Xtreme Calculus: Part 1

Activity Overview

In this activity, students will explore relative maximums and minimums by drawing tangent lines to a curve and making observations about the slope of the tangent line. This activity uses both the script feature and a program that enables the drawing of tangent lines to be animated.

Topic: Relative Extrema

- Relative minimum
- Relative maximum
- Critical values

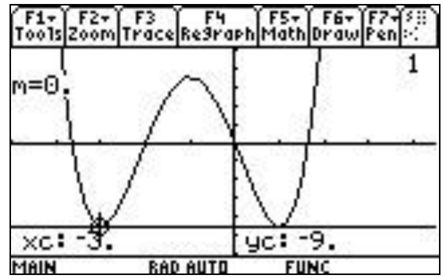
Teacher Preparation and Notes

- Students will need two files, main.xtreme1.89t and main.tanimat2.89p. The main.xtreme1 script asks the program main.tanimat2 to run. The program tanimat2 has numerous functions that are not explored in this brief activity.
- Before beginning the activity, review with students the definitions of relative maximum, relative minimum, and critical values.
- **To download the student worksheet, go to *education.ti.com/exchange* and enter "11407" in the keyword search box.**

Suggested Related Activities

To download any activity listed, go to education.ti.com/exchange and enter the number in the keyword search box.

- Extrema (TI-Nspire™ Technology) — 9414
- Graphical Derivatives (TI-Nspire™ Technology) — 8499



This activity includes screen captures taken from the TI-89 Titanium.

Compatible Devices:

- TI-89 Titanium

Associated Materials:

- XtremeCalculusPart1_Student.pdf
- XtremeCalculusPart1_Student.doc
- main.xtreme1.89t
- main.tanimat2.89p

Click HERE for Graphing Calculator Tutorials.

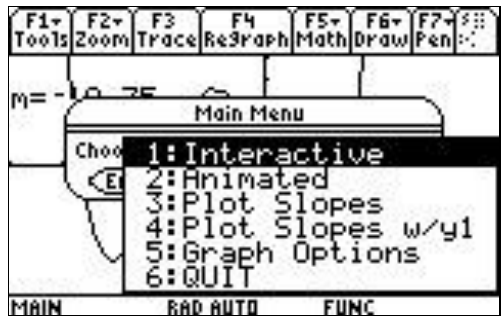
Introduction

After transferring the two files *xtreme1* and *tanimat2*, students will run the script by pressing [APPS], selecting the *Text Editor* application, and then opening *xtreme1*.

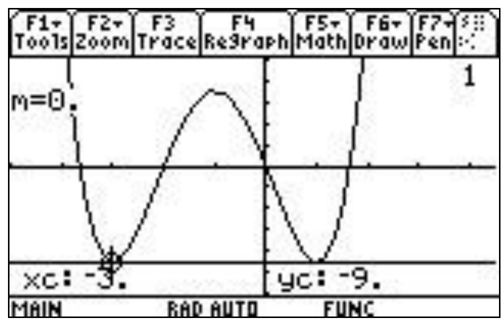
Students are instructed to press [F4] to advance through the script. Reading the text will provide definitions and questions similar to the student handout.

Graph 1 – Polynomial

The script sets up the window and defines a polynomial for **y1**(x). The *tanimat2* program uses whatever function is in **y1**(x) for its initial exploration. It is possible to change the function without exiting the program, but the *xtreme1* script will set up the viewing window and next function for students.



Students are instructed to explore 10 slopes. Their goal should be to find the x-value for when the slope is zero. (**<u>Note</u>:** the tangent line will not be shown for the last point.)



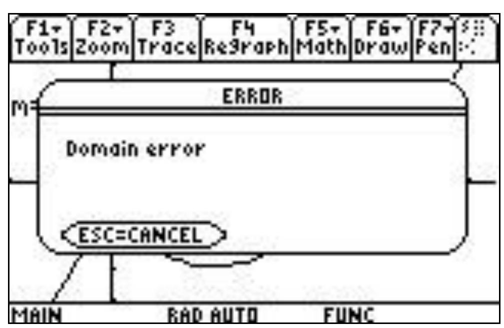
Students are asked to find the critical numbers of **y1**(x). Students are asked what occurs at each critical number of **y1**(x).

