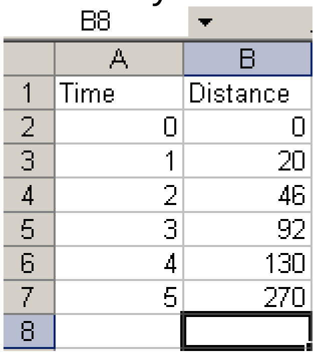
Regression Using an Excel Spreadsheet

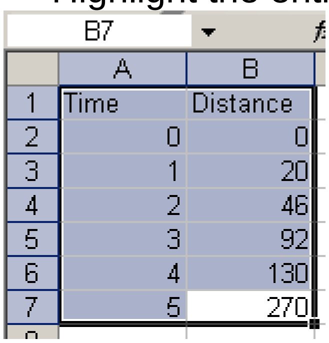
Using Technology to Determine Regression

- Enter your data in columns A and B for the x and y variable respectively



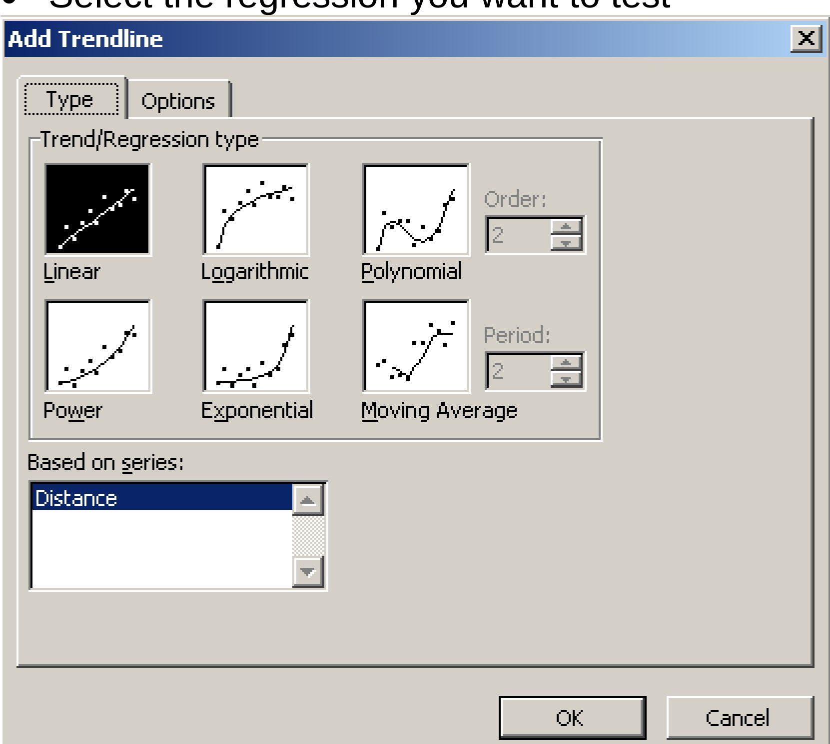
	A	B
1	Time	Distance
2	0	0
3	1	20
4	2	46
5	3	92
6	4	130
7	5	270
8		

