**ENGR 2013: Engineering Analysis and Applications**

**Laboratory No. 2: Who Wants to Be a Billionaire?**

**Goal:** The goal of this lab is to show you a simple practical application of the linear equation solver you have learned in the first part of this course. Students always seem to be motivated by the chance to make lots of money ;)

**Preliminary Work:** Review how to do simple x-y plots in Python using the Matplotlib library. This tutorial will help you:

https://www.geeksforgeeks.org/matplotlib-tutorial/

This is very similar to what you have learned in MATLAB. Windows users should be able to display plots on their local screen using MobaXterm’s built-in Xserver (a special program that lets you display graphical output from a remote host on your screen).

A screenshot of a computer

Description automatically generated

Figure 1. Graphical output from the xeyes program on a Mac

Mac users will have to install an Xserver known as Xquartz (<https://www.xquartz.org/>). Once this is installed, when you ssh into ece-000, you need to throw the “-Y” option:

ssh -Y <user>@ece-000.eng.temple.edu

After you log in, test this capability by typing “xeyes”. If everything is set up properly, you should see a screen that looks something like Figure 1.

**Tasks:**

1. *Creating Data:* Select your favorite stock. Locate its price history on the Internet by Google searching the name of the stock. I would recommend NVIDIA stock, which has been volatile recently (Google search “NVIDIA stock price”). But be creative and pick a stock in which you have a personal interest. Create a data set consisting of a time value and a stock price by sampling the history of your stock price. A typical data set might look like what is shown in Table 1. The independent variable is the number of days in the past. The dependent variable is the stock price at 12 PM on that day (approximations are okay as long as the time span is long). Do not use the data in Table 1. Find your own data.

Table 1. Stock price data

|  |  |
| --- | --- |
| **Days Before** | **Price** |
| 0 (today) | $255.50 |
| -1 (yesterday) | $200.00 |
| -2 (two days ago) | $199.75 |
| -30 (one month ago) | $175.00 |
| -180 (6 months ago) | $165.65 |
| -365 (1 year ago) | $155.25 |
| -1,825 (5 years ago) | $125.10 |

1. *Curve Fitting:* Using the data points corresponding to “yesterday” and “two days ago” ([-2, $199.75] and [-1, $200.00]), construct a system of equations that describe a line. There are two equations and two unknowns, so the rank of the system is 2.

Solve for the parameters of this line using an appropriate Python tool to solve a system (2x2) of linear equations (e.g., Gaussian elimination). Check the result with manual calculations or using Excel to make sure you are getting the correct result.

Plot the resulting line over the range [-30, 0] and determine how well it predicts the past and future values of the stock. Do not solve the equations manually. Though this is a simple system to solve, later in the course we will extend this model to something much more powerful and complex. Such models require computer tools to be solved.

1. *More Curve Fitting:* Repeat this process for two data points using the price for yesterday and one month ago ([-30, $175.00] and [-1, $200.00]). Continue by using the points corresponding to these combinations:

[-180,$165.65] and [-1, $200.00],

[-365,$155.25] and [-1, $200.00],

[-1,825, $125.10] and [-1, $200.00].

Compare the plots and determine which best predicts the future price of your stock, which you can assume is “today’s” price.

**The Check Off Process:**

For each lab, you will meet with a lab TA during the lab session. The TA will ask you to demonstrate your solutions and will ask you to answer some questions about your code. Though we encourage group work in this course, your ability to answer questions about your code will be a large part of your lab grade. Your TA will form an impression of how well you have mastered the concepts in this lab by the way you answer questions about your solutions and assign a grade accordingly. If you fail to provide working commands or programs, you will receive a score no higher than 50/100 ­­– quite possibly much lower.

Note you only get one chance to check off, so be well-practiced before you attempt the check off.

**Summary:**

How could you use what you have learned to predict the price of a stock tomorrow using today’s price and the previous history of the stock? What is wrong with your “linear” model? How could you improve this model?

The ability to solve a system of linear equations numerically is very important. Throughout this course we will introduce you to many methods to address the above application using much more powerful methods based in statistics. These methods use linear algebra techniques to find their solutions.