

**EVALUATING EXPRESSIONS**

(Finding the output, given an input value)

**Q:** According to the *Toys R Us 1995 annual report*, the number of stores between the years 1984 and 1994 can be modeled by the following equation:

$$y = 2x^2 + 56x - 53 \text{ stores, where } x \text{ is the number of years after 1980.}$$

Use this model to estimate the number of stores in 1985 and in 1993.

This handout will teach four methods of evaluating the right hand side of an equation (an expression) for a given value of  $x$ . The methods will include arithmetic, tables, graphs and function notation on the TI-86 graphing calculator.

To answer the previous questions, first let  $x = 5$  for 1985 (5 years after 1980) and  $x = 13$  for 1993. These will be the input values used to find the corresponding number of stores in each year (the output values).

**METHOD #1:** Arithmetic on the graphing calculator

- Using  $x = 5$ , type the numerical expression (the right hand side of the equation) onto the home screen. Hit **ENTER** to evaluate.

There were 277 stores in 1985.

A TI-86 calculator screen showing the expression  $2(5)^2+56(5)-53$  entered on the top line. The result  $277$  is displayed on the right side of the screen. A cursor is visible on the left side of the screen.

- To answer the second question, let  $X = 13$ . Instead of retyping the entire expression, hit **2<sup>nd</sup> ENTER** and the last expression will appear again. Use the arrow keys to backspace and replace each 5 with a 13, then hit **ENTER** to reevaluate. (Use the insert key: **INS** – above **DEL**, for the 13.)

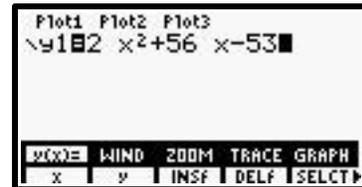
There were 1013 stores in 1993.

A TI-86 calculator screen showing the expression  $2(5)^2+56(5)-53$  entered on the top line. The result  $277$  is displayed on the right side of the screen. A cursor is visible on the left side of the screen.

A TI-86 calculator screen showing the expression  $2(5)^2+56(5)-53$  on the top line and the result  $277$  on the right. The second line shows the expression  $2(13)^2+56(13)-53$  with a cursor at the end. The result  $1013$  is displayed on the right side of the screen.

For the remaining methods, the equation will need to be typed into the "Y=" screen as follows:

1. Hit **GRAPH**.
2. Choose "**y(x)=**" (using the function keys at the top) and type the equation into y1. (To get rid of the menu on the bottom when you are finished, hit **EXIT** twice.)



\*Make sure Plot1, 2 and 3 are turned off (NOT highlighted).

## METHOD #2: Using a table on the graphing calculator

The TI-86 is capable of showing a table of values for the equation(s) stored in the "Y=" screen. The table can be set to begin at any value of x. Because the first x value to be evaluated in the problem is  $x = 5$ , set the table to begin there (TblStart). The table must also be set for a distance between x values. Since x represents the number of years after 1980 it would make sense to let the distance between x values be 1 ( $\Delta Tbl$ ).

1. Make sure the equation is typed into y1. Hit **GRAPH**, then choose "**y(x)=**" and type in the equation. (It was already typed in for this problem. ) Hit **EXIT** twice.



2. Hit **TABLE**. Choose **TBLST**. Set TblStart to be 5 and  $\Delta Tbl$  to be 1.



3. Choose **TABLE** to view the table.

There were 277 stores in 1985.

x	y1
5	277
6	355
7	437
8	523
9	613
10	707

x=5

4. To answer the second question, scroll down the table using the down arrow key until the x value of 13 can be seen in the window.

There were 1013 stores in 1993

x	y1
8	523
9	613
10	707
11	805
12	907
13	1013

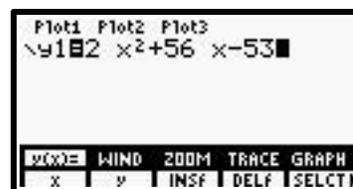
x=13

**METHOD #3:** Using a graph on the graphing calculator

The TI-86 is capable of using a graph of an equation stored in the "Y=" screen to find the output value for any input value within a given window. The first thing to do is to set up the viewing window. *To use the "EVAL" feature, the input values to be used must be within the window.* Set the x values of the window to be between 0 and 15 (xMin and xMax), to include  $x = 5$  and  $x = 13$ . xScl is used to show tick marks on the x-axis; set this value to be 5, to show a tick mark every 5 units.

The y values on this graph represent the number of stores in a given year. An idea of the output values must be known to be able to set them. Set the y values of the window to be between 0 and 1200 (yMin and yMax), and yScl to be 100.

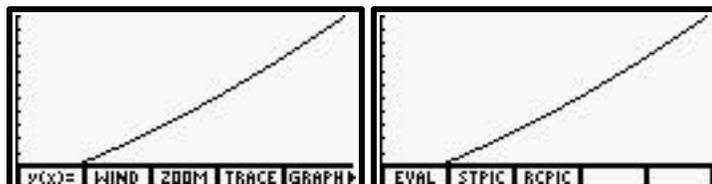
1. Make sure the equation is typed into y1. Hit **GRAPH**, then choose "**y(x)=**" and type in the equation. (It was already typed in for this problem. ) Hit **EXIT** once.



2. Set the window by choosing **WIND**. Use the values in the screen to the right (notice 5 and 13 are contained in the X values).



3. To view the graph choose **GRAPH**.



4. To find the output value at  $x=5$ , hit **MORE** twice and then choose **EVAL**. Type in a 5 after "Eval x=". Hit **ENTER**.

There were 277 stores in 1985.



5. Follow the same steps for  $x = 13$ .



There were 1013 stores in 1993.

**METHOD #4:** Using function notation on the graphing calculator

The TI-86 is capable of recognizing function notation. To use this feature, an equation must be stored into the "Y=" screen. The name of the function will be the location the equation is stored in (i.e. y1). Find  $y_1(5)$  and  $y_1(13)$  as follows:

1. Make sure the equation is typed into y1. Hit **GRAPH**, then choose "**y(x)=**" and type in the equation. (It was already typed in for this problem. ) Hit **EXIT** twice.



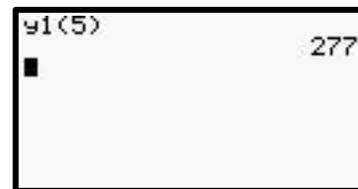
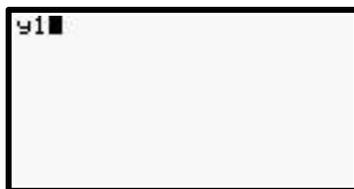
2. The process must be started from the home screen. Get the variable name "y1" by hitting 2<sup>nd</sup> **CATLG-VARS**, then hit **MORE** and choose **EQU**.



3. Hit **ENTER** to choose y1. "y1" should show up on the home screen.

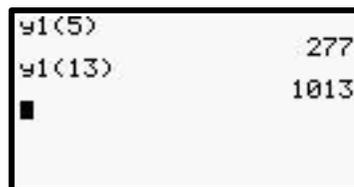


4. Finish the function notation by typing "(5)". Hit **ENTER** to evaluate.



There were 277 stores in 1985

5. To answer the second question, retrieve the last statement by hitting 2<sup>nd</sup> **ENTER**. Edit it using the arrow keys to replace the 5 with a 13. Hit **ENTER**.



There were 1013 stores in 1993.