

### Homework Assignment 3: Due at the beginning of class 10/2/02

The specific learning goals of this assignment are for you to:

- Use graphical and numerical tests to determine whether a given set of data is perfectly linear or not.
- Create linear functions to approximate the trend in a set of data points.
- Use your linear functions to make predictions about the future performance of an economy.
- To examine the appropriateness of continuing with a linear model when circumstances change.

**Note: To expedite your work, the last page of this assignment has two graphs on it. You should hand in this extra page as part of your completed homework assignment.**

During the early 1990's, Argentina was the economic star of South America and widely regarded as a model for the free-market reform of an economy. Beginning in 1993, the Argentine government began to borrow heavily. In February 2002, Argentina defaulted on its foreign debt – the largest default by any country in history. The data in Table 1<sup>1</sup> gives the amount of debt that the central government of Argentina accumulated as time went by. The units of debt<sup>2</sup> used in Table 1 are the percentage of Argentina's GDP<sup>3</sup>.

Year	Debt (% of GDP)
1993	29
1994	31
1995	33
1996	35.5
1997	34
1998	38
1999	43
2000	45.5
2001	52.5

Table 1: Argentine central government debt (as a percentage of GDP), 1993-2001.

<sup>1</sup> The data in Table 1 was obtained from the Argentine Ministry of Economics and the Fundación de Investigaciones Económicas Latinoamericanas (FIEL) a non-profit organization devoted to social and economic research in Argentina and other Latin America countries. Their web site is: <http://www.geocities.com/fielargentina/what.htm>

<sup>2</sup> For example, if the GDP was \$200 billion, and the government owed \$150 billion in debt, this would be expressed as  $(150/200) \cdot (100/1) = 75\%$ .

<sup>3</sup> Remember from Homework 1 that GDP (or Gross Domestic Product) is the value of all goods and services produced within a country's borders during a given year.

1. In this assignment, it will make the most sense to use *year* as the independent variable and *debt* as the dependent variable. Is the relationship between debt and year perfectly linear?

**NOTE:** You should present numerical *and* graphical evidence to support your answer. The graphs included with this homework assignment might be useful when assembling some graphical evidence to back up your answer.

2. On the last page of this homework assignment, you will find a plot of the data from Table 1. Using the plot provided on the last page, sketch the graph of a linear function that does a reasonable job of representing the trend in the data. Find an equation for this linear function. Use  $x$  to represent the year and  $y$  to represent the Argentine government debt.
3. Estimate the Argentine government debt at the time of their default ( $x = 2002$ ). If the Argentine government had not defaulted on their debt, when (i.e. in what year) would the debt have equaled the GDP?
4. In this question, the idea is for you to enter the data from Table 1 into a graphing calculator and use the linear regression capability of the calculator to find the equation for a linear function. Figure 1 (see next page) shows the steps that are involved in doing this on a TI-83 calculator. If you are using another make or model of calculator, you should consult your manual to determine how to:
  - Enter the data into your calculator.
  - Produce an equation for a “least squares” regression line using the data that you have entered.

When you have found the equation for the linear equation using your calculator, record the equation on your homework and sketch a graph of this linear function using one of the plots provided at the end of this homework assignment.

```

[2nd][STAT] CALC TESTS
1:Edit...
2:SortA(
3:SortD(
4:ClrList
5:SetUpEditor

```

Figure 1a: Press the [STAT] button on your calculator. Press [ENTER] to begin data entry.

L1	L2	L3	1
1993	29		
1994	31		
1995	33		
1996	35.5		
1997	34		
1998	38		
1999	43		

L1(=1993

Figure 1b: Enter the data from Table 1 into the lists L1 and L2 of your calculator.

```

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

```

Figure 1c: When you have finished entering the data, press the [STAT] button again. Use the arrow keys to select the CALC menu and move down to “LinReg(ax+b)”

```

LinReg(ax+b) L1,
L2

```

Figure 1d: Press the [ENTER] button to get back to the usual calculator screen. “L1” is entered by pressing the [2nd] and [1] buttons.

```

LinReg
y=ax+b
a=2.666666667
b=-5287.388889
r²=.9102761645
r=.95408394

```

Figure 1e: Press the [ENTER] button again and the calculator will find the equation of the “Least Squares” line that best fits the data.

5. When the Argentine government defaulted<sup>4</sup> on their foreign debt, very few institutions were willing to lend them more money. This effectively froze the amount of money that the government owed. Given this, do you think that the linear functions that you found in Questions 2 and 4 could possibly continue to be accurate predictors of “debt” after 2002?

Two factors to take into account when answering Question 5 are:

- a. What we have been calling “debt” is not simply the dollar amount that the Argentine government owed to its creditors. The quantity that we have been using (represented as an equation) is, in fact:

$$Debt = \frac{\text{Amount of money owed by government}}{\text{Argentina's GDP}} \times \frac{100}{1}.$$

- b. Since 1999, the GDP of Argentina has been decreasing<sup>5</sup>. During 2002, the Argentine GDP is predicted to decrease by about \$38 billion, and many economists forecast that the GDP will continue to shrink for the foreseeable future.

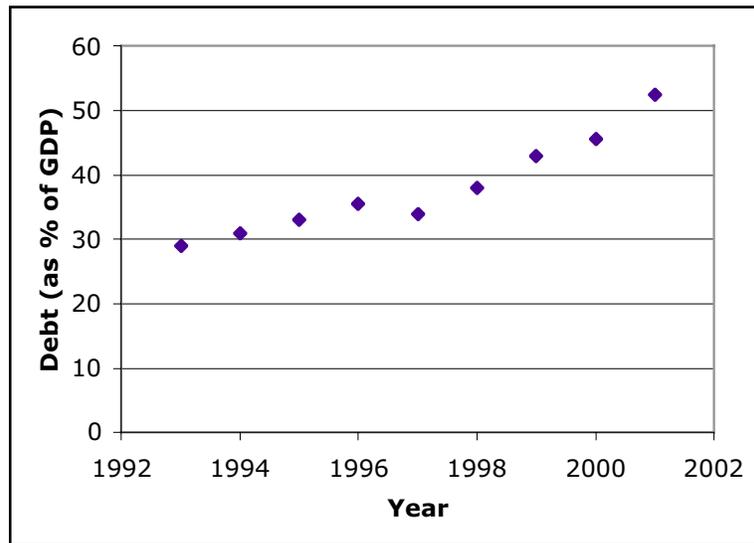
<sup>4</sup> When you take out a loan for something like a car or a house, you normally have to repay the loan in monthly installments. The situation is roughly similar for governments that borrow money. By saying that the Argentine government defaulted on their foreign debt, we are saying that they were no longer able to come up with their monthly installment.

<sup>5</sup> This information was obtained from the International Monetary Fund ([www.imf.org](http://www.imf.org)) and J.P. Morgan, Inc.

**Homework Assignment 3: Graphs for Questions 1, 2 and 4.**

**NOTE:** You should hand in this page (with your name on it) as part of your completed homework assignment.

**Graph 1:** Use this graph as evidence in Question 1, and as a place to draw your linear function in Question 2.



**Graph 2:** Use this graph to draw the sketch of the linear function produced by your calculator in Question 4.

