Research Project Proposal for DCC-UFMG Classes "*Modelagem e Projeto de Algoritmos para o Mercado Financeiro AND Processamento de Dados Massivos*"

J.F.R. Fonseca*
BlueDog Studio
Belo Horizonte, Brazil
jfra.fonseca@gmail.com

ABSTRACT

Proposal for a Research Project to be performed as part of the requisites for concluding the classes "*Modelagem e Projeto de Algoritmos para o Mercado Financeiro AND Processamento de Dados Massivos*" of the Department of Computer Science (DCC) of the Federal University of Minas Gerais (UFMG).

Keywords

Algorithmic trading, Geometric Models, Massive Data, Correlation, Patterns, Supply and Demand

1. INTRODUCTION

The prices of most products are derived from the relation of supply and demand - how much it is available of item A, and how much buyers want of it. The products of the stock market - bonds, assets, stocks - are no different. Various common methods to identify and predict trends of price fluctuations are based on indexes and indicators obtained from important institutions, and analysis based on calculating Moving Averages (MAs), average of the latest few operations involving certain stock. MA methods are efficient to visualize trends on a time series, however, being based on the last several operations, may be slow to respond to change on values observed in fewer operations than the amount considered by the methods.

In this paper, we develop and evaluate GeoSDR (Geometric Supply-Demand Relation) Model, a novel mathematical-Geometric model that illustrates the momentary relation between the Supply and Demand for stocks of a single company, and produces data that can be used to model the behavior of the prices of said stock interactively. We modeled real data of the Brazilian BMFBovespa stock exchange with GeoSDR and supplied the output to the black-box predictive analysis methods "SVM" and "Neural Network", and the white-box "Fuzzy Logic". The GeoSDR data were modeled against real price fluctuations in the periods observed. The predictive models were then used in a simple buy-and-hold speculation strategy simulated using historical data of the same stocks, but in different time periods than the used to create the models. The financial performance was then compared to the variations of the BOV4 index, mutual fund yields, savings account yields, Treasury bonds yields, inflation, purchasing power and cost of living in Brazil in the same period, as well as naive and trivial baseline strategies like random and inverted orders.

*Course-free class student.

2. METHODOLOGY

2.1 GeoSDR Model definitions

The GeoSDR *Model*, Geometric Supply-Demand Relation *Model*, expands the traditional "flattened" view of prices of a stock in a given moment, namely, a single "stick" in the "candlestick" chart. In the GeoSDR *Model*, we plot every offer to buy and sell a given stock in a given moment in a Cartesian plane with the y-axis being the price per share of the offer, and the x-axis being the amount of shares involved. The plot is viewed from the share owner's perspective, so a positive value in the Y axis means that money is being given to the owner, as opposed to a negative value. A Positive value in the x axis means the owner is acquiring shares, and a negative that the number of owned shares is being reduced. So opportunities to sell a owned stock will appear in the quadrant II, named the *Sell* quadrant, where the money flows into the owner's account, and shares flow out. Opportunities to buy new shares will be placed on quadrant number IV, named the *Buy* quadrant.

The *Center of Mass* of each quadrant is the average price practiced, and should be plotted in the barycenter of the cluster of points in the quadrant. The *Center of Mass* is squarely affected by the amount of shares in an offer (the x-value of a point in the plot), as opposed to linearly affected by the price (the y-value). Thereby, each offer plotted in the chart may be considered of a "different mass" depending of its position in the x-axis, pulling the barycenter closer to the bigger modal values and farther of the center of the plot. Plotting the *Center of Mass* of the *Sell* and *Buy* quadrants, we trace the line segment that connects both points. This line segment, named "Geometric Supply-Demand Mass Relation Line", or simply *Mass Relation Line* (MRL), is a vector that expresses information in its length, direction, angle with the normal line, and distance of its midpoint to the

center of the graph. Similar information can be extracted of the line segment that connects the midpoint of the MRL to the center of the graph.

2.2 Predictive Analysis Models

We collected real historical data from the biggest Brazilian stock exchange, BMFBovespa, and randomly selected several periods and stocks to be modeled with GeoSDR. The output of such modelling were fed to the black-box predictive analysis methods "SVM" and "Neural Network", using the observed variations in the prices of the selected stocks as reference data. We also applied the GeoSDR-modelled output to the white-box predictive analysis method "Fuzzy Logic".

2.3 Investment Strategies

The predictive models evolved were used in a simple buy-and-hold investment strategy simulated using historical data of the same stocks used to evolve the model, but in different time periods.

2.4 Results Validation

The financial performance was compared to the variations of the BOV4 index, mutual fund yields, savings account yields, Treasury bonds yields, inflation, purchasing power and cost of living in Brazil in the same period, as well as naive and trivial baseline strategies like random and inverted orders.