Adaptive stock trading strategies with deep reinforcement learning methods

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2020: In order to make profit from the stock market,the GDQN and the GDPG are proposed for quantitative stock trading

**Some Necessary Terminologies**

Adaptive stock trading strategies using deep reinforcement learning methods, specifically the Gated Recurrent Unit (GRU), have been proposed to address the challenges of complexity and dynamism in stock markets, with two strategies, GDQN and GDPG, outperforming traditional strategies and achieving stable returns in both trending and volatile markets.

In ‘Adaptive stock trading strategies with deep reinforcement learning methods’, a group at the University of Sannio led by Xing Wu (2020) reported that the proposed GDQN and GDPG are deep neural networks combined with reinforcement learning for quantitative stock trading.  
They extract informative financial features and improve accuracy and robustness.  
The GDQN and GDPG are effective in diverse stock markets and overcome the shortcomings of traditional trading strategies.  
They achieve stable returns under an acceptable risk level compared to the state-of-the-art DRL trading strategy.  
Future work will focus on utilizing deep reinforcement learning methods in portfolio management.  
  
The authors suggest that the future work will focus on using deep reinforcement learning methods in portfolio management for a good quantitative stock trading strategy.

#The process involves dropout probability set to 20%

**Roles of above terms**

* The financial industry exists to make profits by allocating resources to where they are most effective
* The proposed GDQN and GDPG are the combination of deep neural networks and reinforcement learning and they are promising in quantitative stock trading due to following advantages: 1. They extract informative financial features with Gated Recurrent Unit (GRU) from raw financial data and technical indicators to improve the accuracy and robustness for the representation of stock market conditions
* In order to make profit from the stock market, the GDQN and the GDPG are proposed for quantitative stock trading
* For the time-series nature of financial data, the deep learning module is implemented with the GRU
* According to the experimental results, the proposed GDQN and GDPG are effective in diverse stock markets
* Our future work will focus on utilizing deep reinforcement learning methods in the portfolio management

**Summary**

**Introduction**

The financial industry exists to make profits by allocating resources to where they are most effective. Investors used to trade stocks based on their perceptions of the stock market.

This way of trading is usually inefficient and prone to major losses caused by investors’ irrational behaviors. Different from typical trading behaviors, quantitative trading is a mode of profit mining from historical market data, which can be realized automatically by algorithms.

We are motivated by the call to develop quantitative trading strategies adapting to the ever-evolving stock market. The investment to stock markets aims to realize profit maximization, whereas the objective of reinforcement learning methods is to maximize some portion of the cumulative reward.

It is promising to propose adaptive stock trading strategies with deep reinforcement learning methods

**Contributions**

The proposed methods are composed of deep learning module and reinforcement learning module. The deep learning module is used to extract stock market features from raw market data and technical indicators. For the time-series nature of financial data, the deep learning module is implemented with the GRU. Meanwhile, reinforcement learning module executes trading actions through GRU extracted deep features. Extensive experiments are carried out to verify the effectiveness and robustness of the proposed GDQN and GDPG methods. According to the experimental results, the proposed GDQN and GDPG are effective in diverse stock markets. They overcome the shortcomings of traditional trading strategies that can only perform well in a single market pattern. Furthermore, compared with the state-of-the-art reinforcement learning method, DRL trading strategy, our proposed methods effectively capture more market opportunities to achieve more stable returns under an acceptable risk level.

**Results:**

* In order to verify the effectiveness and robustness of the proposed trading strategies, the GDQN and GDPG are evaluated and compared with the Turtle Trading Strategy and a state-of-the-art direct reinforcement learning strategy, DRL.
* The DRL utilizes an actor-only framework, which learns the policy directly from the continuous sensory data, stock market features, and defines a spectrum of continuous actions according to the learned policy.
* What’s more, the DRL achieved good performance in stock markets.
* Since the proposed GDQN and GDPG share the same structure as the DRL, it is natural to make comparisons between proposed methods and the DRL trading strategy.
* The experimental stock data is selected from three countries: the U.S stock market, the U.K. stock market, and the Chinese stock market.

**Two-Cents**

* Deep reinforcement learning in stock trading is new horizons in industry and in academia.
* Stock trading is the buying and selling of shares of one or some companies.
* A quantitative stock trading strategy relies on quantitative analysis, which combines mathematical computations with statistical technical indicators to identify market patterns and make trading actions.
* While deep reinforcement learning is to take suitable actions to maximize reward in a particular situation.
* It is reasonable for reinforcement learning methods to play some roles in quantitative stock trading.
* The GDQN and the GDPG are proposed to maximize the profitability through a sequence of steps in different stock markets

**Conclusion**

* Conclusion and future workIn order to make profit from the stock market, the GDQN and the GDPG are proposed for quantitative stock trading.
* The proposed methods are composed of deep learning module and reinforcement learning module.
* The deep learning module is used to extract stock market features from raw market data and technical indicators.
* For the time-series nature of financial data, the deep learning module is implemented with the GRU.
* Reinforcement learning module executes trading actions through GRU extracted deep features.
* According to the experimental results, the proposed GDQN and GDPG are effective in diverse stock markets.
* They overcome the shortcomings of traditional trading strategies that can only perform well in a single market pattern.
* Compared with the state-of-the-art reinforcement learning method, DRL trading strategy, our proposed methods effectively capture more market opportunities to achieve more stable returns under an acceptable risk level

**Future-Motivation:**

A good quantitative stock trading strategy needs to build portfolios of multiple stocks. Our future work will focus on utilizing deep reinforcement learning methods in the portfolio management.