- Highlight the entire data series by selecting it with the mouse

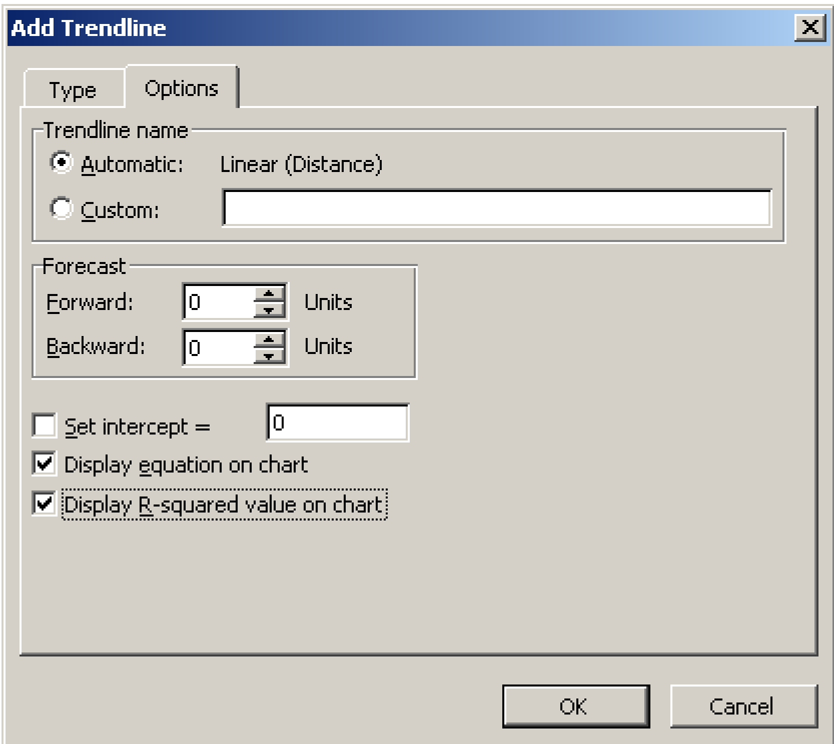


	A	B
1	Time	Distance
2	0	0
3	1	20
4	2	46
5	3	92
6	4	130
7	5	270

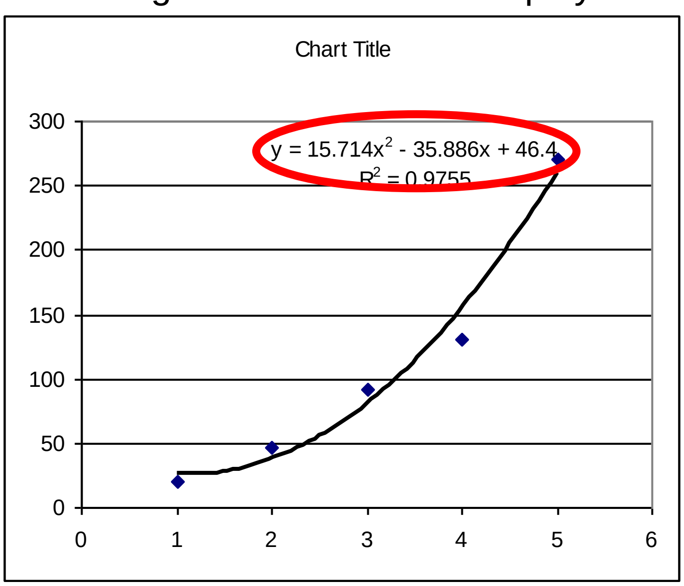
- From the **Insert** menu select **Chart**
- Select the **XY (Scatter)** for the plot type then click on **Next** → **Next** → **Next** → **Finish** (During this time you can change the axis name, colour and scale)
- To find the regression for the graph select the graph and click on the **Chart** menu then select **Add Treadline…**
- Select the regression you want to test



- Note: The polynomial regression tool allows you to choose the degree of the polynomial:
  - Order 2→Quadratic
  - Order 3→Cubic
  - Order 4→Quartic
  - …etc
- Click on the **Options** tab
- Then check off **Display equations on chart** and **Display R-Squared value on chart** then click **OK**



