

**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-82 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

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

A TI-82 calculator screen showing the expression  $2(5)^2+56(5)-53$  on the top line and the result  $277$  on the bottom line.

There were 277 stores in 1985.

2. 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.)

A TI-82 calculator screen showing the expression  $2(5)^2+56(5)-53$  on the top line and the result  $277$  on the bottom line. Below this, the same expression  $2(5)^2+56(5)-53$  is shown with a cursor at the end of the line.

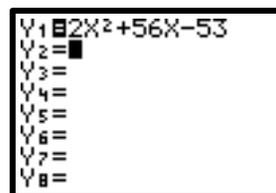
A TI-82 calculator screen showing the expression  $2(5)^2+56(5)-53$  on the top line and the result  $277$  on the bottom line. Below this, the expression  $2(13)^2+56(13)-53$  is shown.

A TI-82 calculator screen showing the expression  $2(13)^2+56(13)-53$  on the top line and the result  $1013$  on the bottom line.

There were 1013 stores in 1993.

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

Hit "Y=" and type the equation into Y1.  
(To get back to the home screen, hit 2<sup>nd</sup> Quit.)



```

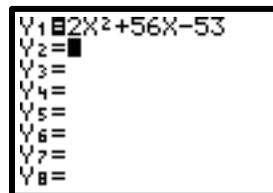
Y1=2X^2+56X-53
Y2=
Y3=
Y4=
Y5=
Y6=
Y7=
Y8=

```

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

The TI-82 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 (TblMin). 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 "Y=" and type in the equation. (It was already typed in for this problem. )



```

Y1=2X^2+56X-53
Y2=
Y3=
Y4=
Y5=
Y6=
Y7=
Y8=

```

2. Hit 2<sup>nd</sup> TBL SET. Set TblMin to be 5 and  $\Delta Tbl$  to be 1.



```

TABLE SETUP
TblMin=5
ΔTbl=1
Indent: Auto Ask
Depend: Auto Ask

```

3. Hit 2<sup>nd</sup> 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	
11	805	

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	
7	437	
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-82 is capable of using a graph of an equation stored in the "Y=" screen to find an 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 "value" 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 the Yscl to be 100.

1. Make sure the equation is in Y1. Hit "Y=" and type in the equation. (It was already typed into Y1)

```

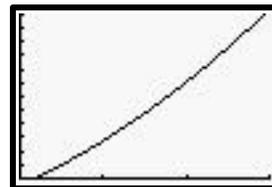
Y1: 2X^2+56X-53
Y2:
Y3:
Y4:
Y5:
Y6:
Y7:
Y8:
  
```

2. Set the window by hitting WINDOW. Use the values in the screen to the right.

```

WINDOW FORMAT
Xmin=0
Xmax=15
Xscl=5
Ymin=0
Ymax=1200
Yscl=100
  
```

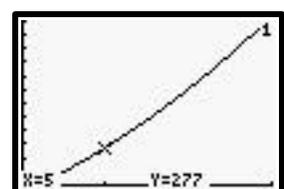
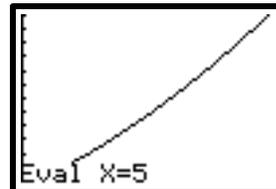
3. To view the graph hit GRAPH.
4. To find the output value at  $x=5$ , hit 2<sup>nd</sup> CALC and then choose 1:value. Type in a 5 after "Eval X=". Hit ENTER.



```

CALCULATE
1:value
2:root
3:minimum
4:maximum
5:intersect
6:dy/dx
7:∫f(x)dx
  
```

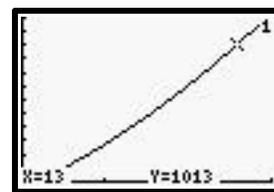
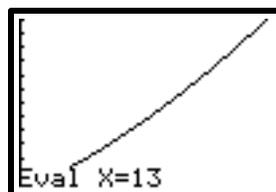
There were 277 stores in 1985.



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

```

CALCULATE
1:value
2:root
3:minimum
4:maximum
5:intersect
6:dy/dx
7:∫f(x)dx
  
```

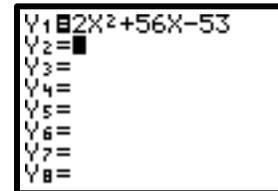


There were 1013 stores in 1993.

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

The TI-82 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  $Y1(5)$  and  $Y1(13)$  as follows:

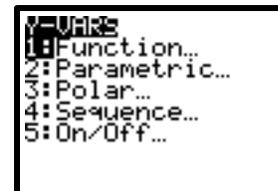
1. Make sure the equation to be used is typed into Y1. Hit "Y=" and type in the equation. (It was already typed into Y1.)



```

Y1=2X^2+56X-53
Y2=
Y3=
Y4=
Y5=
Y6=
Y7=
Y8=
  
```

2. The process must be started from the home screen. Go to the home screen by hitting 2<sup>nd</sup> Quit. Get the variable name Y1 by hitting 2<sup>nd</sup> Y-VARS.



```

Y-VARS
1:Function...
2:Parametric...
3:Polar...
4:Sequence...
5:On/Off...
  
```

3. Choose 1:Function..., then Y1. "Y1" should show up on the home screen.



```

FUNCTION
1:Y1
2:Y2
3:Y3
4:Y4
5:Y5
6:Y6
7:Y7
  
```



```

Y1=
  
```

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

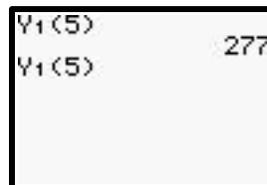


```

Y1(5)
  277
  
```

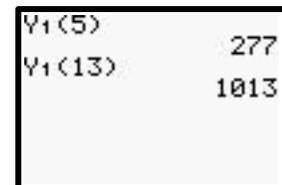
There were 277 stores in 1985

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.



```

Y1(5)
  277
  
```



```

Y1(5)
  277
Y1(13)
  1013
  
```

There were 1013 stores in 1993.