# Prosperity and the Family Farm

TI-82 and TI-83 Version

Some historians believe that the **size of the average family farm** can serve as a measure of the prosperity of the country - at least to the degree that as long as the farm continues to increase in size, the efficiency improves and the food supply increases. The ability to feed ourselves and much of the rest of the world then assures our prosperity. If this is true, one would expect to be able to forecast the downturn in prosperity and, indeed, perhaps even the beginning of the demise of our way of life, if one could forecast the point at which the average farm will reach its maximum size.

On the other hand, other historians have pointed to the fluctuations in **number of farms** as an indicator of economic prosperity. They have noted that, when times are bad, many seek refuge in a less expensive rural life where self-sufficiency is more nearly possible. But when the economy improves, high salaries lure people to the cities, and the number of farms declines.

Data from *The U.S. Bureau of the Census, Statistical Abstracts of the United States*, give us some information on both of these phenomena. And when **year** is used as the independent variable, each fits a fourth degree polynomial equation quite well. In other words, if one assumes that **X= year** is the independent variable and either **Y= size** or **Y= number** is the dependent variable, then Y can be closely approximated by substituting X in a formula of the form

$$Y = a X^4 + b X^3 + c X^2 + d X + e.$$

The values a,b,c,d and e, called the regression coefficients of the fourth degree least squares polynomial can be found easily with your TI-82 or TI-83 calculator. But first, let's look at the data.

| YEAR 1800=0 | NUMBER in 10000s | ACREAGE per farm | YEAR cont'd | NUMBER cont'd | ACREAGE cont'd |
|---|---|---|---|---|---|
| 50 | 144.9 | 203 | 130 | 629.5 | 157 |
| 60 | 204.4 | 199 | 140 | 610.2 | 175 |
| 70 | 266.0 | 153 | 150 | 538.8 | 216 |
| 80 | 400.9 | 134 | 160 | 396.2 | 297 |
| 90 | 456.5 | 137 | 170 | 294.9 | 374 |
| 100 | 574.0 | 147 | 180 | 242.8 | 427 |
| 110 | 636.6 | 139 | 187 | 217.6 | 461 |
| 120 | 645.4 | 149 | | | |

It is possible to graph the fourth degree approximations for both NUMBER and ACREAGE on the same screen of your calculator. Here's how:

In the STAT Edit menu, select 1:Edit and clear lists L1, L2 and L3. Enter the data above, putting Year in L1, Number in L2 and Acreage in L3. Set your window to a suitable size for this data, remembering that the variable Acreage is increasing rapidly, and that we will want to forecast well into the next century. Press STATPLOT ( above the [Y=] key) select Plot 1, turn on the scatter plot (the first Type) with L1 and L2 as your selected Xlist and Ylist, respectively.

Press graph, and the number of farms will appear as a function of year. To place the best fitting quartic (4th degree polynomial) on your graph, proceed as follows: From the STAT Calc menu, select QuartReg {selection 8 on the TI-82, 7 on the TI-83} . Before you press enter, press [2nd] [L1] [ , ] [2nd] [L2] so that your screen looks like

**QuartReg L1,L2**

Then press [ENTER]. Write your best fitting quartic here:

$$Y= \_\_\_\_\_ X^4 + \_\_\_\_\_ X^3 + \_\_\_\_\_ X^2 + \_\_\_\_\_ X + \_\_\_\_\_ .$$

To graph it press [Y=] , make sure Y1 is clear, and, with the cursor to the right of the "=" mark on Y1, press [VARS] 5:Statistics ▸ ▸ EQ RegEQ {selection 7 on the TI-82, 1 on the TI-83}. Your regression equation above should appear in the function list as Y1. Press[GRAPH]. Note, especially, the year in which the number of farms is projected to begin its increase. Record the year here: _____.(You may wish to use the trace feature of the calculator.)

To set up the calculator for superimposing the function for acreage on the same screen, return to the STATPLOT menu, select Plot2, turn on scatter plot for lists L1 and L3, and choose a different Mark ( say, the +) for your second graph. Press [GRAPH] and your new scatter plot is added to the screen. A return to the STAT Calc menu allows you to produce a quartic regression as before using List 1 and List 3 for your independent and dependent variables, respectively. Write your new function here:

$$Y= \_\_\_\_\_ X^4 + \_\_\_\_\_ X^3 + \_\_\_\_\_ X^2 + \_\_\_\_\_ X + \_\_\_\_\_ .$$

Graph this function as before, using Y2 in your function list. Use the trace feature to determine when a downturn in acreage is expected _____ and what the maximum average farm size will be _____.

Use your analysis to pick the more plausible of the two models and justify your choice, OR find a rationale for discarding both models. **Using a word processor**, write a short report explaining your choice. Make sure your decision is based on verifiable criteria. ( In other words, do not base your decision on opinion. ) Include, if appropriate, your forecast for prosperity.