

Strengths and Weaknesses of Graphing Calculators, Excel, Geogebra, and Winplot

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Shameless Advertising

- UH High School Mathematics Contest – February 11, 2012 <http://mathcontest.uh.edu>
- Online Masters Degree in Mathematics – <http://www.math.uh.edu> (click on Graduate, Master's Degree Programs, MAM)
- AP Calculus Materials from UH – <http://online.math.uh.edu/apcalculus>
- A Variety of Online Help Materials from UH – <http://online.math.uh.edu>
- More junk <http://www.math.uh.edu/~jmorgan/Rice>

Grader Preview

(to be released in October)

- Posting an online assignment.
- Creating a Google Form
- Formatting the Google Spreadsheet
- Linking the Form to Your Students
- Grading Numeric and Formula Based Answers
- Recording Grades to the Gradebook

Overview Of Calculus at UH

(in case you want to know)

- Class/Lab Structure
- Prerequisite Exams
- Daily Grades
- Weekly Written Homework
- Multiple Electronic Assignments Per Week (EMCF and Online Quizzes)
- Common Exams
- Student Performance
- <http://www.math.uh.edu/~jmorgan/Math1431>

Today's Focus

- Graphing Calculators
- Excel
- Geogebra
- Winplot

TI – 84 Capabilities

- Graphs – Function, parametric, polar
- Tables
- Simple Statistics
- Simple Programming

TI – 84 Strengths

- Simple Interface
- Useful through Calculus
- Programmable
- Easy Memory Management

TI – 84 Weaknesses

- Poor Screen Resolution
- Screen is not Interactive
- Very Slow Processor (see next slide)

Two TI – 84 Examples

- Summing a Series
- Understanding the Behavior of Random Processes by Studying Coin Flips

Approximating an Infinite Series

Approximating $\sum_{n=1}^{\infty} \frac{1}{n^2}$ with $\sum_{n=1}^N \frac{1}{n^2}$ for large N .

Understanding Randomness with Coin Flips

Suppose you perform the following experiment:

Flip a fair coin 100 times.

What do you expect to see?

Activity: Send one student out of the room. Then divide the remaining students into groups A and B. Record the names of the students in each group, and give the students the following task.

Group A: Each student will flip a fair coin 100 times, recording the results in the order they occur by writing an H for “heads” and a T for “tails.”

Group B: Each student will simulate the task of flipping a coin 100 times by writing H for “heads” and T for “tails” on a sheet of paper in the manner they think the flips will occur.

Now invite the student back into the room. Have them view the student H/T lists and guess their group.

Exploring with TI Basic

We can use the TI calculator to simulate 100 experiments of flipping a coin 100 times, where we keep track of the maximum streak length in each experiment.

The program on the right uses J to keep track of the experiment. In each experiment, a list of length 100 containing random 0's and 1's is stored in L1. Then L2 is created to keep track of the streak lengths. Finally, the maximum value of the streaks for the experiment is recorded in L3(J). We display J at each step to keep track of the progress.

```
For(J,1,100)
randInt(0,1,100) → L1
1 → L2(1)
For(K,2,100)
If L1(K) = L1(K-1)
Then
L2(K-1)+1 → L2(K)
Else
1 → L2(K)
End
End
max(L2) → L3(J)
Disp J
End
```

TI – nspire CAS Strengths

- TI – 89 + Geometer's Sketchpad
- Tables and Spreadsheets
- Reasonable Screen Resolution
- Structured Programming
- Fast Processor

TI – Inspire CAS Weaknesses

- It's a Computer Wannabe
- Screen Causes Eye Fatigue (no back lighting)
- It's more than most students need, and not as much as the advanced students can have with computer based products.

TI – *nspire* Examples

- Basic Calculator Functions – Algebra, Calculus, Templates, Summing Series (revisited)
- Graphing Capability – Functions, Parametric Plots
- Geometry – Constructions, Basic Maximization Problem

Excel Strengths

- Data, Data, Data, Data
- Industry Standard
- Flexibility
- Programmable Using VBA
- Rapid Calculation

Excel Weaknesses

- Nontrivial Interface (aside from entering numbers)
- Advanced Use Requires Study

Excel Examples

- Function Plotting
- Using Parameters and Spinners
- Advanced Plotting – Serpinski Triangle
- Rapid Simulation – Coin Tosses

What Does Random Look Like

(Part II)

