Cell Phone Range

ID: 11601

Time Required
15 minutes

Activity Overview

In this activity, students will learn to identify the domain and range of various real-world step functions. They will graphically explore numerical data points and observe step functions. Open and closed points on a graph are investigated and discussed. Students use self-check questions to check their understandings with immediate feedback. Extension questions are also provided to apply what is learned to determine the domain and range of other functions.

Topic: Domain and Range

- *Step functions, and other functions*
- *Open and closed points on a graph*

Teacher Preparation and Notes

- *It would be beneficial for students to be familiar with navigating between pages (ctrl + ◀ or ctrl + ▶), toggling between apps (ctrl + tab) and using self-check questions. These questions can be checked by using ctrl + ▲ or* ***MENU > Check Answer****.*
- *This activity can serve as a good introductory exploration to functions. It can be used in either an Algebra 1 or Algebra 2 class.*
- *Notes for using the TI-Nspire™ Navigator™ System are included throughout the activity. The use of the Navigator System is not necessary for completion of this activity.*
- ***To download the student worksheet and student TI-Nspire document (.tns file), go to education.ti.com/exchange and enter "11601" in the keyword search box.***

Associated Materials

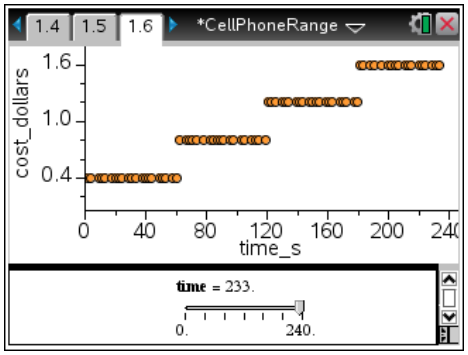
- *CellPhoneRange_Student.doc*
- *CellPhoneRange.tns*

Suggested Related Activities

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

- *How Changing Parameter in a Function Affects Aspects (TI-Nspire technology) — 9363*
- *First Semester Algebra Basics (TI-Navigator) — 8412.*
  ***This Learning Check document can be converted into a TI-Nspire file using the TI-Nspire Teacher Edition software. Some formatting will need to be done, especially for graphs or drawings.*
- *Algebra Nomograph (TI-Nspire technology) — 8266*

Problem 1 – Cell Phone Situation

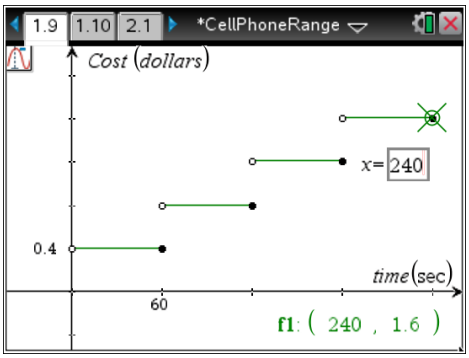


The definition for domain and range is explained. The cell phone situation is explained to be 40 cents per minute with a limitation of 4 minutes per call.

The fee for 0.5 seconds is 40 cents (written as $0.40). It is important for students to realize that $0.40 is not the same as 0.40 cents.

The domain is 0 < time ≤ 240 sec.

Points are plotted using the slider below the graph and an automatic data capture. As the students drag the slider, data points will be added to the graph above in the *Data & Statistics* application.



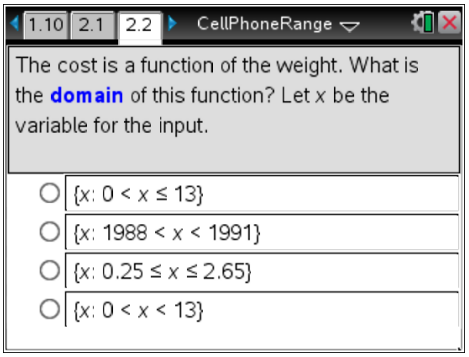
The range is {$0.40, $0.80, $1.20, $1.60}

Closed points are where the function is defined; open points mean the function in not defined there.

TI-Nspire Navigator Opportunity: *Class Capture*

See Note 1 at the end of this lesson.

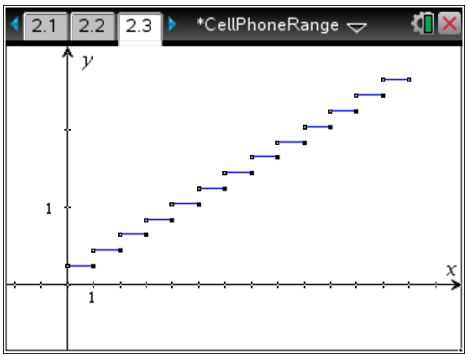
Problem 2 – Snail Mail "Pen Pal"



From April 3, 1988, to February 3, 1991, the U.S. postage rate was $0.25 for the first ounce and $0.20 for each additional ounce. For this first class postage the letter must weigh less than 13 ounces.

