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Virtual Stock Exchange. The Java Software

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Abstract

This work is to investigate both the influence of over-fitting and the relation of profits to the prediction errors. The second problem is probably more important, since this is almost an open area so far, in the field of financial optimization.

The new, and, in our opinion, the most important observation of this work was that minimal prediction errors do not necessarily provide maximal portfolio profits. A possible reason of this seemingly counter-intuitive result is that these profits are not necessarily monotonous functions of prediction errors in the standard statistical prediction models.

If this observation will be confirmed by independent sources, then the results may influence the future research in the investment optimization. The emphasis should be switched to direct search of robust trading rules, less sensitive to unpredictable market changes. Therefore, the software is platform independent, open, and designed as a tool for scientific cooperation.

Keywords: Stock-Exchange, Computer Simulation, Java Software

1. On the PORTFOLIO Model

The software is in Java and implements the PORTFOLIO model including the basic algorithm and the data base for running the experiments and analyzing the results. The mathematical description is in the paper Mockus et al. (2014). However, to grasp the basic ideas, a description of the simple singe-stock version is included in the software documentation, using the notation of the prototype model byMockus (2011). The complete user guide also is in the software documentation. In this document, the mathematical description is replaced by the basic algorithm scheme in Figure 1. It reflects model's work-flow and shows the main blocks.

PORTFOLIO model simulates stock exchange market work. Here participants communicate with stock exchange environment, but not directly to each other. Before simulation

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initial data must be set up. There are three types of data in PORTFOLIO model: exchange environment data, stocks data and customers data. Exchange environment data includes transaction cost, bank interest rate, yield of, customer credit limit, count of stocks and count of customer, which be included into simulation and other system data. Every stock has data about it, such as this stock is real or virtual, its name if it is real, bankrupt probability, inertia, dividend and volatility. Every market participant or customer has data about his prediction strategy and trading rule he uses, information about initial stocks, funds and also other setting, used to set up strategy or trading rule. In this game every customer has these objectives: to minimize prediction error and to maximize his profit. So every customer uses selected strategy to predict next day value of every stock, and then uses selected trading rules to make buy or sell operations. At the end of game every customer has profit or loss. PORTFOLIO model includes 19 prediction models: eight AR(p) models with p parameter from 1 to 9, eight AR-ABS(p) models with p parameter from 1 to 9 and Wiener (or Random walk) model. Also 10 trading rules are implemented: 4 short terms trading rules and 6 long term trading rules. Programming language: Java / PHP (for analytics GUI) Database: MySQL Open source license: GPL Website: Software requirement: java version 1.8 or higher, PHP 5.3 or higher, MySQL 5.0 or higher Operating system: software independent User interface: java swing GUI / Web interface

PORTFOLIO model has several modes: Run (or Run with delay) mode, which shows simulation result in program GUI and Experiment Mode which writes all result in given data base. After simulation these data can be shown in web interface from special script or by custom SQL query, report or script. All SQL structures and their configuration are in source code and can be change programmatically. Analytic part of model (PHP) can be extended, but it depends on data table structure.

The objective of the PORTFOLIO model is not forecasting, but simulation of stock exchange processes that are affected by predictions of the participants. The multi-stock extension and a number of different trading rules represent both the heuristics of potential investors and the well-known theoretical investment strategies. This makes the model more realistic and allows the portfolio optimization in the space of investment strategies, in both the historical and virtual environments. The model is designed as a tool to represent behavior of individual investor, which wants to predict how the expected profit depends on different investment rules using different forecasting methods of real and virtual stocks. It is assumed that only available information is the historic data of real stocks.

Optimization in the space of investment strategies and implementation of both the real and virtual stock market in the single model are the new properties of the PORTFOLIO model. The unexpected result was that the minimal stock price prediction errors do not necessarily provide the maximal profits. The complete information is presented for the independent testing and verification of this important new result. Therefore, this result can be tested and verified independently without special skills and equipment, all the experimental conditions are defined and reproducible.

2. On the Software of the PORTFOLIO Model

The algorithmic diagram and the process logic is presented in Figure 2.