- The regression model will display on the graph



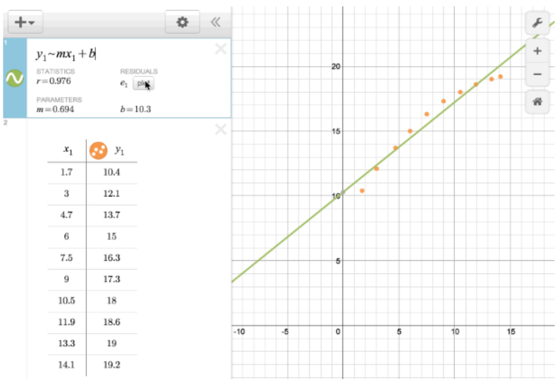
Regression with DESMOS.COM

Using Technology to Determine Regression

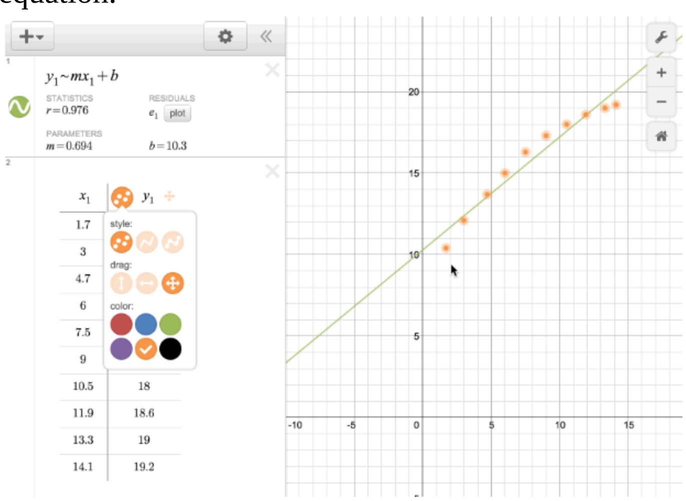
If you'd like to learn more about regressions, check out the [Regressions](#) page at [Learn Desmos](#):
To get started with regressions, you'll need some data. You can copy data from a spreadsheet and paste it into a blank expression in the calculator.

x_1	y_1
1.7	10.4
3	12.1
4.7	13.7
6	15
7.5	16.3
9	17.3
10.5	18
11.9	18.6
13.3	19

Next, enter your regression model, like $y_1{\sim}mx_1{+}b$ or $y_1{\sim}ax_1^2{+}bx_1{+}c$ or $y_1{\sim}ax_1^3{+}bx_1^2{+}cx_1{+}d$ or other degree polynomial or exponential like $y_1{\sim}a(b)^{x_1}{+}c$ or other model… (use subscripts on variables x and y).
To decide which model is best – look at R^2 value (needs to be as close to 1 as possible.)



You can also long-hold the colored icon and make the points draggable to see how their values change the equation.



Watch the video to learn more: https://www.youtube.com/watch?v=E9B0hQYfziw

Regression with the Graphing Calculator TI-89

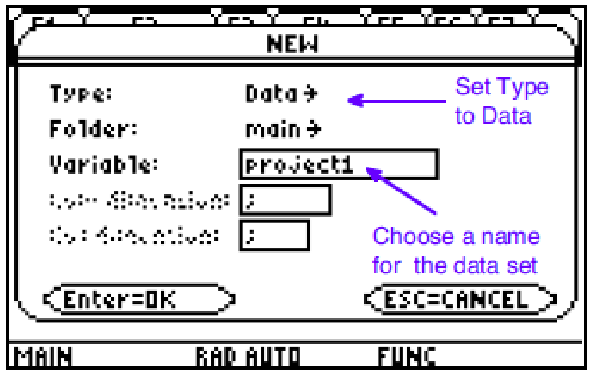
Using Technology to Determine Regression

- **Enter the Data**

Press the $\boxed{\text{APPS}}$ key and choose 6:Data/Matrix Editor and then 3:New… (Fig. 1). This brings up the NEW window (Fig. 2). Type should be set to Data. The default folder Main is fine, or you can create your own folder. (See the manual for how to do this if you are interested.) For Variable choose a name that reflects the contents of the data

Fig. 1 Applications Menu for Data Entry

Fig. 2 The New Data Window



set, e.g., Project1. The name you choose is the one you will use to recall the data set. Press $\boxed{\text{ENTER}}$ twice to bring up the Data/Matrix Editor window (Fig. 3).