Students can use Graph Trace to find the cost for any weight between 0 and 13 ounces.

Solutions:



The domain is {x: 0 < x < 13}. You could lead the students in considering if the domain should be less than or equal to 13 ounces or only less than. The weight certainly cannot be negative or equal to zero.

A 7.25 ounce letter costs $1.65.

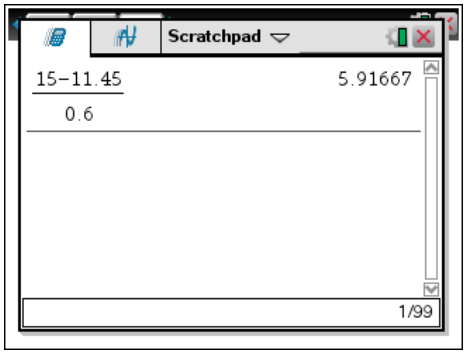
This is a step function with a range of {y: y = 0.25, 0.45, 0.65, 0.85, 1.05, 1.25, 1.45, 1.65, 1.85, 2.05, 2.25, 2.45, 2.65}.

TI-Nspire Navigator Opportunity: *Quick Poll*

See Note 2 at the end of this lesson.

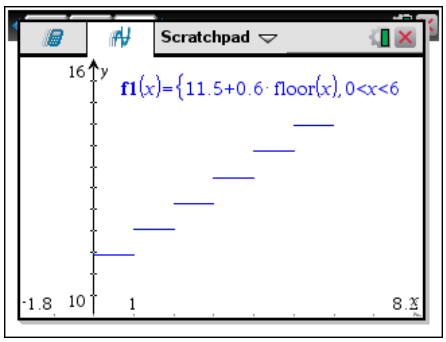
Extension/Homework #1 – Shipping

The students are given the situation where the shipping cost is \$11.45 for the first pound and \$0.60 more for each additional pound. You decide you can only spend \$15 for shipping. Students can press [calc] to use the **Scratchpad** to make their calculations. Press [esc] to return to the lesson.



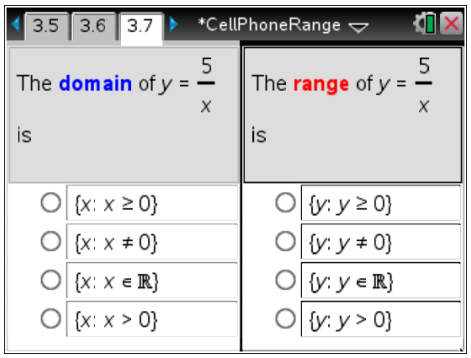
Solutions:

The domain is $\{x: 0 < x < 6\}$. The range for this function that again looks like a step function is $\{y: y = 11.45, 12.05, 12.65, 13.25, 13.85, 14.45\}$.



Extension/Homework #2 –Functions

Various functions are considered. The domain is restricted by the allowable inputs. Dividing by zero and taking the square root of negative numbers are not allowed. A graph of these functions can be helpful by allowing students to see that the domain can be limited. Similarly, have students graph the function and ask what output values occur for functions like $y = x^2$.



Solutions:

- $y = x^2$, **domain**: $\{x: x \in \mathbb{R}\}$, **range**: $\{y: y \geq 0\}$
- $y = \sqrt{x}$, **domain**: $\{x: x \geq 0\}$, **range**: $\{y: y \geq 0\}$
- $y = \dfrac{5}{x}$, **domain**: $\{x: x \neq 0\}$, **range**: $\{y: y \neq 0\}$
- $y = \dfrac{3}{x+5}$, **domain**: $\{x: x \neq -5\}$, **range**: $\{y: y \neq 0\}$
- $y = \sqrt{2x-6}$, **domain**: $\{x: x \geq 3\}$, **range**: $\{y: y \geq 0\}$

TI-Nspire Navigator Opportunities

Note 1

Problem 1: *Class Capture and/or Live Presenter*

Throughout the lesson, use Class Capture to verify students have entered the correct answers to the questions. Page 1.6 is a good place to use Class Capture to display student data sets. Scroll through the different student results. Students should see that the data is not continuous because it "jumps" from one value to the next.

Note 2

Problems 2 and 3: *Quick Poll*

You may want to use Quick Poll to verify students understand the concepts of domain and range. The questions provided in the Extension/Homework assignments may be used for this purpose.