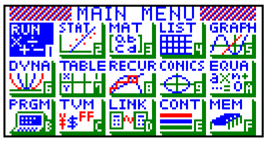
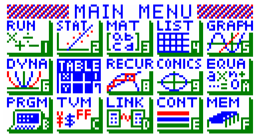
Estimating π.

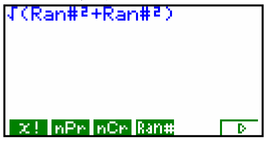
Select RUN icon (press 1) and TABLE (press 7) from the main menu or by using the arrow keys to highlight and then press EXE.



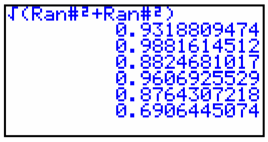


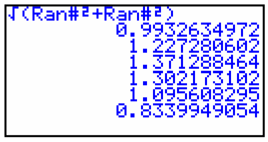
Introduction: π = 3.14159 26535 89793 23846 26433 83279 50288 41971 69399 37510 58209 74944 59230 78164 06286 20899 86280 34825 34211 70679 82148 08651…
Generally associated with the circle and the length of the circumference, or its area in relation to the circles radius (or diameter). There are tales and stories that exhibit π is within the great pyramids!
Using random numbers to estimate the value of **π**.

In **RUN** mode enter in $\sqrt{(\text{Ran\#}^2+\text{Ran\#}^2)}$ then **[EXE]**, **[EXE]**, …You will receive output numbers such that: $0 \le x < \sqrt{2}$.



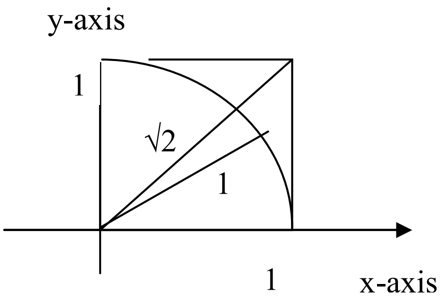
Some results:

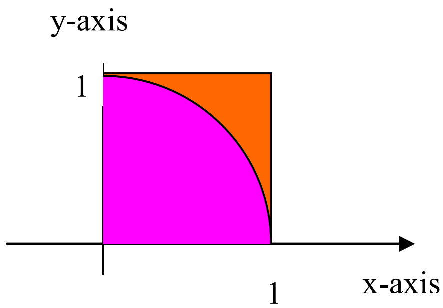




Ran# Menu trail: **[OPTN] [F6] [F3] [F4]**

A diagram here will assist:





Thus all results such that $\mathbf{0} \le \sqrt{(\text{Ran\#}^2+\text{Ran\#}^2)} \le 1$ lie inside or on the circle, and all other points $1 < \sqrt{(\text{Ran\#}^2+\text{Ran\#}^2)} < \sqrt{2}$ are outside the circle, but inside the remaining part of the square. The co-ordinate points are given by (Ran#,Ran#).
The area of the square is 1 mu^2, and by definition the area of the ¼ circle is ¼**π** mu^2
Hence the ratio of the areas, ¼ circle to the square is **¼π : 1**
So, generating random numbers and applying Pythagoras' theorem, will assist us in estimating **π**.
Keeping a tally chart of the results for example:

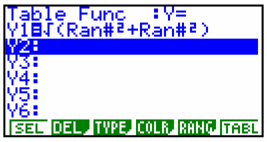
L = $\sqrt{(\text{Ran\#}^2+\text{Ran\#}^2)}$	**L ≤ 1**	**1 < L <** √2
…	**…**	**…**
Total:	**A**	**B**

OR

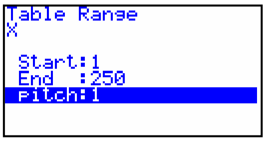
L = $\sqrt{(\text{Ran\#}^2+\text{Ran\#}^2)}$	
L ≤ 1	**1 < L <** √2
Total = A	**Total = B**

An estimate for **π** will be $^{\mathbf{A}}/_{\mathbf{(A+B)}}\mathbf{\times 4}$

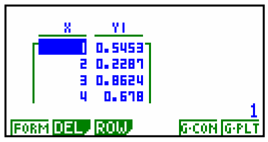
In **TABLE** mode enter in the Y1 space: √(Ran#^{2}+Ran#^{2})



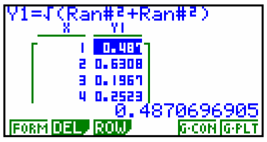
Set the range to generate 250 points.

