Finding Linear Models Part II

Math Concepts	
Math Concepts • Linear functions • Graphing • Slope/rate of change **Materials** • TI-83 Plus	**Overview** The student will use the TI-83 Plus to find the average rate of change and intuitively develop a linear model for a set of data graphed in a scatter plot.

Teacher Notes

• Students should have already entered the data into lists, set the Window values, and graphed the scatter plot. (Figures 1, 2, and 3)

• The goal for this activity is to have students find a good linear model for the data **without** using the linear regression function of the TI 83 Plus. That feature should be reserved until students fully understand how to analyze and find a linear model themselves.

• This activity assumes that students have already entered the data, selected an appropriate window, and graphed a scatter plot.

We continue the discussion of the example from **Finding Linear Models Part I** shown below:

Year	Profit in Thousands of Dollars
90	125
91	205
92	296
93	510
94	620
95	904
96	1040

Figure 1

```
WINDOW
 Xmin=90
 Xmax=100
 Xscl=1
 Ymin=100
 Ymax=1200
 Yscl=100
 Xres=1
```
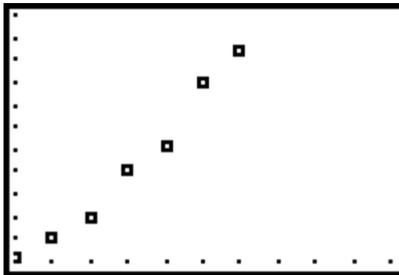
Figure 2

Figure 3

- **Find an average rate of change for the data set.**

  Press [STAT] [ENTER] to open the data editor. Move the cursor so that it is on L3. (Figure 4)

```
L1      L2      ▉◳      3
 90      125     ------
 91      205
 92      296
 93      510
 94      620
 95      904
 96      1040
L3 =
```

Figure 4

Press [2nd] [STAT] [▶] [7]. (Figure 5)

```
NAMES OPS MATH
1▉SortA(
2:SortD(
3:dim(
4:Fill(
5:seq(
6:cumSum(
7↓ΔList(
```

Figure 5

Press [2nd] [2] [)] to complete the line shown on the entry line of the edit screen. (Figure 6) Press [ENTER] to execute the command.

- Students will use the spreadsheet-like features of the data editor to find the average change in profit per year.

L1	L2	■3	3
90	125	------	
91	205		
92	296		
93	510		
94	620		
95	904		
96	1040		

L3 =ΔList(L2)■

Figure 6

- The ΔList command defines:

  L3(1) = L2(2) - L2(1)

  L3(2) = L2(3) - L2(2)

  L3(3)= L2(4) - L2(3)

  and so on.

  (Figures 7 and 8)

L1	L2	L3	3
90	125	80	
91	205	91	
92	296	214	
93	510	110	
94	620	284	
95	904	136	
96	1040	------	

L3(1)=80

Figure 7

Press [2nd] [STAT] [▶] [▶] [5] to find the sum of the numbers in L3. (Figure 8)

```
NAMES OPS MATH
1:min(
2:max(
3:mean(
4:median(
5■sum(
6:prod(
7↓stdDev(
```

Figure 8

- Students may find the mean or average rate of change by traditional methods i.e. finding the sum of the values in L3 and dividing by "6" or they may use the TI-83 Plus to continue the analysis. (Figures 8 and 9)

Press [2nd] [3] [)] [÷] [6] [ENTER]. (Figure 9)

```
sum(L3)/6
              152.5
■
```

Figure 9

Use the TI-83 Plus to find the mean directly by pressing [2nd]
[STAT] [▶] [▶] [3]. (Figures 10)

```
NAMES OPS MATH
1:min(
2:max(
3:mean(
4:median(
5:sum(
6:prod(
7↓stdDev(
```

Figure 10

Press [2nd] [3] [)] [ENTER]. (Figure 11)
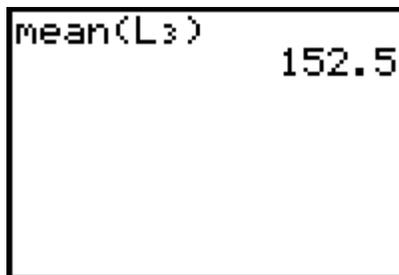
```
mean(L₃)
          152.5
```

Figure 11

Once students have found the average rate of change in profit,
they are ready to find a function to model the data.

