DIVERSIFICATION PHILOSOPHY AND BOOSTING TECHNIQUE FOR TRADE EXECUTION STRATEGY

By

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CERTIFICATE OF AUTHORSHIP/ORIGINALITY

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

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To My Wife Ying Liu and My Parents

Abstract

This thesis explores the rationale and effectiveness of diversification across time and strategies, which is an important philosophy for risk management in practice, in the framework of developing trade execution strategies. In this thesis, the strategies are defined as making a series of decisions based on real-time state variables over a fixed period to achieve high reward and low risk with given resources. Trade execution strategies are to make a series of decisions on how to place an order in markets based on real-time market information over a fixed period to fill the order with low cost and risk in the end.

In the 1st part, this thesis explores diversification across time. The research of trade execution has shown that although limit order strategy achieves lower cost than market order strategy does, it may incur nonexecution risk and miss trading opportunities. This thesis proposes a strategy that reflects the idea of diversification across time to improve the limit order strategy. In the 2nd part, this thesis explores diversification across strategies. Techniques for implementing this idea have been proposed to acquire strategies from a candidate strategy set and determine their weights. For those techniques, the candidate strategy set normally only contains finite strategies and the risk that they reduce is only measured by one specific standard. This thesis proposes a technique that overcomes those drawbacks. In the 3rd part, the proposed technique is applied to improve trade execution strategies.

The strategy proposed in the 1st part is called DF (dynamic focus) strategy, which incorporates a series of small market orders with different volume into the limit

order strategy and dynamically adjusts each market order volume based on two real-time state variables: inventory and order book imbalance. The sigmoid function is adopted to map the variables to the market order volume. Experiments show that the DF strategy achieves lower cost and risk than the limit order strategy does.

The technique proposed in the 2nd part extends the key idea of the AdaBoost (adaptive boosting) technique, which is discussed mostly in the supervised learning field. It is named DAB (diversification based on AdaBoost) in this thesis. The DAB technique adaptively updates the probability distribution on training examples in the learning process, acquires strategies from a candidate strategy set and determines their weights. Resources (e.g. money or an order) are allocated to each acquired strategy in proportion with its weight and all acquired strategies are then executed in parallel with their allocated resources. The DAB technique allows the candidate strategy set to contain infinite strategies. Analysis shows that as the learning steps increase, the DAB technique lowers the candidate strategy set's risk, which can be measured by different standards, and limits the decrease in its reward.

The DAB technique is applied in the 3rd part to acquire DF strategies from a candidate DF strategy set and determine their weights. The entire order is allocated to each acquired DF strategy in proportion with its weight and all acquired DF strategies are then executed in parallel to fill their allocated order. In this thesis, this parallel execution is called BONUS (boosted dynamic focus) strategy. Experiments support theoretical analysis and show that the BONUS strategy achieves lower risk and cost than the optimal DF strategy and two simple diversification techniques do.

This thesis is contributed to both finance and computer science fields from the theoretical and empirical perspectives. First, the proposed DF strategy verifies the effectiveness of diversification across time through improving the existing trade execution strategies. Second, the proposed DAB technique provides a flexible way for implementing diversification across strategies to complement the existing diversification techniques and enrich the research of the AdaBoost technique. Third, the proposed DAB technique and BONUS strategy provide a flexible way to improve trade execution strategies.

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List of Publications

Below listed are my research papers that have been finished during my PhD study at the University of Technology, Sydney and published in the international journals or conferences:

1. Wang, J. Q. and Zhang, C. Q. (2006) Dynamic Focus Strategies for Electronic Trade Execution in Limit Order Markets, In *Proceedings of the 8th IEEE International Conference on E-Commerce Technology.*
2. Wang, J. Q., Zhang, C. Q., Wu, X. D., Qi, H. W. and Wang, J. (2006) SVM-OD: SVM Method to Detect Outliers, *Foundations and Novel Approaches in Data Mining (Eds. Lin, T. Y., Ohsuga, S., Liau, C. J. and Hu, X.)*, Springer-Verlag, 129-141.
3. Wang, J. Q., Wu, X. D. and Zhang, C. Q. (2005) Support Vector Machines based on K-Means Clustering for Real-time Business Intelligence Systems, *International Journal of Business Intelligence and Data Mining*, 1 (1), 54-64.
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