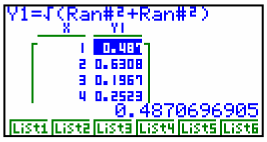


Some examples.

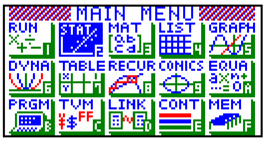


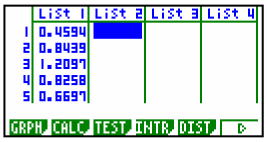
Again you can scroll down the list recording the results in the tally chart illustrated above.
OR
Transfer these randomly generated values into a list in **STAT** mode.
Move the cursor onto the Y1 column and then **[OPTN] [F1] [F2] [F1]** to place this data set into List 1.



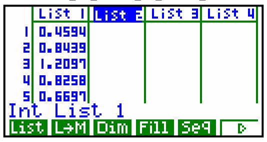


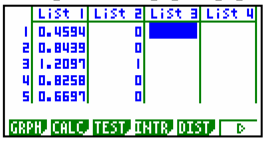
Enter into **STAT** mode to view the list.





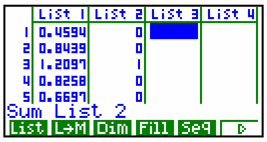
Move the cursor so that it is on top of 'List2' (as illustrated in the screensnap below) and type in the commands: **[OPTN] [F4] [F2]** for **'Int'** and **[OPTN] [F1] [F1]** for **'List'**, then **[1]** and **[EXE].**

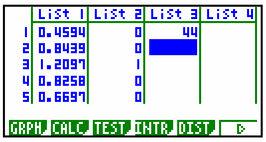




Int List 1 will return either a **'0' or '1',** as **Int** takes the integer value, truncating the decimal component of the number, e.g. Int0.23445874 = 0 and Int1.4369541 = 1.

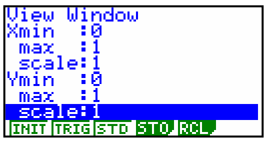
Now, to sum up List 2, the number of results where **L** = √(Ran#^{2}+Ran#^{2}) > 1.

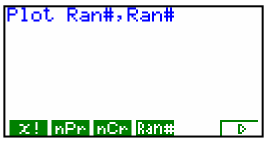


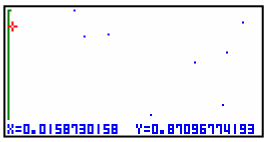


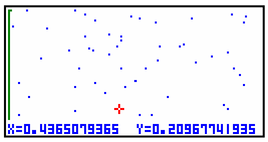
Sum List 2 has a menu trail: **[OPTN] [F1] [F6] [F6] [F1] [F6] [F1] [1]** and **[EXE].**
The result shown here as 44 will assist in our estimation of π using random numbers.
Estimation of **π = (250-44)/250×4 = 3.296**

Seeing the points (Ran#,Ran#) being plotted. Set the V-Window **[SHIFT] [F3]** to the following:

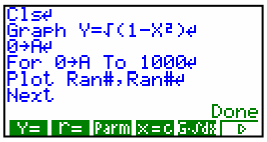


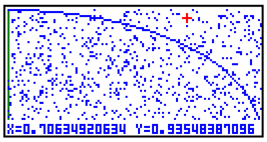




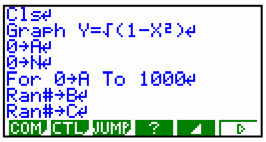


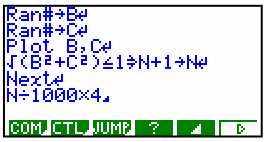
A small programme:

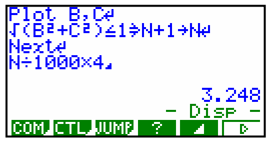




A more complicated programme:







Now, count the dots outside of the ¼ circle, **N**.
Estimation of **π = (1000-N)/1000×4**

Estimation of **π = 3.248**

How accurate? As the sample size increases so does the accuracy, and that's another statistical story...