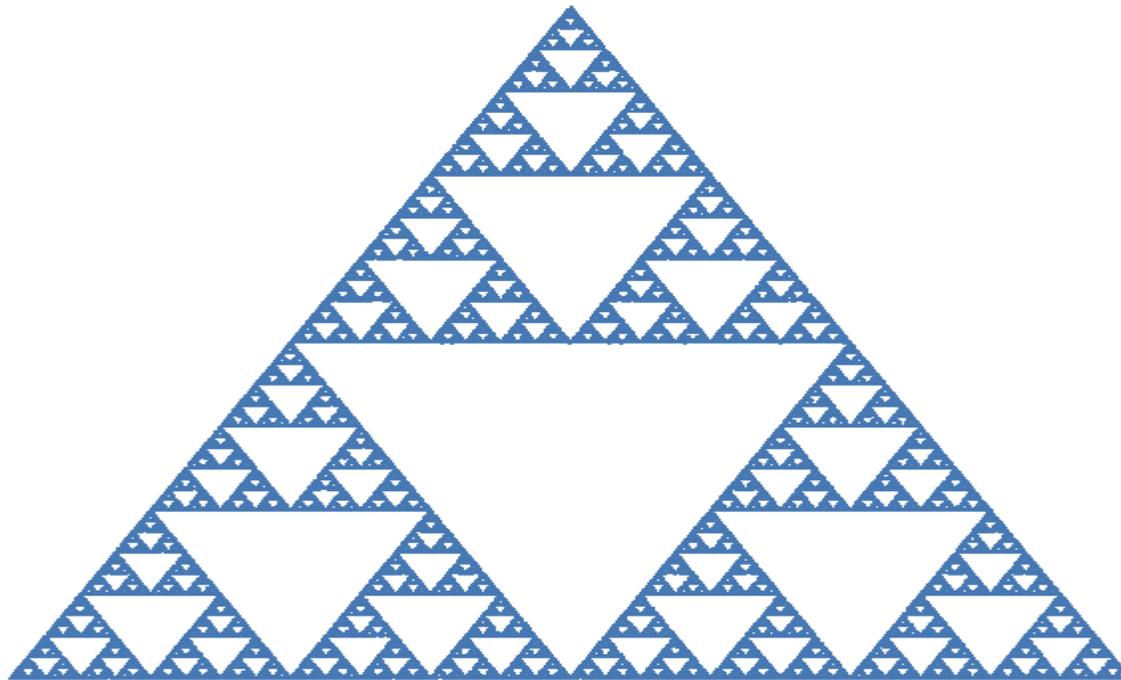
Create 3 points in the xy plane and label them A, B and C. Then pick a point P in the plane (at random) and plot it. Now pick a random integer from the set $\{1,2,3\}$. If the number selected is 1, then plot the midpoint between P and A. If the number selected is 2, then plot the midpoint between P and B. Otherwise, plot the midpoint between P and C. Whichever point you plot, call this new point P (removing the name from the old point P), and repeat the process MANY times (e.g. thousands of times).

Question: Will any pattern appear, or will the resulting sketch look like a complete mess?

What Does Random Look Like

(Part II)

Amazing Answer: Regardless of the starting point, if you throw out the first 20 points, the remaining points will given a plot which looks like the one below.



Note: This figure is called the Sierpinski triangle.

Geogebra Strengths

- FREE
- Simple Interface
- Highly Interactive
- Geometer's Sketchpad Capabilities
- Calculus Capabilities
- Spreadsheet

Geogebra Weaknesses

- Not Programmable (without export as a web applet and interface with Javascript)
- No Implicit Plots
- No Built-in ODE Solvers

Geogebra Examples

- Basic Interface – Functions, Plots (function, parametric, polar, sequence)
- Calculus Capabilities – Tangent lines, areas, upper and lower sums, Taylor Polynomials, Sequence Plotting
- Parabolas and Reflection
- Geometric Constructions – Feuerbach 9 Point Circle

Winplot Strengths

- FREE
- Many Plotting Options, Including Implicit
- Built-In ODE Solvers for Single Equations and Systems
- User Defined Functions

Winplot Weaknesses

- Not Programmable
- Not Available for Macs

Winplot Examples

- Function Plot and Interaction with Parameters
- Implicit Plotting
- ODE Plotting
- Seeking Local Min/Max for Functions of 2 Variables