Xtreme Calculus: Part 1

Student Activity

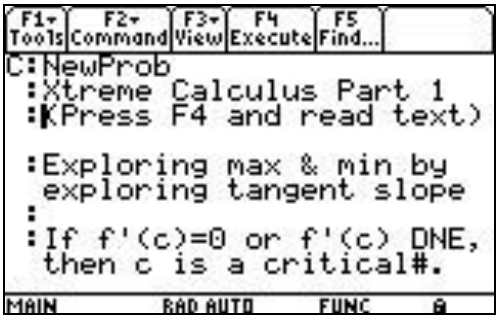
Name _____

Class _____

In this activity, you will explore relative maximums and minimums by drawing a tangent line to a curve and making observations about the slope of the tangent line.

First, install the files *main.xtreme1.89t* and *main.tanimat2.89p* on your TI-89 as directed by your teacher.

Press [APPS], select the *Text Editor* application, and open *xtreme1*. Press [F4] to execute each command line and read the questions or instructions.



When [F4] is pressed on the line **tanimat2()**, the *tanimate2* program begins. In the pop-up box, choose **Interactive**. Press [alpha] and then **10** to find the slope 10 times. (You can choose a smaller number next time.) Select the **Tangent Only** option. Arrow to a point where you want to find the slope and press [ENTER], or type a value and press [ENTER] twice. Observe the slope of the tangent line and determine the critical number(s) of the polynomial function $y1(x) = x^4 + 4x^3 - 2x^2 - 12x$. (**Note:** the tangent line will not be shown for the last point.)

1. What is (are) the critical number(s) of **y1**(*x*)?

2. What occurs at each of the critical numbers of **y1**(*x*)?

From the Main Menu pop-up box, arrow to the right, select **QUIT** and press [ENTER]. (Note: If "Pause" is displayed in the lower right corner of the screen, press [ENTER] to return to the Main Menu.) You will return to the script. Continue pressing [F4] to progress down and set up the next function, $y1(x) = 3x^{\frac{5}{3}} - 15x^{\frac{2}{3}}$.

3. For the graph that has a cusp:
   a. What is (are) the critical number(s) of **y1**(*x*)?

   b. What occurs at each of the critical numbers of **y1**(*x*)?

4. For the cubic function:
   a. What is (are) the critical number(s) of **y1**(*x*)?

   b. What occurs at the critical numbers of **y1**(*x*)?

   c. Does a relative extreme value occur at every critical number? Describe a way to help determine whether or not there is a relative extreme value at a critical number.

Think about how you can tell if a critical number will be at a relative maximum, a relative minimum, or neither. When using *tanimat2* for the quadratic opening down ($y1(x) = -0.5x^2 + 6$), move the point of tangency along the curve from left to right. Find the slope of the tangent at many locations to observe what happens.

5. When the point of tangency is to the left side of the relative maximum, will the slope of the tangent line be positive, negative, or zero?

6. What about when the point of tangency is to the right of the relative maximum?

From the Main Menu pop-up box, select Quit. Continue to follow the script, pressing F4 to execute each command line and reading the questions or instructions. You will explore the quadratic function opening up ($y1(x) = 0.5x^2 - 7$).

7. For this function, when the point of tangency is to the left side of the relative minimum, will the slope of the tangent line be positive, negative, or zero?

8. What about when the point of tangency is to the right of the relative minimum?

9. Fill in the blanks of the following sentences.

   a. Let f have a critical number at $x = c$. If $f'(x) > 0$ on an open interval extending left from c, and $f'(x) < 0$ on an open interval extending from right of c, then f has a _____at $x = c$.

   b. Let f have a critical number at $x = c$. If $f'(x) < 0$ on an open interval extending left from c, and $f'(x) > 0$ on an open interval extending from right of c, then f has a _____at $x = c$.

   c. Let f have a critical number at $x = c$. If $f'(x)$ has the same sign on an open interval extending left from c and on an open interval extending right from c, then f has a _____at $x = c$.

Extension

10. How many relative extrema can an nth degree polynomial have? Explain.