Supervised Deep Learning for Optimized Trade Execution

Hua Wanying, Long Zijie, Wang Kunzhen

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1 Introduction

2 Literature Review

3 Model

In this project, we developed the following supervised deep learning model to predict the optimal execution strategy. The model is implemented with *Tensorflow* and *Tensorflow Keras* provided by Google Brain, using *Python*. Implementation of the model can be found in the file *Model.py*.

- **Input Layer** The model input consists of two categories. Being natural to base the decision on market environment, we carefully choose the following 4 input variables to reflect the market conditions, i.e., price level and trend, volume mismatch and bid-ask spread. They are referred to as the **market variables**. In addition, the model is also fed with two factors that are specific to the problem itself which we called the **private variables**. These include the remaining time before the end of the time horizon, t, and remaining inventory to be sold, i. Detailed definitions, rationales and extractions of these variables are provided in Section 4.2 and 4.3.

- **Hidden Layers** The model is composed of 5 fully-connected hidden layers with 256 neurons each. Activation functions for each layer is, correspondingly, *leakyReLu*, *sigmoid*, *dropout* with a rate of 0.5, *leakyReLu*, *sigmoid*. These activations are chosen after taking into consideration the nature of the problems. For example, noting the sparse activation characteristic of the *leakyReLu* activation and that the outputs are discrete, we chose *leakyReLu* to denoise the training process. Another advantage of the *leakyReLu* is its computational efficiency and ability to avoid dead neurons. The *sigmoid* activation is chosen for its ability to capture non-linear relationships. A *Dropout* layer is chosen in the middle to denoise and speed up the descent.

- **Output Layer**

4 Model Training

4.1 Data Description

4.2 Market Variables

4.3 Private Variables

5 Results

6 Remarks

7 Conclusion

References

[1] Yuriy Nevmyvaka, Yi Feng, Michael Kearns. *Reinforcement Learning for Optimized Trade Execution*. Proceedings of the 23rd International Conference on Machine Learning, Pittsburgh, PA, 2006.