Labels for the columns can be entered in the row above the column headings. These labels are for your reference only; the actual names for the variables are c1, c2, etc. and it is these names that are used in calculations. Enter the data values as columns each column corresponding to a variable. For our data I place the t-values in c1 and N-values in c2.

Fig. 3 The Data/Matrix Editor

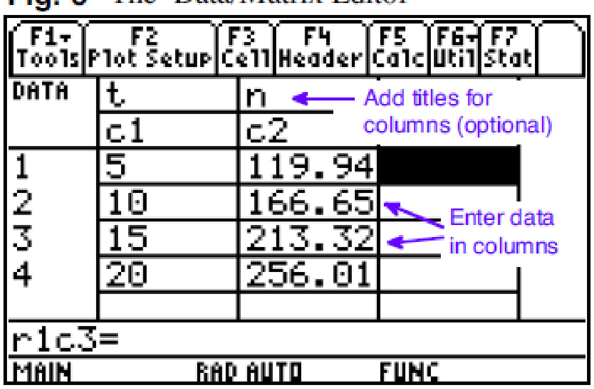
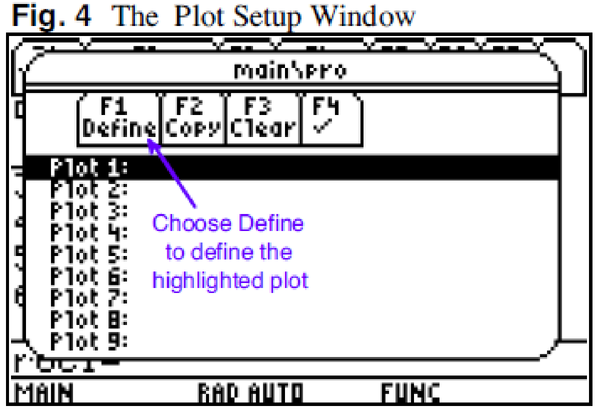


Fig. 4 The Plot Setup Window



- **Plot the Data**

To decide which empirical model to fit, create a scatter plot of the data. Begin by setting up the plot. From the Data/Matrix Editor window press **F2** to select Plot Setup. This brings up the display shown in Fig. 4. With the first plot selected, press **F1** to Define the settings for this plot (Fig. 5). The Plot Type should be Scatter. I choose the Box for Mark since this symbol is large and easy to see. Enter c1 for *x* and c2 for *y*. Press **ENTER** twice to save the settings.

Fig. 5 Plot Definition Settings

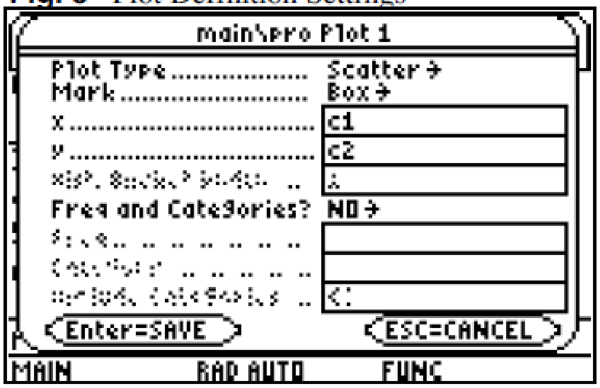
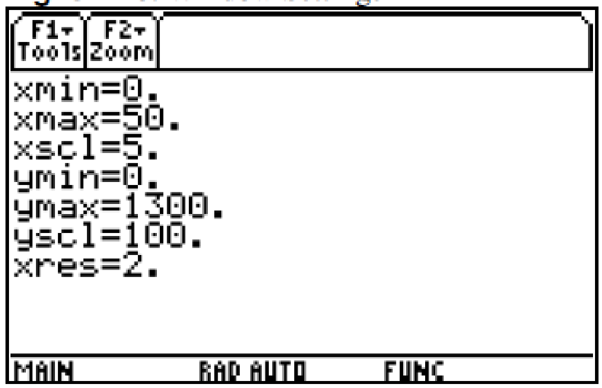


