Local Linearity

ID: 10889

Time required
10-15 minutes

Activity Overview

This is a short activity designed for a first time user. In this activity, students will explore zooming in on various functions including piecewise. They will investigate the concept of local linearity. This introductory calculus activity has strong connections to many calculus concepts including slope, limit of a difference quotient, the definition of the derivative, and the criteria for differentiability.

Topic: Local Linearity

- *Slope of the tangent*
- *Connections to definition of the derivative and differentiability*

Teacher Preparation and Notes

- *This activity will help students learn how to graph piecewise functions using the* ***when(*** *command.*
- ***To download the student worksheet, go to education.ti.com/exchange and enter "10889" in the keyword search box.***

Associated Materials

- *LocalLinearity_Student.doc*

Suggested Related Activities

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

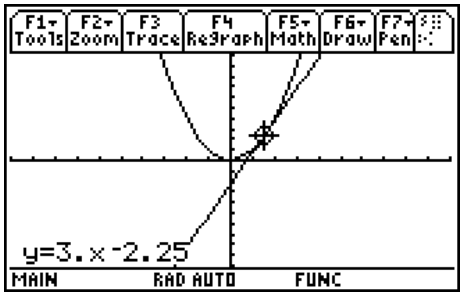
- *Local Linearity, Differentiability and Limits of Difference Quotients (TI-84 Plus family) — 5585*
- *Continuity and Differentiability of Functions (TI-Nspire technology) — 8498*
- *Differentiability and Continuity (TI-84 Plus family) — 5417*
- *Piecewise Functions: Continuous-Differentiable (TI-89 Titanium) — 3293*

Problem 1 – Draw a Tangent Line by Hand

Students will begin the activity by drawing a line tangent to the graph of $y = x^2$ at some point in the first quadrant. Students can approximate the slope and equation of the tangent line using the grid points on the graph

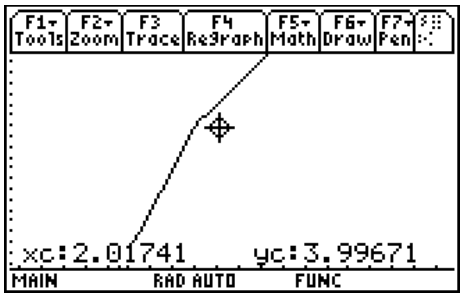
Problem 2 – Draw and Explore Tangent using Technology

Students will graph the function **y1** = x^2 and draw a tangent line as they did in Problem 1. Note: If the tangent line that is created using **F5:Math > A:Tangent** is not saved in **y2** then it will disappear when the screen is regraphed.



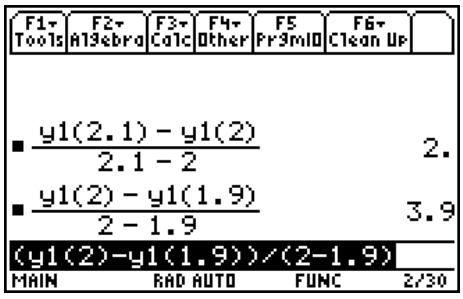
Problems 3 and 4

In Problems 3 and 4, students will graph piecewise functions and observe whether or not the graph is local linear in the neighborhood of (2, 4). Students will observe that some piecewise functions have the local linearity property, while other piecewise functions lack this property.

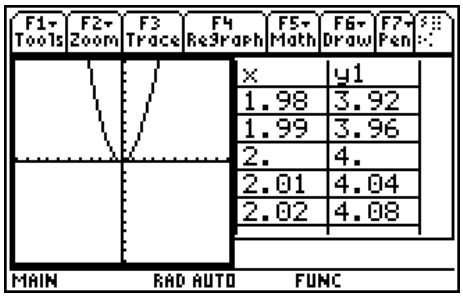


Extension

Connect the concept of local linearity to the definition of the derivative, continuity and differentiability. On the HOME *screen explore the slope numerically.*



Consider using a split screen with the graph and table.



Solutions – Student worksheet

Problem 1

- Answers may vary.

Problem 2

- Sample answer: when examined close up, the tangent line and the graph of $y = x^2$ look to be the same line.
- Sample answer: this behavior will not occur for all other functions because some functions are not continuous.

Problem 3:

- Sample answer: when zoomed in, the line does not appear to be linear. There is a cusp where the slopes on both sides of (2, 4) are not equal.

Problem 4

- Sample answer: This function does appear to be locally linear in the neighborhood of (2, 4). For this function, there is not a cusp at (2, 4) like there was in Problem 3.

Problem 5

- Sample answer: as the interval of a graph is repeatedly zoomed in, Δx becomes closer to zero.