

Interactive Visualization of Multivariate Stock Data

Mansha Mahtani

Advisor: Norman I. Badler and Aline Normoyle

University of Pennsylvania

ABSTRACT

Data visualization techniques have been integral to almost all fields of study ever since the need to observe trends and analyze data qualitatively. This project focuses on analyzing multi-dimensional stock data by creating an interactive tool that visualizes information with 3D interactive visualizations. Because of the dilemma with making comparisons between stocks without compromising the level of detail within a stock, it is important to modify the way data is represented and allow for interactivity to control how much of the data should be viewed.

Project Blog: <http://manshamahtani.blogspot.com>

1. INTRODUCTION

The explosive growth of data and the computerization of financial institutions have created a need for tools that reveal the underlying patterns of a data set. Financial information, for example stock data, is known to be large, complex, and multidimensional and therefore there have been considerable efforts to visualize such data using 3D plots or innovative geometric methods.

The real issue arises when stocks are compared with each other and the orders of magnitude are vastly different. This eventually leads to the loss of detail when plotting the variables like volume and price, which could eventually compromise the level of analysis.

Currently, there are attempts to plot these graphs using percentages that infer change in the stocks with relation to each other. However when doing this one tends to compromise the ability to distinguish stocks that are traded at very different values. For example Stock A and Stock B could be experiencing a 10% volume change but stock A jumps from 1000 to 1100 while stock B jumps from 100,000 to 110,000. It is difficult to treat these stocks similarly.

The challenge in creating visualizations of three-dimensional data is ensuring that the complexity of the data does not reduce our understanding of it. Interactivity can help a user dynamically filter information for his or her needs. However, it is important to research the kind of interactivity that will not only provide the maximum utility but also create the best experience for the user.

This project makes the following contributions:

- Developing of an interactive tool to allow for better comprehension of 3-D stock data
- Creating a stylized scale that allows for the comparison between stocks without compromising the level of detail within a stock
- Designing of UI features specific to financial information to enable the revealing of trends in data sets

1.1 Design Goals

This project targets professionals in financial institutions that have to deal with analyzing high dimensional stock data. However, this project can be extrapolated for other kinds of multivariate data beyond financial data. In that case, any professional interested in understanding patterns of multivariate data could be part of the target audience as well. The users of this tool will be able to understand the underlying meaning of their data with the specialized interactivity included.

1.2 Projects Proposed Features and Functionality

This project will incorporate features, including but not limited to:

- Loading data from 'csv' files
- Viewing visualization from all angles
- Specialized UI features to filter the data
- Plotting different stocks together
- Two scales: Logarithmic and Relative

2. IMPLEMENTATION

2.1 Stylizing the Scale

The scale for price and volume is divided into log base 10 sections. The sections do not need to be equally divided and should be dependent on the spacing the user deems fit. As soon as the specific stocks are chosen, they are bucketed in the different sections of the scale – separately for price and volume. For example, if we have the following stocks with ranges:

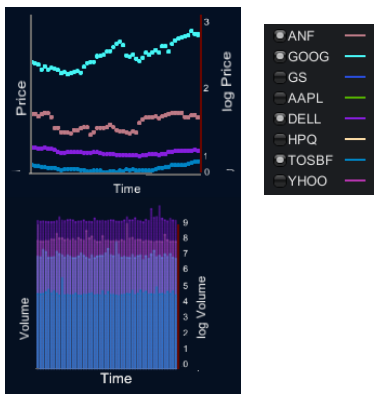
| | Price ranges | Volume Ranges |
|---|---------------|---------------|
| A | \$110 – \$200 | 110K – 115K |
| B | \$300 - \$400 | 15K – 16K |
| C | \$50 - \$70 | 200 - 500 |

Stocks A and B would be in the price section between 10^2 and 10^3 sections while Stock C would be placed in the 10^1 to 10^2 bucket. However in the volume buckets, stock A

would be in the 10^5 to 10^6 bucket, stock B in the 10^4 to 10^5 bucket, and stock C in the 10^2 to 10^3 bucket.

