1.6 Fitting Linear Functions to Data

Laboratory Data: Viscosity of Motor Oil

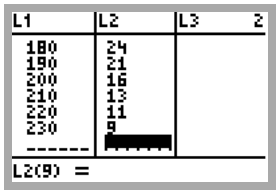
[44] The viscosity of a liquid (its resistance to flow) depends on the liquid's temperature. Viscosity of motor oil is a measure of its effectiveness as a lubricant in the engine of a car. Thus, the effect of the engine temperature is an important determinant of motor oil performance. See the following table for example data.

T, temperature (ºF)	v, viscosity (lbs·sec/in^2)
160	28
170	26
180	24
190	21
200	16
210	13
220	11
230	9

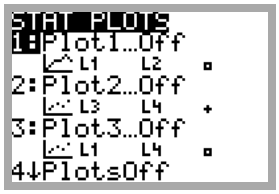
Find a formula that can be used to approximately predict the viscosity of the oil at a given temperature.

Graphing a Scatter Plot

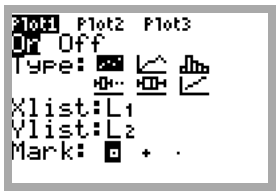
Press STAT ENTER to enter the list editor. If necessary clear previous data in the list. Enter the values from the data table. Note that not all the values show on the screen at one time. This screen and the next require care to distinguish between the keys labeled STAT and STATPLOT, the latter is a 2nd key above the Y= graph key.



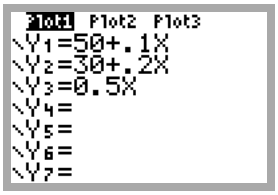
Press 2nd STATPLOT to show a menu of the three special plots called Plot1, Plot2 and Plot3. In this screen we see they are all turned Off. We need to set the first one to On.



We select the first plot by pressing 1, and see a setup screen that allows us to make all the graph settings (except for the window). The settings are changed by arrowing to a choice and pressing ENTER. First turn the plot On. The Type icon shown is a scatter plot. The Xlist and Ylist are set by pasting in L1 and L2. The Mark for each point is a square.

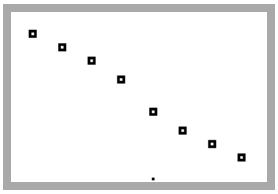


Press Y= to return to the function definition screen. On this screen you see Plot1 highlighted. Turn off any functions that are unrelated to this plot.

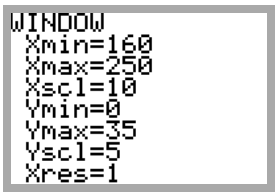


We could look at the data and figure out a good viewing window but the ZOOM menu has a special setting ZoomStat that does this automatically.

Now we see the data points graphed as little square marks. However there are no axes and it may be necessary to press WINDOW to see what the window settings are. (You can also press TRACE and jump from point to point.)



We reset the window slightly to see the horizontal axis. The new window is used as we proceed to the next stage where we draw an approximating line on the graph.



Tip: After a Plot is properly setup, you can turn it on and off from the top of the Y= menu.

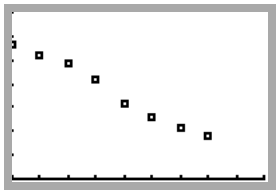
Regression Curves

A regression curve is a function that approximates the data. In this case we see that the data values approximate those of a linear function. The approximating line is called a regression line.

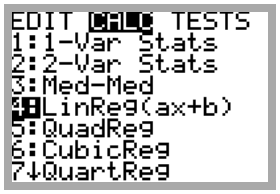
In the coming section, your screen may not appear exactly like the one shown. To avoid dealing with this in the middle of the example we now make a settings change. Start with a clean home screen and use 2ndCATALOG to paste in DiagnosticsOn. Press ENTER, and Done appears. Once this is done, this setting stays on unless it is deliberately reset to be off.

Finding a regression line

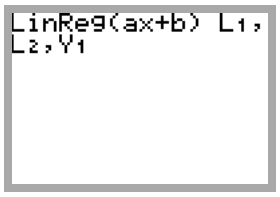
This screen is our scatter plot using the window from the previous plot.



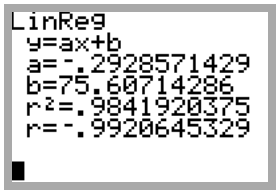
Press STAT and arrow to the CALC menu. Make the choice 4:LinReg(ax+b). Choices 4 and after are the different kinds of regression curves that you can use. We use other regression curves in Section 3.3 and Section 9.7.



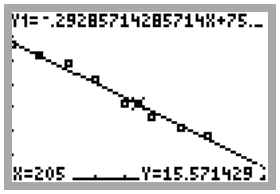
After pasting LinReg(ax+b) on a clean home screen, we specify the two lists and (optionally) a Y to write the regression equation into. We are using L1 and L2 and pasting the equation into Y1. Press ENTER to see the screen in the next frame.



This gives the equation of the regression line, but it also has other information. The r is called the correlation coefficient, and it tells you the closeness of the approximation equation. See your text for more information.



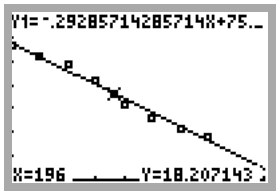
We press TRACE to see the scatter plot and the regression line. Press the up arrow to see that at the top of the screen the regression equation has been pasted to Y1 with full accuracy.



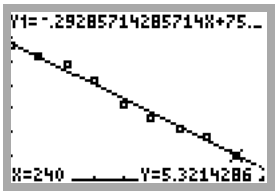
Interpolation and Extrapolation

So what is the use of a regression line? It is a compact formula that can be used to approximate the data values. When it approximates a value between known values it is said to be an interpolation. If the value is before or after known values, then it is called an extrapolation.

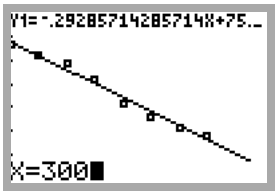
We press TRACE and then up arrow to move onto the regression line. The value of Y for X=196 is an interpolation value.



Arrow right to find the value for X=240. This is an extrapolation.



If you decide you would like to see a value for X=300, which is not on the screen, then you get an error.



To remedy this error, expand the window or use just the TABLE feature.