- **Find a mathematical model to fit the data by entering a
  function in [Y=] and editing it to find the best fit.**

  The average rate of change tells us that each year the profit
  increases by about $152.50.

  Press [WINDOW] and change "Xmin" to "0" and "Ymin" to "0".
  (Figure 12)
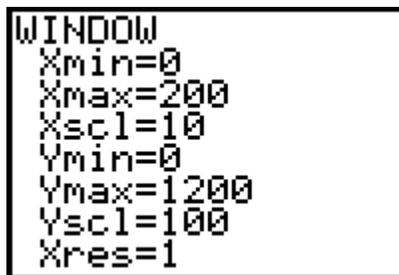
```
WINDOW
 Xmin=0
 Xmax=200
 Xscl=10
 Ymin=0
 Ymax=1200
 Yscl=100
 Xres=1
```

Figure 12

- When finding models by
  this method it is often
  advisable to change the
  window so that the x-axis
  and y-axis are visible.
  Usually students are better
  able to adjust the function
  if the axes are visible.
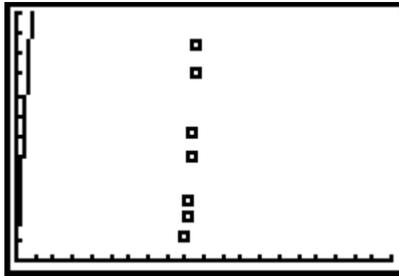
For the first "guess", let Y1= 152.5x. (Figure 13)

Figure 13

- Discuss with students what must be done to adjust the graph of the function. In order to move the graph to the right, what must be changed?

To shift the function to the right, edit **Y1** as shown. (Figure 14)
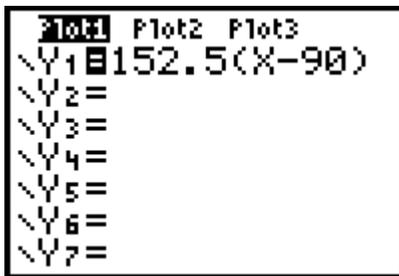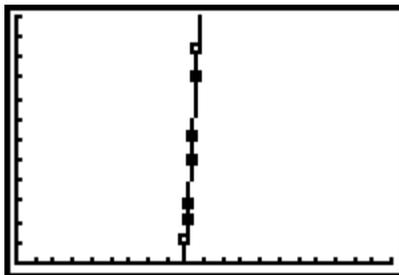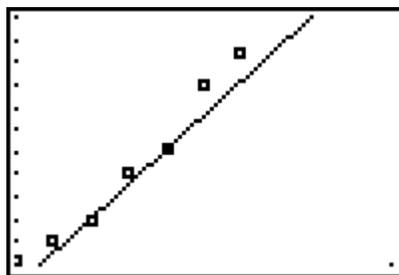
Figure 14

Press [GRAPH]. (Figure 15)

Figure 15

Change the window setting to the original values and determine what other changes might need to be made. (Figure 16)

Figure 16

- Remind students that there should be as many points above the line as below the line.

- How should this function be changed to better fit the data? Have students continue to adjust the rate of change (slope) and the y intercept until the fit is acceptable.

A final version might be similar
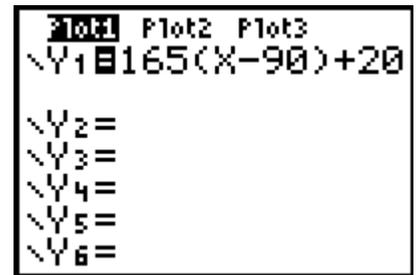to the function shown below.
(Figure 17)

Plot1 Plot2 Plot3
\Y1 ☐165(X-90)+20

\Y2=
\Y3=
\Y4=
\Y5=
\Y6=

Figure 17