

## Finding Linear Models Part III

<p><b>Math Concepts</b></p> <ul style="list-style-type: none"> <li>• Linear functions</li> <li>• Graphing</li> <li>• Slope/rate of change</li> <li>• Linear Regression Model</li> <li>• Median-median Model</li> </ul> <p><b>Materials</b></p> <ul style="list-style-type: none"> <li>• TI-83 Plus</li> </ul>	<p><b>Overview</b></p> <p>The student will use the TI-83 Plus to find a linear regression and/or a median-median line for a set of data graphed in a scatter plot. The student will use the models to predict profit.</p>
---	---

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 following example shown below from Parts II and I.

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

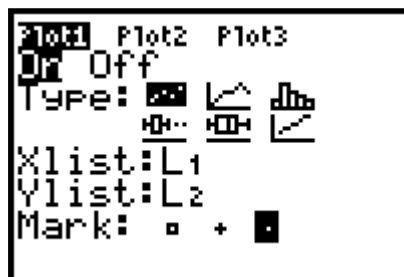


Figure 1

### 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)
- Have students keep the model developed in Part II in **Y1** so they may compare it to the models generated by the handheld.
- The goal of this activity is to have students find a linear regression model and/or a median-median model for the data. Use of the regression capabilities of the TI-83 Plus should be reserved until students fully understand how to analyze and find a linear model intuitively.
- It is essential that students understand the difference between a linear regression and a median-median line.

The TI-83 Plus' linear model is a **least squares regression line**. The handheld generates a list called "Resid" where the

```

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

Figure 2

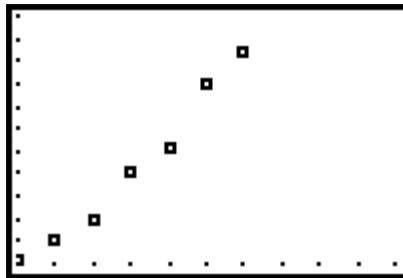


Figure 3

- Use the TI-83 Plus to determine a linear regression model for the data.

Press **STAT** **▶** **4** to place the **LinReg** command on the home screen. (Figure 4)

```

EDIT [DEL] TESTS
1:1-Var Stats
2:2-Var Stats
3:Med-Med
4:LinReg(ax+b)
5:QuadReg
6:CubicReg
7:QuartReg
    
```

Figure 4

Press **2nd** **1** **,** **2nd** **2** **,** **VARs** **▶** **1** **2**

```

LinReg(ax+b) L1,
L2, Y1
    
```

Figure 5

residuals (distances from the data points to the line) are stored as a part of the process of finding the linear regression model.

A **median-median model** is developed by graphing the data points and dividing them into three sets (from left to right). The median x-value and median y-value are then determined for each group of data. The resulting three points are used to determine a line of best fit.

The significance of a median-median model is that it is affected less by outliers than a linear regression.

A median-median model is much easier for students to develop without technology than linear regression. For a more detailed set of instructions consult any statistics text.

Press **[ENTER]** to execute the **LinReg** command.

```
LinReg
y=ax+b
a=159.5357143
b=-14308.25
```

Figure 6

Press **[GRAPH]** to compare your model developed in Part II to the linear regression model. (Figure 10)

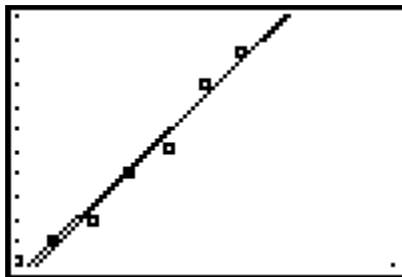


Figure 10

Which model is better?

Which model is more meaningful to you?

- Use the TI-83 Plus to develop a Median-median model for the given set of data.

Press **[STAT]** **[>]** **[4]** to choose the Med-Med command. (Figure 11)

