VISRA: Visualization Tool for Sovereign Risk Analysis

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1 Introduction

Evaluating risks in international markets is an incredibly difficult problem. The data to consider for a sovereign market is overwhelming and the complexity of analytical models is confusing [1]. These large data sets have typically been evaluated by humans interfacing with a database or through 2D graphs and charts [2]. This method leaves much to be desired in terms of productivity and effectiveness, as users cannot detect trends fast enough or at all.

As a solution, a visualization tool, VISRA (VIsualization for Sovereign Risk Analysis) has been designed that allows users to interact with these data sets in a 3D environment that supports manipulation of the data, benchmarking against historical data, and analysis using statistical models. VISRA has been demonstrated to both increase the productivity of its users and to enhance the ability of users to effectively assess markets' risks.

VISRA is a proof-of-concept for further work on devising a more complete, robust tool.

2 Methods

VISRA is a dynamic, interactive 3D-visualization tool that allows users to interact with large sets of data appropriate to sovereign risk analysis. VISRA uses 3D visualization techniques, color and transparency cues, access to historical data and a modular system for statistical analysis. VISRA was created using the Visualization Toolkit version 2.4 and OpenGL [3].

2.1 3D Visualization Techniques

3D visualizations allow large amounts of information to be displayed to users in an intuitive fashion. VISRA uses 3D bar charts and line-graphs to serve as the basic building blocks to encode information. Custom textures are applied to these graphs and to the walls and floor of the environment to encode additional information. These textures, along with 3D layout schemes, cluster relevant information to ensure that users are not overwhelmed by information overload.

2.2 Color and Transparency Cues

Color is used to designate relationships between variables and to provide an initial interpretation of the variables' values to the user. Hue is used to cluster variables. This clustering may be based on a built-in quantitative model or a user-defined model. Saturation is used to indicate the relative contribution of a variable's current value to its underlying model. Low saturation signals safe values. High saturation signals a possibly dangerous situation. The scale is such because the human eye more readily catches high saturation [4].

Transparency is used to deal with visual clutter and to provide a quick evaluation of the reliability of a variable's value. Variables that have not been recently interacted with slowly decrease their alpha values causing them to fade from a user's vision. [Figure 1] Users may also override this system to hard code an alpha value. To signal the reliability of a variable's value (since not all data comes from reliable sources), a near transparent shell the color of the background forms around geometries that represent variables that are not reliable. Decreasing reliability of variables is conveyed through an increasing alpha value, creating the visual effect of the geometry turning into a shadow and disappearing into the background.

2.3 Access to Historical Data

Historical data provides empirical evidence of relations between certain variables under which models predict future risks. VISRA allows users to quickly scan historical data and benchmark it against current data. This is done through the creation of "water-levels" representing historical evidence. [Figure 2] A water-level is a 3D curve built from splines that pass through the historic values of the variables being considered in the current model. This is essentially a surface which can be moved up or down to the wanted level, thus enabling the user to see data above a certain level. This allows for a visually simple benchmark to be conducted: if a variable with a high saturation is above the water-level, it should be investigated. The water-level is semi-transparent so as to not interfere with the overall clutter of the scene.

3 Results

Through experiment, VISRA was demonstrated to allow for both productivity gains and better decision-making in evaluating sovereign risk. A study also showed that VISRA was preferred to the traditional methods.

The success of the project was evaluated by constructing an experiment whereas the data for the variables of interest was presented in either traditional form (spreadsheet and 2D graphs) or within VISRA to a statistically acceptable number of subjects (14) grouped according to finance backgrounds ("Strong", "Some", "None"). Of the group using the new tool, the correct trend was detected roughly 75 percent of the time versus 50 percent for those using the traditional tools. Further, VISRA was shown to enable users to make more accurate quantifications of risk. The average error in quantifying the risk (this amount was only taken into account if the trend estimate was correct) was under 30 percent for VISRA users versus over 40 percent for users of the traditional tools. These results are complementary in proving the fundamental usefulness of VISRA.

A more detailed analysis was conducted to evaluate under which circumstances VISRA was most successful. The experiment was designed to indicate the optimal amount of data VISRA can convey and to which audiences VISRA is particularly effective. It was found that as the amount of data increased, the usefulness of VISRA increased in a linear fashion until a level of 42 data variables was reached, after which the usefulness of VISRA leveled to a constant value (perhaps indicating that there are but 42 important variables to take into consideration when analyzing sovereign risk). It was also found that regardless of the amount of data, the more informed and experienced the user, the more VISRA was useful.

Further tests were conducted to evaluate productivity. Results from this show that VISRA is more time effective than the traditional methods: on average it took VISRA users less than 6 minutes to determine a trend and to then quantify the risk versus over 10 minutes for users of the traditional tools.

Additionally, when prompted to choose between using VISRA versus traditional methods, the volunteers overwhelmingly favored VISRA by a 9:1 ratio.

4 Conclusion

VISRA has been shown to contribute considerably to the analysis of sovereign risk. This is especially true for individuals having past experience in sovereign risk analysis and mostly interested in risks which can be best evaluated through considering 42 or fewer variables.

VISRA currently represents the state of the art tool available for analyzing sovereign risk. However, there are many other areas of finance and complex quantitative analysis in which VISRA may be applied. As such, it should be used as a proof-of-concept for developing complex 3D visualization tools in various disciplines that may benefit from scientific visualizations of large data sets.

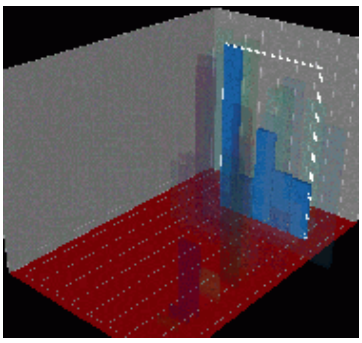

Figure 1: At 50% opacity

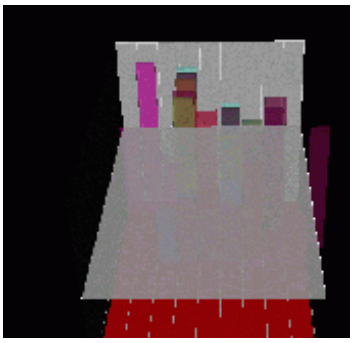

Figure 2: A water-level

References

[1] "International Lending: Country risk analysis", Emilio Mayer, Reston, 1985, p65-93.

[2] "Country Risk", Thomas E. Krayenbuehl, Lexington, 1985 p73-83.

[3] "The Visualization Toolkit", W Schroder, K Martin, B Loresen, 1997.

[4] "Understanding Charts and Graphs: A Project in Applied Cognitive Science," Kosslyn, S. Pinker, W. Simcox, and L. Parkin. NIE 83, 1.310/2:238687.