Ke Xu

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Education

University of Notre Dame, Ph.D. Candidate 08/23–05/28 (expected)
Applied and Computational Mathematics & Statistics (GPA: 3.861/4.000)
University of Chicago, M.S. in Statistics (GPA: 3.874/4.000) 09/21–06/23
Fudan University, B.S. in Statistics 09/16–06/21

Selected Research Projects

High-Dimensional Matrix Time-Series Modeling *Python* | [2, W2]

- Built a Python pipeline for **expanding-window forecast evaluation** on quarterly macroeconomic data from 18 OECD countries, outperforming four factor-model baselines in mean one-step-ahead error across all evaluation windows.
- Co-developed a novel **modewise additive factor model** separating row- and column-specific latent signals in matrix time series, with finite-sample recovery guarantees and data-driven uncertainty quantification for factor loadings.

Low-Rank Contextual Bandits: Regret and Inference *Python* | [W1]

- Developing a **two-stage contextual GLM bandit policy** for low-rank context–action interactions: uniform exploration, then greedy selection and refitting without further randomization. Proved **sublinear expected cumulative-regret bounds** with dependence on the **sum rather than product of feature dimensions** at fixed rank.
- Separately developed **cross-fitted inference** for prespecified linear functionals, including user–item interaction contrasts, from adaptive bandit feedback, yielding **asymptotically valid confidence intervals** at fixed rank.

Causal Inference with Genetic Summary Statistics *R/Rcpp* | [3, 4, 5]

- Developed int2MR [R/Rcpp package], a genetic instrumental-variable method for detecting **differences in causal effects across groups** using summary statistics **without individual-level data**.
- Integrated group-specific and pooled summary statistics to **improve power for detecting interaction effects** while **maintaining Type I error control**.

Riemannian Optimization for Noisy Low-Rank Recovery *R/Rcpp* | [1]

- Developed Riemannian gradient and Gauss–Newton algorithms in SegreCP [R/Rcpp package] for noisy CP tensor recovery, with **provable quadratic-to-linear convergence** of Gauss–Newton to the statistical noise floor.
- In simulations, gradient descent remained **stable under high noise and coherence**. Gauss–Newton converged faster than gradient descent, with **lower regression estimation error than CP-ALS**. Both ran **faster than CP-ALS**.

Statistical Inference for Low-Rank Tensor Models *R* | [6]

- Developed a unified **uncertainty quantification framework** for low-rank tensor regression and PCA, supporting inference on individual entries, aggregate summaries, and contrasts, including dense linear functionals.
- Constructed **data-driven, asymptotically valid confidence intervals** with lengths matching **minimax lower-bound scales**. In particular, tensor-PCA simulations showed **shorter confidence intervals than prior work**.

Selected Research Papers

[1] **Ke Xu** and Yuefeng Han. "Guaranteed Noisy CP Tensor Recovery via Riemannian Optimization on the Segre Manifold." ***NeurIPS 2026*** (main track, poster; accepted). [earlier preprint: arXiv:2510.00569] [R/Rcpp package]

[2] Elynn Chen, Yuefeng Han, Jiayu Li, and **Ke Xu** (equal contribution; alphabetical author order). "Modewise Additive Factor Model for Matrix Time Series." Major revision at ***Annals of Statistics***; arXiv:2512.25025.

[3] **Ke Xu**, Nathaniel Maydanchik, Bowei Kang, et al. "Integrative Mendelian Randomization for Detecting Exposure-by-Group Interactions Using Group-Specific and Combined Summary Statistics." ***PLOS Genetics***, 2025. [R/Rcpp package]

[4] Bowei Kang, David Li, **Ke Xu**, et al. "A Flexible and Unified Framework for Single- and Multi-Outcome Mendelian Randomization Using Summary Statistics." ***The American Journal of Human Genetics***, 2026.

[5] Yihao Lu, **Ke Xu**, Nathaniel Maydanchik, et al. "An Integrative Multi-Context Mendelian Randomization Method for Identifying Risk Genes across Human Tissues." ***The American Journal of Human Genetics***, 2024.

[6] **Ke Xu**, Elynn Chen, and Yuefeng Han. "Statistical Inference for Low-Rank Tensor Models." arXiv:2501.16223 (2025).

Working Papers

[W1] "Regret Minimization and Statistical Inference for Low-Rank Contextual Generalized Linear Bandits, with Applications to Advertising and Product Design." With Zifeng Zhao and Yuefeng Han; in preparation.

[W2] "Inference of Group Factor Model for High-Dimensional Matrix Time Series." With Tiantian Ji, Bin Chen, Yuefeng Han.

Technical Skills

Programming: Python (NumPy, SciPy, pandas, statsmodels); R; Rcpp (C++); MATLAB
Statistical Methods: Statistical inference and uncertainty quantification; Monte Carlo simulation; linear and generalized linear models; time-series forecasting and factor models; contextual bandits; causal inference; low-rank matrix/tensor models

Research Communication

Invited speaker: 2025 ICSA China Conference, Modern Multivariate Analysis for Tensor and Multiview Data Session.
Instructor: Statistical Methods & Data Analysis I (lab sections), Notre Dame (Spring 2025; Fall 2026).