Fig. 6 Plot Window Settings



Define the data range for the plot. Press **WINDOW** (green key of **F2**) and enter the settings shown in Fig. 6. Next press **Y=** (green key of **F1**). If there are any functions displayed be sure they are deselected. A function is selected if it is preceded by a check mark, ✓ (Fig. 7). To deselect a function, use the arrow keys to highlight that function and press **F4**. **F4** is used to toggle function selection. Finally, press **GRAPH** (green key of **F3**) to produce the scatter plot (Fig. 8).

or after graph is plotted go to F2: ZoomFit

Fig. 7 Deselecting Functions

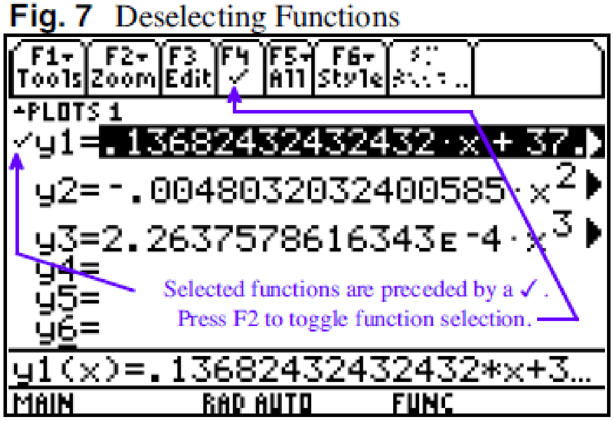
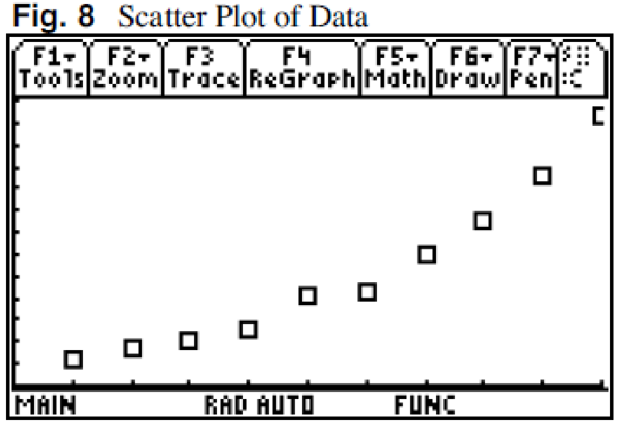


Fig. 8 Scatter Plot of Data

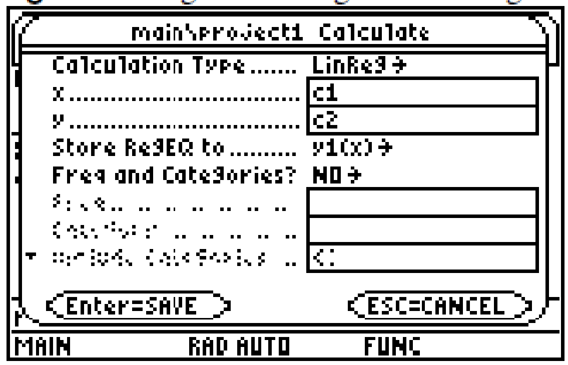


- **Fitting a Linear Function**

The scatter plot in Fig. 8 suggests that a straight line relationship is reasonable. Return to the Data Editor window by pressing the **APPS** key and choosing 6:Data/Matrix Editor and then 1:Current… (Fig. 9). To fit a regression, press the **F5** key to select the Calc menu option and bring up the Calculate window (Fig. 10).

