

Zhiyu Xu

GPA: 3.97/4.00

Weiyang College, Tsinghua University

Personal Website
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Education

Tsinghua University

Mathematics and Physics + Energy and Power Engineering

Sep, 2020 – June, 2024 (expected)

Beijing, China

Research Experience

Covariate-assisted Spetrum Estimation for Grade of Membership Model

May, 2023 – Present

Advised by Prof. Yuqi Gu, Columbia University

- Established a non-iterative spectral algorithm for Grade of Membership models
- Derived expectation identifiability for the algorithm and entry-wise estimation guarantee (l_∞ type bounds), showing the superiority of covariate assistance in both convergence rate and identifiability
- Illustrated the easy achievability of assumptions and the choice of tuning parameter with theoretical support
- Applied to psychometric, educational assessment and scATAC-seq data to show superiority of covariate assistance and computation speed and working on the manuscript

A Novel Resampling Criterion for Sequential Monte Carlo

Aug, 2022 – Present

Advised by Prof. Ke Deng and Dr. Yichao Li, Tsinghua University and Harvard University

- Established a resampling criterion based on asymptotic variance
- Applied to models including Stochastic Volatility, Gaussian Mixture Models, Particle Markov Chain Monte Carlo and Self-avoiding walks
- Derived the asymptotic variance of resampling matrices
- Concluded the simulation performance based on theory and discussed its constraints

Covariate-assisted MLE Estimate of Grade of Membership Models

Mar, 2023 – May, 2023

Advised by Prof. Yuqi Gu, Columbia University

- Added covariate graph regularized terms to incorporate covariate information in likelihood function
- Applied MM algorithm (Majorize-Minimize) to derive the update rule
- Adopted projected gradient descent (PGD) to solve the constrained optimization problem
- Found out the previous likelihood-base algorithms may trap in local mode by comparison with the new algorithm

Related Courses

Real Analysis	A	Logistic Regression (Categorical Data Analysis)	A
Elementary Probability Theory	A	Calculus A(1)	A
Statistical Inference	A, 98	Calculus A(2)	A
Multivariate Statistical Analysis	A+	Linear Algebra	A+
Linear Regression Analysis	A	Mathematical Physics Equations	A
Statistical Computing and Software	A, 99	Introduction to Complex Analysis	A+
Introduction to Bayesian Statistics	A	Introduction to Statistical Learning	A-

Currently taking Convex Optimization, Introduction to Causal Inference, Introduction to Nonparametric Statistics.

Project Experience

Popular Words Extraction for US Hit Song Lyrics in different periods

May, 2023 – June, 2023

Introduction to Statistical Learning

Tsinghua University

- Analyzed the core problem being how closely lyrics associate with time period and how to divide time periods, and proposed the general framework to tackle these two issues
- Performed SVM, word embedding and XGBoost to investigate the potential boundary of prediction accuracy of the project, and discussed SVM and word embedding's failure in short and not logistic texts like lyrics
- Performed LDA, embedded topic models, and BERTopic for unsupervised era division
- Performed regularized Logistic regression for interpretable extraction and wrote English report presented [here](#)

Analysis of EES consistency in 7 districts of Beijing

Apr, 2022 – June, 2022

Linear Regression Analysis

Tsinghua University

- Applied entropy weight method to give weight to each variable and performed L_1 regularized multiple linear regression to screen explanatory variables
- Adopted DPSIR analysis to categorize the variables to make concrete conclusion from the perspective of environmental science
- Diagnosed the flaws of multiple linear regression, and made transformationss to fulfill normality, and decrease variance inflation factor

Analysis of gender equality based on economic and religion

Apr, 2022 – June, 2022

Multivariate Statistical Analysis

Tsinghua University

- Performed EDA including boxplot, scatter plot matrix and direct mapping to identify two major factors in gender equality
- Performed hierarchical clustering and K-means to identify two effects respectively
- Performed MANOVA and CCA to find out the correalation and significance of economic and religion on gender equality

Awards & Honors

Overall Excellence Scholarship

Tsinghua University

Academic Excellence Scholarship

Tsinghua University

Philobiblion Scholarship

Tsinghua University

Excellent Volunteer for Tsinghua University's 110th Anniversary Celebration

Tsinghua University

Specialized Skills

Programming Languages: R, Python, C++, MATLAB

Others: L^AT_EX, git, Pytorch

Extracurricular Activities

Class Monitor

Sep, 2021 – June, 2022

Tsinghua University

- Honored with Outstanding Class Award and Excellent Academic Award
- Collaborated with other classes of different majors in sports activities, ethical discussions and learning activities
- Fundraising from the university to sponsor class extracurricular activities

Registered Volunteer of a Community Service Organization

Oct, 2020 – June, 2022

Tsinghua University

- Arranged volunteer activities that contribute to the bonding between college and high school students
- Organized tutorial classes to prepare students for the volunteer work
- Reorganized the materials needed to submit to make evaluations more truth-oriented

Study Group Organizer

Sep, 2020 – June, 2021

Tsinghua University

- Honored with Class Excellent Academic Award
- Organized class learning activities in Calculus, Linear Algebra and Fundamentals of Physics
- Obtained and handed out learning resources to enhance understanding for classmates

Other Interests

Athletics: Jogging

Arts: Reading, films and music, trumpet