Student Solutions

1. x = –3, –1, 1
2. a relative extreme value

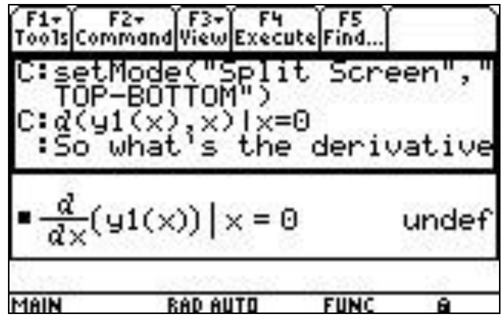
Graph 2 – Cusp

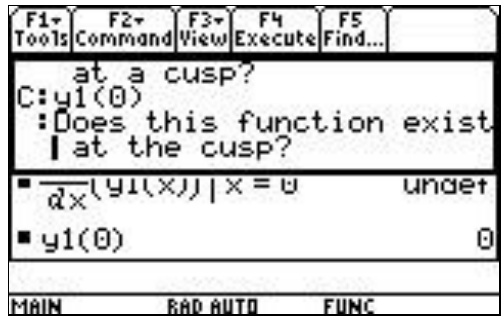
Students are asked to find the critical numbers of **y1**(x). When *tanimat2* is used to explore the slope of the tangent at the cusp (at x = 0), a domain error message occurs.



The script leads students in using CAS to confirm that the derivative at a cusp is undefined.

Students are asked what occurs at each critical number of **y1**(*x*).





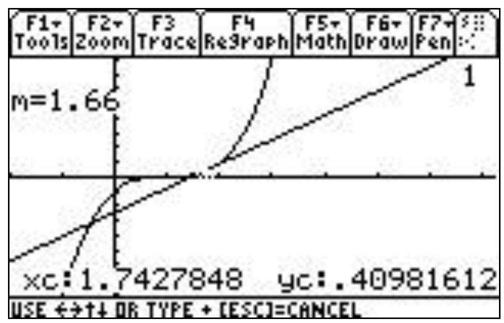
Student Solutions

3. a. $x = 0, 2$

   b. a relative extreme value

Graph 3 – Cubic

Students are asked to find the critical numbers of **y1**(*x*) and what occurs at each critical number of **y1**(*x*).



Student Solutions

4. a. $x = 1$

   b. a plateau

   c. A relative extreme value doesn't occur at every critical number. A critical point is only an extrema if the function changes from increasing to decreasing or decreasing to increasing, i.e., when the derivative changes sign.

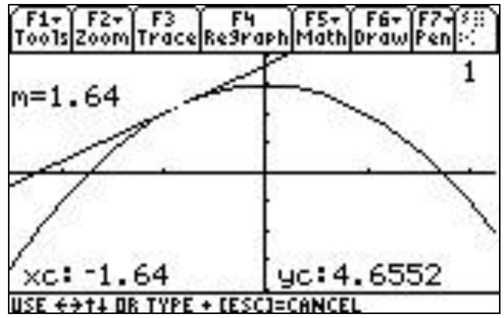
Graph 4 – Negative Quadratic

Students are asked if relative extrema occur at every critical point.

Students are asked if the slope of the tangent line to the left of a relative maximum is positive, negative, or zero.

Student Solutions

5. positive
6. negative



Graph 5 – Positive Quadratic

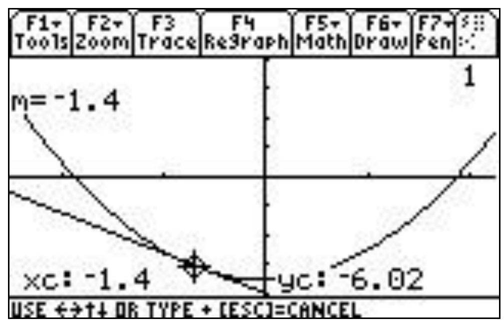
Students are asked if the slope of the tangent line to the left of a relative minimum is positive, negative, or zero.

Students are asked if the slope of the tangent line to the right of a relative minimum is positive, negative, or zero.

This is the end of the script. Press [HOME].

Student Solutions

7. negative
8. positive



Summing It All Up

Students are asked to summarize their findings about critical numbers and local extrema.

Student Solutions

9. a. relative maximum
   b. relative minimum
   c. plateau

Extension

Students are asked how many extrema an *n*th degree polynomial can have. They are also asked to explain their answer.

Student Solution

10. $n - 1$. An *n*th degree polynomial can only change from increasing to decreasing or vice versa $n - 1$ number of times.