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Department of Operations and Risk Management
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LLM-Powered Predictive Inference with Online Text Time Series

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Abstract: Large language models (LLMs) are increasingly used to extract high-frequency signals from large-scale textual data, creating new opportunities for data-driven decision-making under uncertainty. However, when LLM-generated measures are used as proxies for underlying economic fundamentals, they can deviate substantially from gold-standard outcomes, leading to unreliable inference if incorporated directly into traditional time-series models. This discrepancy raises a central predictive-inference challenge: how can one exploit abundant AI-generated side information while preserving interpretability and valid uncertainty quantification? To address this challenge, we propose LLM-powered time series predictive inference (LLM-TS), a statistical framework that integrates low-frequency gold-standard data with high-frequency LLM-generated narrative signals. The framework models the dependence structure between these information sources and extracts the incremental predictive content of LLM-based signals without directly replacing the structural role of observed economic outcomes. We establish the asymptotic properties of the proposed framework and develop two robust forms of prediction intervals. Using 10 years of Wall Street Journal articles and 159.5 million Sina Weibo posts, we apply LLM-TS to inflation prediction for the U.S. and Chinese economies, as well as to a broad set of macroeconomic and financial indicators from the FRED-MD dataset. The results show that incorporating LLM-derived narrative signals improves predictive inference by delivering more informative uncertainty quantification, with larger gains in more complex information environments. This is a joint work with Yingying Fan, Ao Sun and Yurou Wang.

Jinchi Lv is Kenneth King Stonier Chair in Business Administration, Department Chair, Professor in Data Sciences and Operations Department of the Marshall School of Business at the University of Southern California, and Professor in Department of Mathematics at USC. He received his Ph.D. in Mathematics from Princeton University in 2007. He was McAlister Associate Professor in Business Administration at USC from 2016-2019. His research interests include statistics, data science, artificial intelligence, machine learning, and business applications as well as large language models and blockchain. His papers have been published in journals in statistics, economics, business, computer science, information theory, neuroscience, and biology. He is the recipient of the International Congress of Basic Science (ICBS) Frontiers of Science Award and Lecture (2026), the 10th International Congress of Chinese Mathematicians (ICCM) 45 Minutes Invited Lecture (2026), the 10th International Congress of Chinese Mathematicians (ICCM) Best Paper Gold Award (2025), USC Fellow of Big Ten Academic Alliance Department Executive Officer (BTAA-DEO) Program (2025), Fellow of Asia-Pacific Artificial Intelligence Association (2024), Distinguished Scholar (2024, Lingnan University), NSF Grant (2023), NSF Emerging Frontiers (EF) Grant (2022), Fellow of American Statistical Association (2020), NSF Grant (2020), Kenneth King Stonier Chair in Business Administration (2019), Fellow of Institute of Mathematical Statistics (2019), Member of USC University Committee on Appointments, Promotions, and Tenure (UCAPT, 2019-2024), USC Marshall Dean's Award for Research Impact (2017), Adobe Data Science Research Award (2017), McAlister Associate Professor in Business Administration (2016), Simons Foundation Grant (2016), the Royal Statistical Society Guy Medal in Bronze (2015), NSF Faculty Early Career Development (CAREER) Award (2010), USC Marshall Dean's Award for Research Excellence (2009), Journal of the Royal Statistical Society Series B Discussion Paper (2008), NSF Grant (2008), and Zumberge Individual Award from USC's James H. Zumberge Faculty Research and Innovation Fund (2008). He has served as an associate editor of Operations Research (2024-present), Journal of the American Statistical Association (2023-present), Journal of Business & Economic Statistics (2018-2024), The Annals of Statistics (2013-2018), and Statistica Sinica (2008-2016).

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