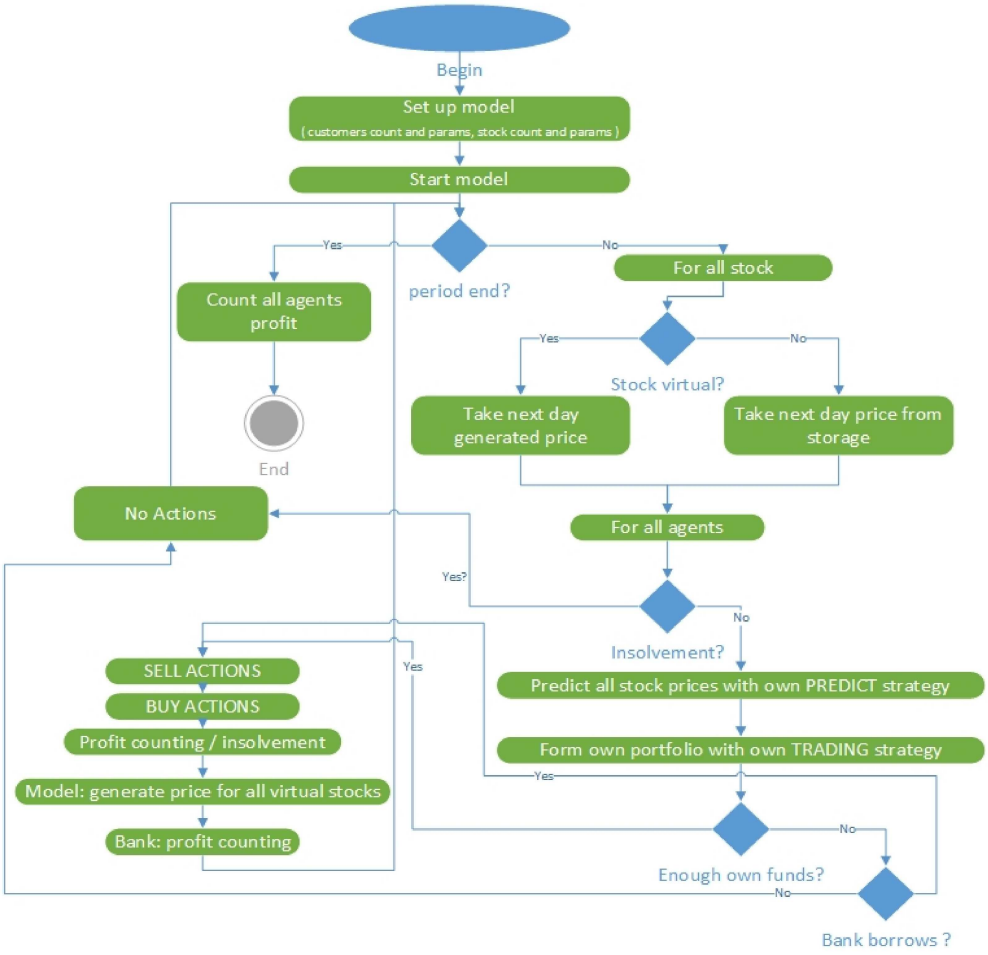

Begin
Set up model
(customers count and params, stock count and params)
Start model
period end?
Yes
No
Count all agents profit
End
For all stock
Stock virtual?
Yes
No
Take next day generated price
Take next day price from storage
For all agents
Insolvement?
Yes?
No
No Actions
SELL ACTIONS
BUY ACTIONS
Profit counting / insolvement
Model: generate price for all virtual stocks
Bank: profit counting
Yes
Predict all stock prices with own PREDICT strategy
Form own portfolio with own TRADING strategy
Yes
Enough own funds?
No
Bank borrows ?
No

Figure 1 *Basic PORTFOLIO scheme*

Using this software, investors can choose one of 190 investment strategies, including ten trading rules and nineteen forecasting models. Three of these trading rules model known theoretical results, the others are new and simulates heuristics of different investors with different approaches to risk.

Investigating the real environment, historical stock prices of popular international companies can be used. In the virtual environment, prices are generated by simulation of behavior of up to eight different major investors. The random noise simulates the influence of small investors.

To make flexible and easily adaptive stock exchange model, the Java technology was selected. The structure of software presents possibility to extend model: to add new prediction methods and trading rules. For large scale automatic experiments, the MySQL technology was applied using the NetBeans and XAMPP tools. So, the software can be used, modified, tested and verified independently.

3. User Guide

- To run PORTFOLIO model just open stock/dist directory and run stock.jar file. After program run and main windows is open, setup all needed options by the examples shown in software documentation.

- To run program in experiment mode change table settings in stock/src/data/Config.java. Also change MySQL connection data here. Here just change table names or make any other changes. Now model configured to read data form MySQL tables. (stock/src/data/Loader.java.) To read data form custom tables change SQL statement in Loader class getRealData2() method.

- To take data from yahoo. Finance (in csv format) just change stock/src/data/Loader.java. Here stock/src/lt/ktu/mockus/srgm/loadYahooData.java can help here. Also any implementation of data loading, which could import data into apl.stockRealData (array) field can be used.

- To store data in SQL tables create then automatically. Their structure is simple and can be viewed in any MySQL client (e.g. PhpMyadmin).

The details are in the software documentation. The underlying theory, applications, and the new results of the software are in the accompanying paper Mockus et al.

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