Chapter 41
iTrade:
A Mobile Data-Driven Stock Trading System With Concept Drift Adaptation

Yong Hu
Guangdong University of Foreign Studies, China & Sun Yat-sen University, China

Bin Feng
Guangdong University of Foreign Studies, China

Kang Xie
Sun Yat-sen University, China

Xiangzhou Zhang
Sun Yat-sen University, China

Mei Liu
University of Kansas Medical Center, USA

ABSTRACT

Among all investors in the Chinese stock market, more than 95% are non-professional individual investors. These individual investors are in great need of mobile apps that can provide professional and handy trading analysis and decision support everywhere. However, financial data is challenging to analyze because of its large-scale, non-linear and noisy characteristics in a varying stock environment. This paper develops a Mobile Data-Driven Stock Trading System (iTrade), which is a mobile app system based on Client-Server architecture and various data mining techniques. The iTrade is characterized by 1) a data-driven intelligent learning model, which can provide further insight compared to empirical technical analysis, 2) a concept drift adaptation process, which facilitates the model adaptation to market structure changes, and 3) a rigorous benchmark analysis, including the Buy-and-Hold strategy and the strategies of three world-famous master investors (e.g., Warren E. Buffett). Technologies used in iTrade include the Least Absolute Shrinkage and Selection Operator (Lasso) algorithm, Support Vector Machine (SVM) and risk-adjusted portfolio optimization. An application case of iTrade is presented, which is based on a seven-year (2005-2011) back-testing. Evaluation results indicated that iTrade could gain much higher cumulative return compared to the benchmark (Shanghai Composite Index). To the best of our knowledge, this is the first study and mobile app system that emphasizes and investigates the concept drift phenomenon in stock market, as well as the performance comparison between data-driven intelligent model and strategies of master investors.

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1. INTRODUCTION

Currently, in the Chinese stock market, there are more than 100 million individual investors, among which 95% are non-professional. Institutional investment only accounts for 10% of total market capitalization, and the majority of total outstanding shares are owned by individuals (Wang & Xu, 2004). These individual investors are in great need of mobile decision support system (apps) for trading analysis and decision making.

Although numerous commercial software and freeware, such as *Dazhihui*, *Qianlong*, *Tonghuashun* (from China), *ProfitSource*, *eSingal*, and *VectorVest* (from other countries, see http://stock-software-review.toptenreviews.com) are available to common investors, none of them incorporates data mining functions; they only provide information retrieval, statistical analysis, trade ordering, and technical analysis-based program trading. Their build-in trading rules/models are empirical and static, and thus they cannot adapt to the varying market in time. In addition, they cannot process large-scale financial data due to the limited computing ability of mobile devices (Goh & Taniar, 2004).

Data mining technologies are suitable to address these limitations because they can handle large-scale, non-linear, noisy data. These techniques are used to study data and discover new, hidden, unexpected, valuable trends or patterns from existing databases, and have gained increasing attention in science and business areas (Daly & Taniar, 2004). Client-Server (C/S) architecture can be deployed to partition workloads and share computing resources. Therefore, this paper is to develop a C/S-based Mobile Data-Driven Stock Trading System (iTrade), which can provide intelligent decision support for non-professional investors on mobile devices. The unique characteristics of iTrade can be outlined in three aspects.

First, a data-driven intelligent learning model is constructed for accurate stock (trend) prediction. Compared to the empirical technical trading rule-based stock analysis software, the proposed model is based on a well-known data mining algorithm, Support Vector Machine (SVM) (Vapnik, 1995), which is gaining more and more popularity in stock prediction (Hu et al., 2013; Huang, 2012; Lee, 2009).

Second, a concept drift adaptation process is proposed to identify market structure changes and adapt the learning model to these changes. This is about how to identify the most informative and up-to-date predictors (e.g., fundamental/technical factors) that can explain future excess returns. This process can be realized by combining feature selection and sliding window method (Tsai & Hsiao, 2010; Zhang et al., 2014). In this paper, feature selection is based on the Least Absolute Shrinkage and Selection Operator (Lasso) algorithm because of its effectiveness in sparse and consistent model selection (Zhao & Yu, 2006). Moreover, sliding window method is combined with Lasso to perform adaptive feature selection, which can handle the phenomenon of concept drift that the most informative predictors are ever-changing from time to time, especially from bull to bear market, vice versus. Concept drifts generally exists in stock market and might be derived from mass psychology, macroeconomic, the development of technology, and so on, which makes adaptive feature selection imperative.

Third, a rigorous benchmark analysis is provided to evaluate iTrade, including performance comparisons with 1) the quantified strategies of three world-famous master investors (Warren E. Buffett, William J. O'Neil and Richard Driehaus), and 2) the Buy-and-Hold strategy. This analysis indicates whether the data-driven intelligent model can defeat the human experts.

An application case was carried out to demonstrate and evaluate iTrade. This case was based on a seven-year back-testing using historical stock data from China Stock Exchanges during the period from 2000 to 2011. Comparative evaluations were conducted to examine whether iTrade could gain higher