Once stocks are placed into buckets, the buckets are individually viewed. For a particular bucket, the highest and lowest values across all the stocks in the bucket are noted. Then all the stocks within a bucket are plotted with respect to this high and low value. In some sense the stocks are normalized against this range.

When a viewer views the plot, they should be aware that stocks in different sections are vastly different in orders of magnitude. This stylized way of plotting points allows a viewer to view different stocks that are of different orders of magnitude (with respect to the different sections they are in) and yet compare it with other stocks within its order of magnitude. Below we can see the 2D views of the graphs as they are placed in different buckets.



2.2 Interactivity

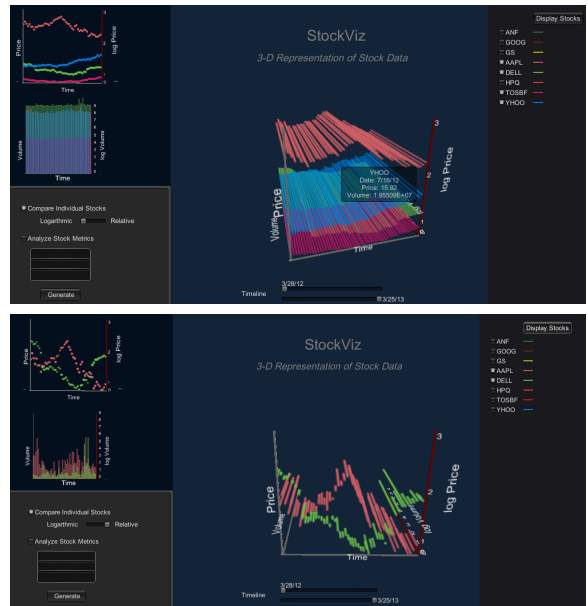
The tool allows for the selection of stocks on the right panel allowing the viewer to decide which stocks he/she wishes to analyze. To view the plot, 2 orthographic views have been provided along with the main 3D visualization. It is possible to rotate and zoom into the 3D visualization with the mouse and arrow keys. Furthermore, there is a mouse over functionality to view the actual values of the points. Since analyst may want to viewer trends within a time frame, it is possible to move the sliders on the bottom panel and constrain the dates.

To allow for some familiarity, there is another mode besides the logarithmic mode. This mode is the relative mode, which normalizes each stock with respect to the upper and lower bounds of the stock itself.

2.3 Technology and Design Decisions

This tool was build with the Unity game engine in C#. In order to display lightweight points, the Particle System game object was used and edited. By placing the cameras in various positions and specifying the camera attributes I was able to create 2D and 3D views. In terms of rotate and zoom, I simply alter the 3D camera's position and field of view.

Because ray tracing the points for the mouse over functionality would be inefficient, I instead projected all the 3D points to 2D space and made a mouse over check at that point. This allowed for greater speed.



3. EVALUATION

Although this tool does solve the problems explained earlier, there are a few issues with this implementation. First, it has an extremely steep learning curve in understanding the data set. For an analyst unfamiliar with the scale, it may be inefficient to learn the scale and then use the tool. Second, this tool can slow down with a large amount of stocks displayed. The implementation is based on lists of data in C# which may not be the best way to create such a tool. Furthermore, the data is formatted in a specific way. However it is rather simply to add more stocks. All that needs to be done is keep just the price, date, and volume columns, rename the file into a text file, and make sure the file name is the stock quote of the stock.

4. FUTURE WORK

The following are a few next steps for this project:

- Support mobile deployment
- Use real time data from Yahoo! Finance
- Use interface techniques an analyst would be familiar with
- Assess trends across metrics. Below is a proof of concept where stocks from the NYSEAMEX are plotted by their P/E ratio, 52-week price change, and free float percentage.

