Ph.D. Dissertation Defense

Candidate:	Jing Chen
Degree:	Doctor of Philosophy
School/Department:	Interdisciplinary / Data Science
Date:	Wednesday, August 20, 2025
Time:	9:00 am – 11:00 am
Location:	Virtual (https://stevens.zoom.us/j/96285754075)
Title:	Integrating Deep Learning and News Analysis for Multivariate Time Series Forecasting
Chairperson:	Dr. Chihoon Lee, Information Systems and Analytics, School of Business
Committee Members:	Dr. Yue Ning, Computer Science, School of Engineering & Sciences Dr. Tal Ben-Zvi, Management, School of Business Dr. Zachary Feinstein, Financial Engineering, School of Business Dr. Ping Wang, Computer Science, School of Engineering & Sciences

Abstract

Multivariate time series (MTS) is widely used in various domains, including healthcare, finance, and industrial applications. While machine learning shows exceptional performance in MTS forecasting, primary challenges remain: 1) difficulties in early-stage prediction due to data scarcity; 2) limited integration of prior experience, as most existing work is isolated without knowledge transfer from related tasks; 3) the underutilization of complex exogenous factors, such as news, policies, and geolocations. This defense utilizes cutting-edge machine learning to improve MTS analysis accuracy and robustness for data-driven decision-making.

Essay 1 is "Forecasting emerging pandemics with transfer learning and location-aware news analysis". We focus on MTS analysis in the healthcare application scenario, specifically addressing the challenges inherent in epidemic forecasting. We proposed an ensemble framework based on graph neural networks. This framework integrates heterogeneous transfer learning architecture to learn and transfer general characteristics from existing epidemic diseases to predict a new pandemic. Moreover, we designed a multimodal data learning module within the proposed framework to learn the impact of news sentiment and semantic information on the epidemic's dynamic propagation.

Essay 2 is "Healthcare sustainability: hospitalization rate forecasting with transfer learning and location-aware news analysis". Hospitalization forecasting is essential for healthcare systems to develop long-term sustainability during pandemics. We propose a framework to accurately predict hospitalization rates by leveraging the established non-linear relationship with infection cases. We examine the impact of public opinion and sentiment from news articles on hospitalizations at both the U.S. national and state scales. By integrating multiple exogenous factors, we improve the performance of hospitalization rate forecasting, thereby providing valuable insights into healthcare sustainability.

Essay 3 is "Investment Decision Support: An Ensemble Transfer Learning Framework for Stock Market Forecasting using Financial News". It extends our research from healthcare to finance, generalizing our approach for diverse applications. Optimal investment decision-making is challenging during periods of heightened market volatility triggered by critical public events. We propose an ensemble framework to enhance prediction accuracy and optimize investment strategies. The framework incorporates an influence network with graph-based neural networks to model interdependencies among stocks and leverages LLMs to assess the impact of public sentiment and financial news on market dynamics. By integrating stock indices, technical indicators, and financial news, the model significantly improves stock prices and volatility forecasting. Furthermore, by combining forecasting outputs with the financial method, the framework enables dynamic portfolio adjustment to promote financial resilience and strategic responsiveness in volatile markets.