Fig. 9 Reopening a Data Set

Fig. 10 Fitting and Storing a Linear Regression



From the menu selection, set Calculation Type to 5:LinReg. The x-variable is c1 and the y-variable is c2. In order to plot the results, I choose y1(x) as the function in which to Store RegEQ. This will overwrite the current contents of y1(x) with the regression function and automatically select y1(x) for plotting. Press **ENTER** to produce the regression results shown in Fig. 11. Finally, press **GRAPH** (green key of **F3**) to produce the scatter plot with the regression line superimposed (Fig. 12).

Fig. 11 Linear Regression Results

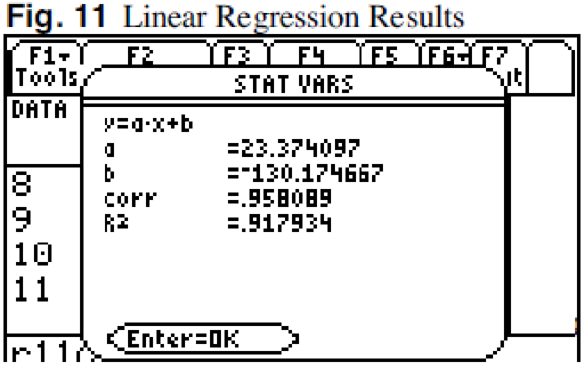
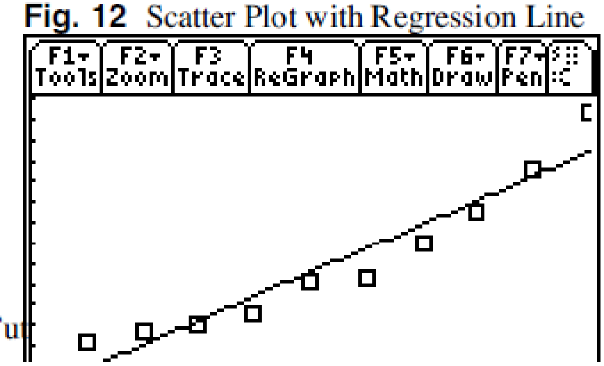


Fig. 12 Scatter Plot with Regression Line



The values of a and b are displayed on the screen along with model that was fit. Based on the output the fitted model is $N(t) = -130.17 + 23.374t$. Qualitatively it would appear from the graph in Fig. 12 that a linear function is a reasonable model. The standard quantitative measure of the usefulness of the regression model is R^2, the coefficient of determination. R^2 measures the fraction of the variability in y that is explained by its linear relationship to x and can take values between 0 and 1. The TI-89 prints R^2 as part of the standard regression output. Since $R^2 = 0.917934$ we conclude that approximately 91.8% of the variability in N is explained by its linear relationship to t. (If the fit were perfect R^2 would equal 1.)

- **Fitting a Quadratic Function**

The scatter plot in Fig. 8 reveals a slight curvilinear trend to the data suggesting a polynomial model might be appropriate. Return to the Data Editor window as explained in the "Fitting a Linear Function" section. Press $\boxed{\text{F5}}$ to select the Calc menu option and bring up the Calculate window. Use the drop down men to set Calculation Type to 9:QuadReg. (Third and fourth degree polynomials can be fit by choosing 3:CubicReg and A:QuartReg respectively.) The *x*-variable is c1 and the *y*-variable is c2. In order to plot the results, choose y2(x) as the function in which to Store RegEQ (Fig. 13). Doing this will overwrite the current contents of y2(x) and automatically select y2(x) for plotting. Press $\boxed{\text{ENTER}}$ to produce the regression results shown in Fig. 14.

