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 \( L_1 \). Then \( L_2 \) is created to keep track of the streak lengths. Finally, the maximum value of the streaks for the experiment is recorded in \( L_3(J) \). We display \( J \) at each step to keep track of the progress.

```
For(J,1,100)
randInt(0,1,100) → L_1
1 → L_2(1)
For(K,2,100)
If L_1(K) = L_1(K-1)
Then
L_2(K-1)+1 → L_2(K)
Else
1 → L_2(K)
End
End
max(L_2) → L_3(J)
Disp J
End
```
TI – nspire CAS Strengths

• TI – 89 + Geometer’s Sketchpad
• Tables and Spreadsheets
• Reasonable Screen Resolution
• Structured Programming
• Fast Processor
TI – nspire 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 Serpinskie 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
• Seaking Local Min/Max for Functions of 2 Variables