PhD Dissertation Defense

NETWORK SCIENCE APPROACHES TO STOCK MARKET PREDICTION AND TEXT CLASSIFICATION PROBLEMS

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Zoom Link: https://binghamton.zoom.us/my/hirokisayama

Abstract

Network science has been widely adopted by a variety of research areas including biomedical, financial engineering, social science, and psychology, providing collective insights and capabilities for understanding complex behaviors. As a powerful tool for analyzing and understanding complex systems by examining relationships between things and deeper structural information, network science has brought a new perspective to analyzing collective phenomena of interconnected components. This dissertation presents the applicability of network science theories in solving real-life business problems involved in large-scale complex systems, and provides methods and applications that may potentially benefit certain businesses such as finance and AI. Specifically, the study investigates how network science can be used in financial market forecasting, decision-making in stock market trading, and conversational AI systems.

In financial market forecasting, the study proposes a new method that utilizes network measurements extracted from S&P 500 networks to improve the predictability of conventional ARIMA models. The study shows that changes in the network strength distributions provide important information on the network's future movements, and the inclusion of network measurements significantly improves the model accuracy. Moreover, the study proposes a network-based Exponential Moving Average (EMA) method for making trading decisions, which outperforms the traditional EMA with an ability to capture more trading opportunities and yield a bigger return at each trade.

In the conversational AI area, the study proposes a network community detection-based approach to automatically label text data for solving a classification problem, which outperforms human-labeled data by 2.68-3.75% in classification accuracy. This approach helps detect mislabeled and ambiguous data points that negatively affect model performance, reducing development time and cost for industries using conversational AI technology.

Overall, this dissertation has demonstrated the innovative applications of network science methodologies in financial market forecasting and conversational AI systems. The findings have revealed the potential of network-based approaches to benefit market prediction accuracy, text classification development workflow, and offer valuable insights for analyzing such complex systems.