Fig. 13 Fitting and Storing a Quadratic Regression

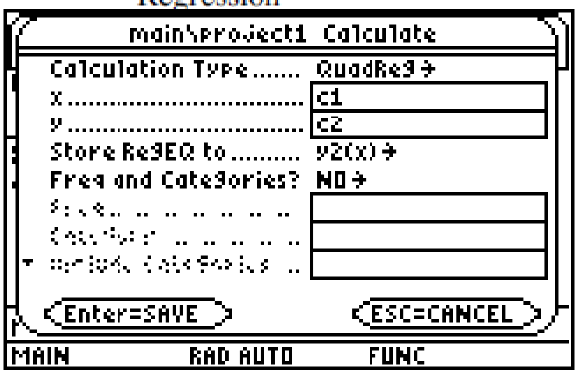
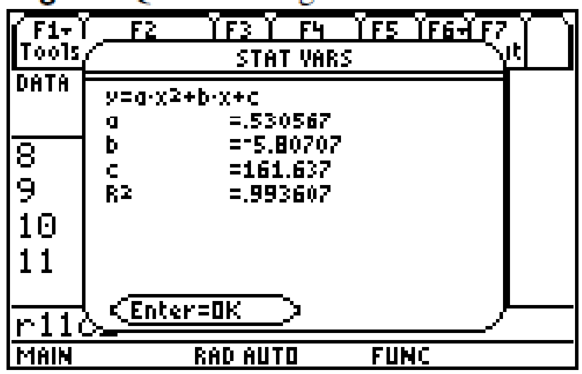
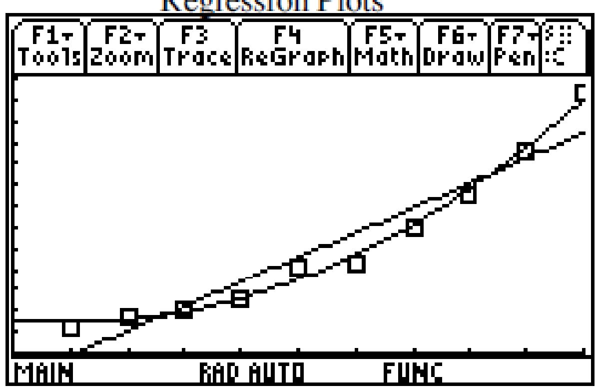


Fig. 14 Quadratic Regression Results



The values of a , b, and c are displayed on the screen along with model that was fit. Based on the output the fitted model is $N(t) = 0.531t^2 - 5.807t + 161.637$. From R^2 we conclude that approximately 99.4% of the variability in N is explained by its quadratic relationship to t. Finally, press $\boxed{\text{GRAPH}}$ (green key of $\boxed{\text{F3}}$) to produce a plot with the quadratic regression function and linear regression function superimposed on a scatter plot of the data (Fig. 15).

Fig. 15 Quadratic and Linear Regression Plots



You can also do - Cubic Regression
- exponential / Log Regression
- others ...

Regression with Curve Expert

Using Technology to Determine Regression
Free download from http://www.curveexpert.net/download/

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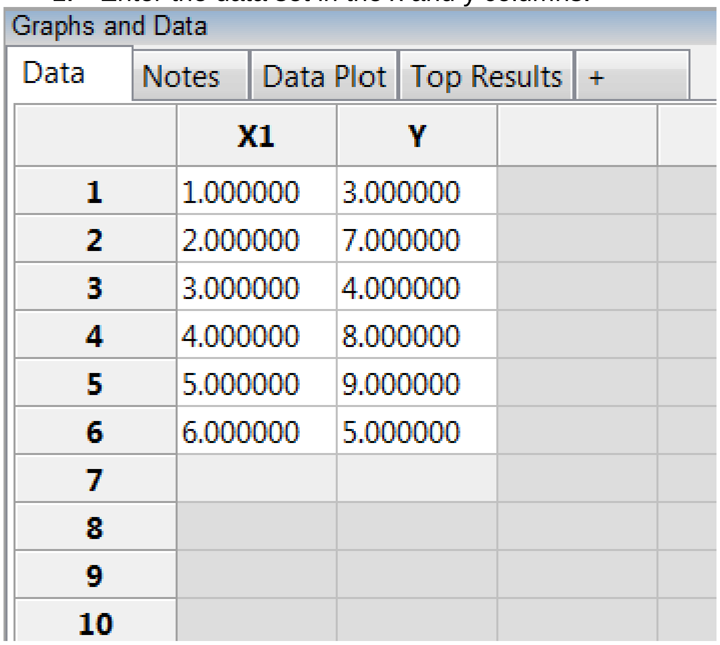
1. Enter the data set in the x and y columns.