```
EDIT [TESTS] TESTS
1:1-Var Stats
2:2-Var Stats
3:Med-Med
4:LinReg(ax+b)
5:QuadReg
6:CubicReg
7↓QuartReg
```

Figure 11

Press **[ENTER]** to place the command on the home screen and press **[ENTER]** once more to execute the command. Press **[2nd]** **[1]** **[,]** **[2nd]** **[2]** **[,]** **[VAR]** **[>]** **[1]** **[3]** to choose L1 and L2 and to put the function in Y3. (Figure 12)

- Notice that the output shown in Figure 6 does not include the values for  $r$  and  $r^2$ . In order to display  $r$  and  $r^2$  the diagnostics must be turned on. To turn on the diagnostics press **[2nd]** **[0]** to open the catalog of commands, and then press **[x<sup>-1</sup>]** to move to the beginning of the d's and **[↓]** until the arrow is on the line with the command **DiagnosticOn**. (Figure 7)

```
CATALOG
Degree
DelVar
DependAsk
DependAuto
det(
DiagnosticOff
▶DiagnosticOn
```

Figure 7

```
DiagnosticOn Done
```

Figure 8

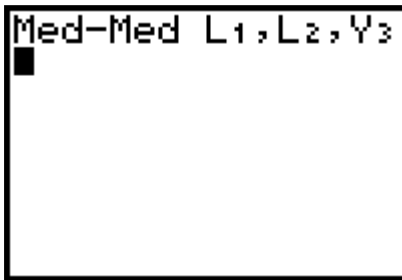


Figure 12

Press **[ENTER]** to execute the Med-Med command. (Figure 13)

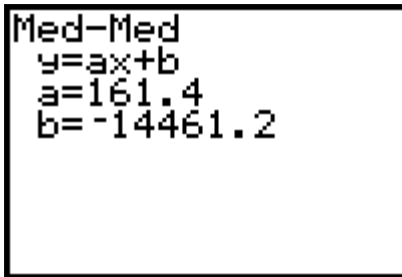


Figure 13

Press **[GRAPH]** and compare the Med-Med model to the intuitive model and the linear regression model. (Figure 14)

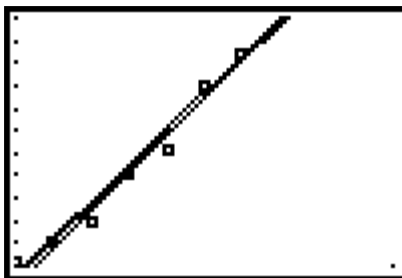


Figure 14

- Use the TI-83 Plus to predict profit for 97, 98, and 99.

Press **[2nd]** **[WINDOW]** to open the Table Setup screen. Press **[↓]** **[↓]** **[→]** to select Ask. (Figure 15)



Figure 15

Press **[2nd]** **[ENTER]** twice to bring up the LinReg command and press **[ENTER]** to execute it. The output now includes values for  $r$  and  $r^2$ . (Figure 9)

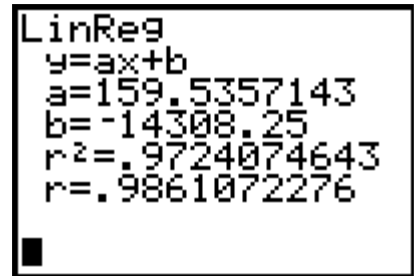


Figure 9

Note that the closer the  $r$ -value is to 1, the better the fit.

- Note in Figure 13 that no  $r$ -values are displayed. The  $r$ -values do not exist in this model since it is generated by median values.
- Note that there is very little difference among the models. Caution students about the pitfalls in using any model to make predictions for values too far outside the current range of data (extrapolation).

Press  $\boxed{2\text{nd}} \boxed{\text{GRAPH}}$  to generate the table. Type "97" in the "X" column then press  $\boxed{\text{ENTER}}$  and type the next x-value. Use the  $\boxed{\blacktriangleright}$  to scroll right and compare the value returned by each of the three models. (Figure 16)

X	Y <sub>1</sub>	Y <sub>2</sub>
97	1175	1166.7
X=		

Figure 16