TECHNOLOGY DRIVEN INVESTIGATIONS FOR INTERMEDIATE ALGEBRA FOR BUSINESS MAJORS

Wendiann Sethi
Seton Hall University
Department of Mathematics and Computer Science
400 South Orange Ave, South Orange NJ 07079
Wendiann.sethi@shu.edu

In the spring and fall semesters in 2008, two sections of Intermediate Algebra with the focus on mathematical modeling were taught as part of piloting a new approach for our Intermediate Algebra class for the pre-business majors. These students would then go onto a Quantitative Methods class. The idea was to give the students the review of the algebraic skills that they were weak on while giving them some of the business applications that they would see in some of their other classes.

During the class the students had regularly scheduled investigative tasks to explore and teach them various models using data, graphs and functions to define the mathematical model. In the class we explored linear, exponential, logarithmic, power and polynomial functions. The following are three examples of the investigations that the students performed. Most of the material for these investigations came from the textbook used for the class: Yoshiwara and Yoshiwara: Modeling, Functions, and Graphs: Algebra for College Students, 4th edition, published by Brooks/Cole.

The students' response to the investigative tasks was quite positive. The students like the opportunity to work in pairs or small groups. I also found that their understanding of the concepts were better after the investigation. This was evident from their answers on the tests. We will continue to use these kinds of activities for the College Algebra class for students going into science majors, Mathematics, Computer Science and Business.

Three Investigative tasks:
I.   Investigative task using graphing calculator (TI-83/84): Interest Compounded Continuously

The learning objective is to take the formula for the amount A accumulated in an account with interest compounded n time annually and discover what happens when the periods are increased to a large number (going towards continuously compounded) and discover the continuously compounded interest rate is related to the natural base e. This exercise is worked in groups of three using their graphing calculator.

We learn in an earlier section that the amount A accumulated in an account with interest compounded n times annually is $A = P\left(1 + \dfrac{r}{n}\right)^{nt}$ where P is the principal invested, r is the interest rate, and t is the time period in years.

1. Suppose you have $1000 in an account that pays 8% interest. How much is the amount after 1 year if the interest is compounded twice a year? Four times a year?

2. What happens to A as we increase n, the number of compounding periods per year? Fill in the table showing the amount in the account for different values of n.

N	A
1 (annually)	1080
2 (semiannually)	
4 (quarterly)	
6 (bimonthly)	
12 (monthly)	
365 (daily)	
1000	
10,000	

3. Plot the values in the table from n = 1 to n = 12, and connect them with a smooth curve. Describe the curve: What is happening to the value of A?

4. In part (2), as you increased the value of n, the other parameters in the formula stayed the same, In other words, A is a function of n, given by
$$A = 1000\left(1 + \frac{0.08}{n}\right)^{n}$$

Use your calculator to graph A on successively larger domains:

   Xmin = 0, Xmax = 12; Ymin = 1080, Ymax = 1084
   Xmin = 0, Xmax = 50; Ymin = 1080, Ymax = 1084
   Xmin = 0, Xmax = 365; Ymin = 1080, Ymax = 1084

5. Use the TRACE feature or the TABLE feature to evaluate A for very large values of n. Round to the nearest penny, what is the largest value of A that you can find?

6. The students continue the exercise to discover the value of e by looking at the values of $1000e^{r}$ for r = .08, .15 and 1. (Determine the value of e, rounded to 5 decimal places.)

7. The final piece is they complete the table:

N	100	1000	10,000	100,000

$\left(1+\dfrac{1}{n}\right)^n$				

II.   Investigative task using Excel: Population Growth
The learning objective is to learn the pattern underlying the exponential growth function
$P(t) = P_0 b^t$ which is the initial amount is multiplied by a certain constant amount over a period of time. Students work in pairs with using Excel to complete the assignment. The instructor demonstrates one example and then the students do another example.

In a laboratory experiment, researchers establish a colony of 100 bacteria and monitor its growth. The colony triples in population every day. Let t = # of days.

1. Fill in the table showing the population P(t) of bacteria t days later

t	P(t)	
0	100	
1		[100*3]
2		[100 * 3] * 3
3		
4		
5		

2. Plot the data points from the table and connect them with a smooth curve.
        Use tools in the Insert tab:
            i. Select the data values.
            ii. Choose scatter chart.

3. Write a function that gives the population of the colony at any time t, in days.
4. Graph your function from part (3). Using your calculator or Maple.
5. Evaluate your function to find the number of bacteria present after 8 days. How many bacteria are present after 36 hours?

Students are asked to do a similar exercise with rabbits that double every 3 months with an initial population of 60 rabbits.

III.   Investigative task using Maple: Graphs of functions and transformation of their graphs

The learning objective is to see the effects of adding terms to the basic function $f(x) = x^2$. Students will be able to identify the vertex, x- and y-intercepts, and axis of symmetry. Also serves as a review of using Maple later in the semester. Students work in pairs and each student hands in their own Maple worksheet.

Find the following for each graph:
    a) x-intercept
    b) y-intercept
    c) axis of symmetry
    d) vertex

1.   Start with $f(x) = x^2$ and plot the function using Maple.
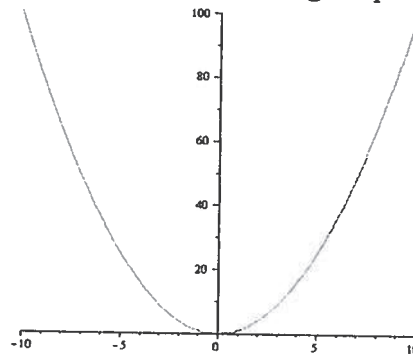
2.   Plot $\frac{1}{2} x^2$, $2 x^2$, x^2 onto one graph

3.   Plot $f(x) = x^2 + 2$ and $f(x) = x^2 - 2$

4.   Plot $f(x) = 2x^2 + 2$ and $f(x) = \frac{1}{2} x^2 - 2$

5.   Plot $f(x) = x^2 + 2x$ and $f(x) = x^2 - 2x$

6.   Plot $f(x) = x^2 + 2x + 1$ and $f(x) = x^2 + 2x - 1$

7.   Plot $f(x) = 2x^2 + 2x + 1$ and $f(x) = 2x^2 + 2x - 1$

8.   Looking at the graphs answer the following questions for $f(x) = ax^2 + bx + c$ in general.
    a) How do you solve for x-intercepts?
    b) How do you solve for y-intercepts?
    c) How do you solve for vertex?
    d) How do you solve for the axis of symmetry?