Optimization of Technical Indicators in Real Time with Multiobjective Evolutionary Algorithms

Francisco J. Soltero CES Felipe II UCM Aranjuez, Spain fsoltero@pdi.ucm.es Diego J. Bodas CES Felipe II UCM Aranjuez, Spain dbodas@pdi.ucm.es J. Ignacio Hidalgo Artecs Group UCM Madrid, Spain hidalgo@dacya.ucm.es

Pablo Fernández CES Felipe II UCM Aranjuez, Spain pfernand@fis.ucm.es Francisco Fernández-de-Vega CUM UNEX Mérida, Spain fcofdez@unex.es

ABSTRACT

Technical analysis uses technical indicators to identify changes in market trends. These are composed by a set of parameters and rules, whose values try to determine the future movements of the assets. The use of Multi-objective Evolutionary Algorithms (MOEAs) is proposed in this work to obtain the best parameter values in real time belonging to a collection of indicators that will help in the buying and selling of shares. This technique can greatly improve the results of the Buy & Hold (B & H) strategy even operating daily.

Categories and Subject Descriptors

I.2.8 [Computing Methodologies]: Artificial Intelligence, Problem Solving, Control Methods, and Search.

General Terms

Algorithms, Economics.

Keywords

Finance, Optimization, Evolutionary Algorithms, Technical trading rules

1. INTRODUCTION

The stock market is the site where investors come together for the sale of financial assets. The behavior of the values has been studied since the early market times. This study can be classified as fundamental or technical analysis. The latter is based on the use of technical stock market indicators (TIs) that are configured according to a set of parameters which work on discrete time series of prices of the target value. Several studies have applied Evolutionary Computation techniques for obtaining trading rules in order to maximize the benefits of investments. A review of the state of the art is done by Lohpetch and Corne in [1],

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GECCO'12 Companion, July 7–11, 2012, Philadelphia, PA, USA. ACM 978-1-4503-1178-6/12/07.

where the use of Multi Objective Genetic Programming is suggested to discover effective trading rules. The rest of the paper is structured as follows. Section 2 provides a short review of related work on Evolutionary Computation and finance. Section 3 explains the method used in this article. Section 3.2 presents the time-real environment. Section 4 shows the experiments performed and result. Conclusions are presented in section 5.

2. RELATED WORK

Related to the creation of technical rules, there are a wide variety of previous researches: Approaches that use Genetic Algorithms or other Evolutionary Algorithms (EAs) to optimize a Neural Network, Algorithms based on Genetic Programming (GP) or EAs to evolve trading rules . In [2] it was proposed a version of a technique for optimizing the parameters of TIs such as Moving Average Convergence-Divergence of indicator (MACD) and the Relative Strength Index (RSI). The technique is based on the use of MOEAs with Super Individual (MOEASI) and can be applied to a large number of TIs.

3. PARAMETER OPTIMIZATION OF TIS USING MOEAS

In dynamic optimization problems, the set of training data, constraints and objective function are static. That generates mainly two problems: 1.-It does not take into account the evolution of the system. 2.-Individuals may be sensitive to training data set. Validation periods named above are included to avoid this overtraining. Thus, the sensitivity to the data set decreases, but it is not eliminated. It would be possible to think of sensitivity of a larger data set. In this work the training set varies with each new data. The solutions are obtained continually and they have a temporary effect. This approach minimizes the two problems described above, since it takes into account both the current state of the system and the changes on it. This implies that the training data set cannot be other that the closest in time. The execution shows the best TIs (non dominated solutions) in the past and the parameters with which these results have



Figure 1:

been achieved. This search is done using an MOEA and is represented in Figure 1. Thus, we can account for the buy and sell orders issued over a period of time and measure the effectiveness of this methodology.

3.1 Fitness and evaluation of the individuals

We work with eight objectives (f1 to f8), four of them associated to the MACD indicator (f1 to f4) and FOUR associated to the RSI indicator (f5 to f8). These objectives are: The maximization of the profits (f1 for MACD and f5 for RSI). Minimization of the transaction costs (f2 for MACD and f6 for RSI). Minimization of the Risk Trend (RT) f3 for MACD and f7 for RSI. Minimization of the Risk VIX (Rvix) (f4 for MACD and f8 for RSI).

3.2 Environment

The theoretical work has been implemented in a realtime software platform. The library provided by jMetal 4.0 (c) has been employed with the heuristic algorithms. For data acquisition and real-time operational software was used Metatrader 4 (c). In this paper we have employed the algorithm NSGA-II, with the S&P500 and for different time intervals. The System Architecture consists mainly of four modules (Figure 2).

4. EXPERIMENTS AND RESULTS

MIX strategy uses a multi-objective strategy that includes elements for risk management. Furthermore, this strategy allows us to combine several indicators. Here, we compare in figure 3, our strategy with the best results showed in [1]. This Experiment optimize the MACD and RSI with the objectives f1 to f8. In this experiment, each solution contains two indicators, since the first three genes describe the MACD and the remaining 3 to RSI. Therefore, each individual provides two potential profits (f1 and f5). The solution with the maximum value of f1 or f5 in the whole set is selected to be apply in the day. The MIX strategy gets similar results in monthly and weekly trading splits. It improves the daily results. Consequently, we conclude that the scheme proposed in Figure 1 is a valid investment strategy.

5. CONCLUSIONS

The continued evolution of the training data set allows greater adaptability of the solutions to the changing mar-



Figure 2: Functional diagram of the system



Figure 3: Perfomance in comparison with B&H

ket. Different objectives for achieve maximum profit, for risk reduction and for decrease transactions cost have been proposed. Therefore, it is possible to conclude that the use of MOEAs to optimize the parameters of TI can lead to a good solution for trading follow the scheme proposed. Future versions will include more indicators which allow the user to choose the indicators with which he wants to operate.

6. ACKNOWLEDGMENTS

This work has been partially supported by Spanish Government grants Avanza Competitividad I+D+i TSI-020100-2010-962, INNPACTO IPT-2011-1198-430000, and TIN 2008-00508. Projects TIN2011-28627-C04-03, Science and Innovation Ministry, GRU10029, Gobierno de Extremadura and EDERF, and Municipality of Almendralejo.

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