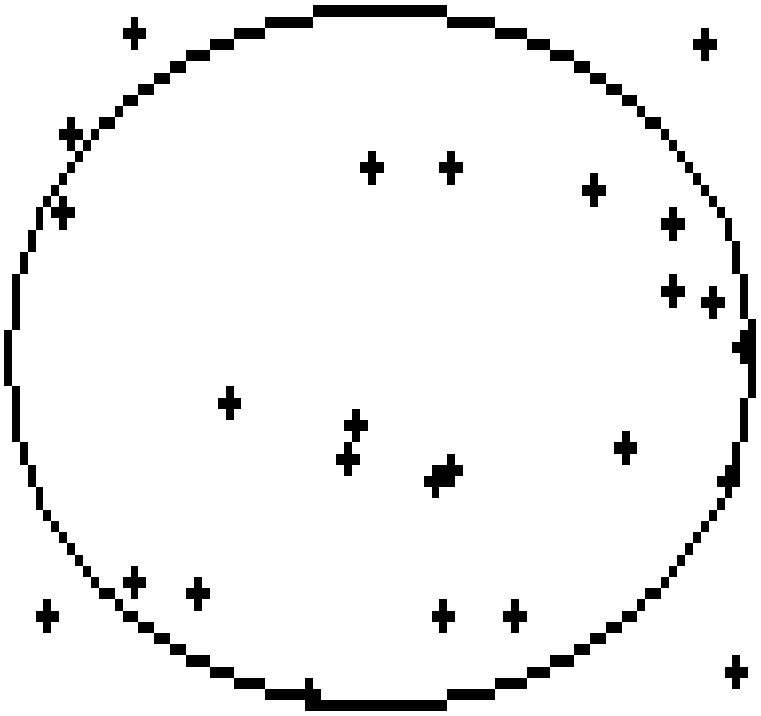
# Mathematics Activity for Precalculus
## Topic Area – Probability

## *"Using Random Numbers to Calculate $P$ "*




Activity developed by

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# *Using Random Numbers to Calculate Pi*

This activity is designed to use the TI-83 calculators random number generator, statistical plots and graphing capabilities to devise a method to find a value for ? using the idea of probability. They will explore the method by estimating area under a curve first, then extend the technique to estimating ? . By plotting random points on the calculator screen and setting up a proportion of points inside the circle to total points and area of circle to area of calculator screen the students will calculate an estimate of ? . The more random points used the more accurate the estimate will become. Finally, by using the programming capabilities of the calculator the student can generate a large number of points and get fairly accurate values for ? .

## *Objectives:*

1. Learn to use various functions on the TI-83
2. Calculate the area under a curve using random generated points.
3. Graph non-function relations (i.e. circles)
4. Use a ratio technique to calculate ?
5. Write a basic program on the TI-83

## *Prerequisites:*

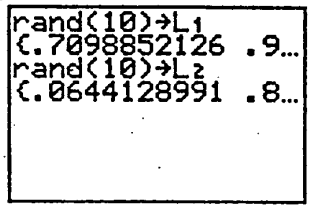
The student should be somewhat familiar with the TI-83 calculator but the calculator manual does explain all of the functions to be used quite simply. Equations of circles in the form $(x-h)^2 + (y-k)^2 = r^2$ must be graphed in $Y_1$ and $Y_2$ because they are not functions.
Basic programming skills for the final project are required but are of a very simple nature. The program is described at the end of the activity for those having difficulty. It is written for only 10 points but can easily be change to any number of random points by changing the C count.

***Procedure:***

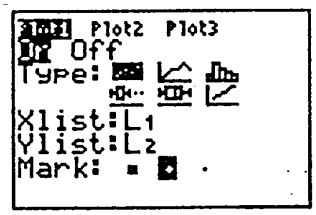
This activity will use random numbers and probability to calculate area under a curve then extends to calculating pi with this same technique.

1. Enter $y = x^2$ into your calculator and set the window for x and y between 0 and 1 and turn your axes off. (as pictured below)

2. Using the random number generator produce 10 values to store into L1 and 10 different ones into L2.



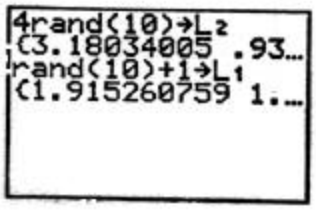

3. Turn on the stat plot as shown with the + mark on and plot.

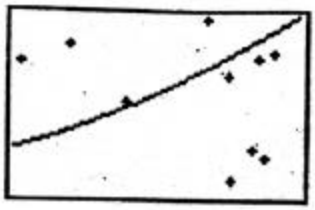



The picture shows 3 random points under the curve and 7 random points above the curve. The area of the screen is 1x1 =1 unit. Thus 30% of the area of the screen is below the curve suggesting the area under the curve is 0.3. Each student can share his numbers with the class and we can have a much larger set of random numbers to make our calculation.

4. Now try to approximate the area under the curve x=1 to x=2. You must adjust your random numbers to fall within the specified area i.e. the x values must be between 1 and 2 and the

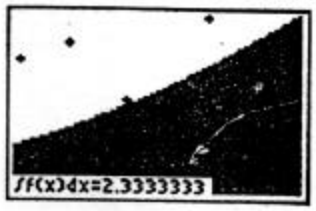
y values must be between 1 and 4. The random number generator will display numbers between 0 and 1. Below shows the calculator screens you could use:

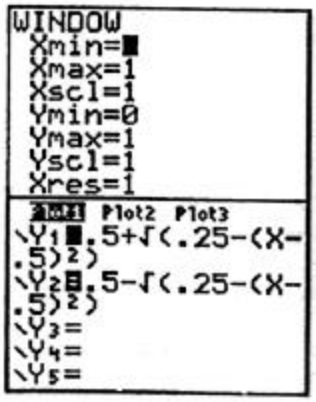



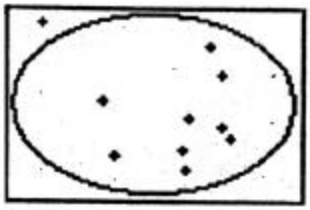
P

This screen has an area of 1x4=4 and there 6 points under the curve so my area is .6 x 4 =2.4
I can then check the actual on the calculator




5. Now devise a method to calculate the value of pi using a circle and a square with this technique.(Hint: place a circle of 0.5 inch radius inside a 1 inch square in the first quadrant and ratio the areas of square to circle and compare that ratio to the ratio of points inside to total points)

The above screens show how the calculator is set for finding the value of pi. The circle is not to scale since the screen is rectangular on the calculator.

For the data above $\Pi r^2/1 = 9/10$ thus $.25\Pi = .9$ or $\Pi = 3.6$
With more data points the accuracy will drastically increase.

6. Write a program on the TI-83 that will find pi using this technique.

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```
ClrHome
0→A:0→B:0→C
0→D
Lbl 1
C+1→C
rand→X
rand→Y
If (X-.5)²+(Y-.5)²>.25
A+1→A
If (X-.5)²+(Y-.5)²<.25
B+1→B
(B/C)→D
If C=10:Goto 2
Goto 1
Lbl 2
Disp D
Disp 4*D
```