

# Understanding the Central Limit Theorem.

*This resource was written by Derek Smith with the support of CASIO New Zealand. It may be freely distributed but remains the intellectual property of the author and CASIO.*

Select PRGM mode from the main menu by using the arrow keys to highlight the PRGM icon or pressing B.



This worksheet looks at how the calculator can be programmed to use the random number generator to assist in understanding the nature of long run probability and its application to the Central Limit Theorem.

The programme to make it all work!

In **PRGM** enter in the name of the file and the type in the commands – you may need to consult the ‘quick access’ hints at the end of the program.

Filename: **RELRFREQ** (give a name to the program)

"RELATIVE FREQUENCY" **EXE**

ViewWindow -1,126,0,-0.01,1.01,0.1 **EXE**

" " **EXE**

Lbl 0 **EXE**

"ENTER PROBABILITY" **EXE**

?→A **EXE**

If A<0 **EXE**

Then "NONSENSE" **EXE**

Goto 0 **EXE**

Else If A>1 **EXE**

Then "NONSENSE" **EXE**

Goto 0 **EXE**

Else Graph Y=A **EXE**

0→K **EXE**

0→N **EXE**

Lbl 1 **EXE**

Isz N **EXE**

N>126⇒Goto 2 **EXE**

Ran#→R **EXE**

R<A⇒K+1→K **EXE**

Plot N,K÷N **EXE**

Goto 1 **EXE**

Lbl 2 **EXE**

0→Z **EXE**

Lbl 3 **EXE**

Isz Z **EXE**

Z<50⇒Goto 3 **EXE**

"RELATIVE FREQUENCY" **EXE**

K÷N **EXE**



**'quick access' hints**

**EXE** produces a broken arrow

“ **ALPHA**

? **SHIFT** **VARS** **F4**

Ran# **OPTN** **F6** **F3** **F4**

◀ **SHIFT** **VARS** **F5**

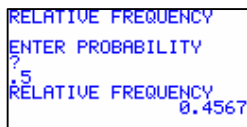
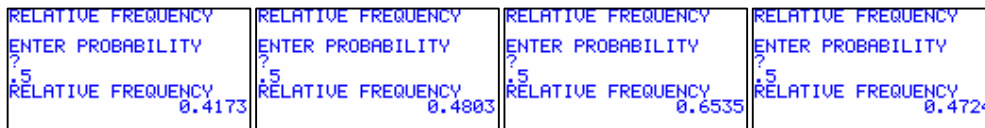
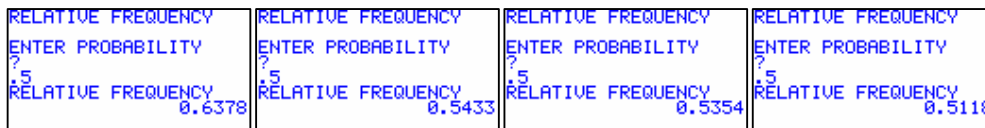
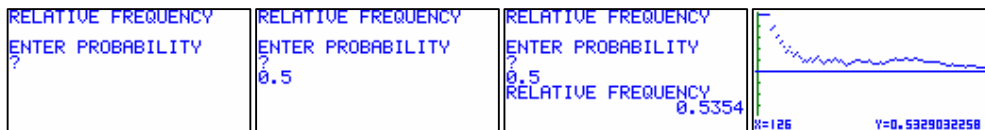
ViewWindow **SHIFT** **F3** **F1**

Graph Y= **SHIFT** **F4** **F5** **F1**

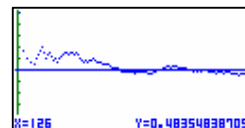
**Example:** For the probability of a success being 0.5, complete a simulation on the calculator and record the probability for the simulation. Repeat this activity 10 times recording the results and combine with the rest of the classes results and observe the combined results in a histogram.

Activate the program, in **PRGM** mode, highlight the program **Z-SCORE** and either press **EXE** or **F1** to activate the program.

Enter in the probability 0.5 then press **EXE**.



Another example of the long run probability simulation.



Results recorded:

	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	Trial 7	Trial 8	Trial 9	Trial 10
Results	0.5354	0.6378	0.5433	0.5354	0.5118	0.4173	0.4803	0.6535	0.4724	0.4567

[N.B. The central limit theorem – The averages of the samples will statistically be represented by a Normal Distribution curve with  $\mu = p = 0.5$  (in this instance) and the standard deviation =  $\sqrt{(p(1-p) \div n)}$ ]

Other examples, e.g.  $p = 0.3$ , or any other value between  $0 < p < 1$ , the CLT will produce similar results,  $\mu = p$  and standard deviation =  $\sqrt{(p(1-p) \div n)}$