	X1	Y
1	1.000000	3.000000
2	2.000000	7.000000
3	3.000000	4.000000
4	4.000000	8.000000
5	5.000000	9.000000
6	6.000000	5.000000
7		
8		
9		
10		

2. Click **APPLY FIT** from the menu, and choose **nth order Polynomial**,
   or from **Calculate** menu select **nth order polynomial fit.**

3. Type in the degree you want to use as regression.

   Note: The polynomial regression tool allows you to choose the degree of the polynomial:
   - Order 2→Quadratic
   - Order 3→Cubic
   - Order 4→Quartic
   - …etc

4. Click **INFO** on the graph to see the coefficients.
   or from **Window** select to view **Messages**

```
Final Result [Linear Regressions/Polynomial Regression (degree=4)]:
  Equation                : a + b*x + c*x^2 + ...
    a = -1.933333333332247E+01
    b = 3.903439153437718E+01
    c = -2.072222222221731E+01
    d = 4.481481481480880E+00
    e = -3.333333333333216E-01
  Standard Error          : 2.015810522715879E+00
  Correlation Coefficient : 9.245946589975047E-01
  Run time                : 0.0010 seconds
```

Regression with the Graphing Calculator TI-83

Using Technology to Determine Regression

Entering data into Lists

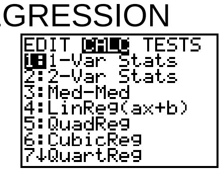
- Press **STAT** and select option **1**
- Clear lists by moving the cursor to the very top of each column in turn and pressing **CLEAR** then **ENTER**.
- Enter the independent variable in $\mathbf{L_1}$
- Enter dependent variable in $\mathbf{L_2}$.

Graphing Your Data

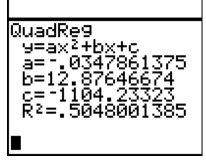
- Draw a scatter plot to show the relationship as follows:
- Use **STATPLOT (2nd Y=)**, select **1** (Plot 1) and press **ENTER**.
- Turn on the plot, choose a scatter plot and enter the correct lists for your **Xlist** is usually L1 (**2nd →1**) and **Ylist** is usually L2 (**2nd→2**).
- Press **GRAPH** to look at the scatter plot. (You may need to use **ZOOM → 9:ZoomStat** in order to see the graph.)

Finding the Equation of the Line of Best Fit (Regression)

- In order to determine the goodness of fit we need the coefficient of determination r^2.
- Press **2nd 0** (**CATALOG**), cursor down to **DIAGNOSTICON**. Then press **ENTER-ENTER-ENTER**. (This only needs to be done one per use)
- Press STAT and cursor across to **CALC**.
- Choose the appropriate regression type:
    - 4:LinReg(ax +b)→LINEAR REGRESSION
    - 5:QuadReg→QUADRATIC REGRESSION
    - 6:CubicReg→CUBIC REGRESSION
    - 7:QuartReg→QUARTIC REGRESSION
    - 9:LnReg→LOGARITHMIC REGRESSION
    - 0:ExpReg→EXPONENTIAL REGRESSION



- For example using linear regression choose **5: QuadReg**. Next, enter the appropriate list names (L_1 first then L_2) separated by commas. The press **ENTER**



- The r^2 value makes the quadratic model not the best fit for the data (moderate fit). The equation of this model is:

$$Y = -0.0348x^2 + 12.876x - 1104.23$$