# Xuanfei Ren

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## Education

**University of Wisconsin-Madison**                                           Madison, USA
*PhD student, Department of Computer Sciences.*                                  *Aug. 2024 –*

**University of Science and Technology of China**                             Hefei, China
*Bachelor of Science in Mathematics, Specialization in Probability and Statistics.*      *Aug. 2020 – Jun. 2024*

**Teaching Assistant, Real Analysis**                                    *Feb. 2023 – Jul. 2023*
**Teaching Assistant, Regression Analysis**                            *Sept. 2023 – Jan. 2024*

## Publication

- <u>Xuanfei Ren</u>, Tianyuan Jin, Pan Xu.
  **Optimal Batched Linear Bandits.**
  *In Proc. of the 41st International Conference on Machine Learning (**ICML 2024**).*

## Research Interests

- Artificial Intelligence
- Large language model
- Reinforcement Learning (bandit problems)
- Information theory
- Optimization
- High Dimensional Statistics

## Research Experience

**A Unifying Framework for Linear Bandits with Finite Arms**                   Duke University
*Advisor: Prof. Pan Xu (Department of Computer Science, Duke University.)*         *Oct. 2023 – Jan. 2024*

- Set up a unifying research framework for linear bandits with fixed finite arms.
- Included classical complexity measures and strategies such as *D-optimal design, best-arm-identification, asymptotically optimal regret analysis*, and algorithms such as *IDS, UCB, TS*.
- Applied this framework to solve new problems, such as non-asymptotic optimal instance-dependent regret analysis.

**Batched Linear Bandits with Optimal Regret and Batch Complexity**           Duke University
*Advisor: Prof. Pan Xu (Department of Computer Science, Duke University.)*         *Aug. 2023 – Jan. 2024*

- Performed an extensive literature review, and devised a groundbreaking algorithm striving for asymptotic and non-asymptotic optimality in the linear bandits setting, an achievement previously unattained.
- Adapted the algorithm into a batched version with least batch complexity, extending applicablity to common real-world problems.
- Confirmed the algorithm's superiority over existing baseline methods through rigorous experimentation, showcasing its practical efficacy in linear bandits problems.

**Reinforcement Learning Theory Reading Group**                               Duke University
*Advisor: Prof. Pan Xu (Department of Computer Science, Duke University.)*         *Jun. 2023 – Present*

- Participated in a specialized reinforcement learning theory reading group, actively engaging in intricate discussions and analyzing state-of-the-art research papers.
- Tackled complex theoretical challenges collaboratively and explored innovative solutions with the group, gaining a deeper grasp of reinforcement learning principles.
- Assumed a leadership role by spearheading discussions on *strategic exploration in MDPs*, covering advanced concepts like *linearly parameterized MDPs* and *generalization with bounded Bellman rank* during a comprehensive book study of reinforcement learning theory.

**Bandit Theory Reading Group**                                               Duke University
*Advisor: Prof. Pan Xu (Department of Computer Science, Duke University.)*         *Jan. 2023 – Aug. 2023*

- Participated in ongoing discussions and consistently stayed abreast of the latest advancements in bandit theory problems through continuous literature reviews.
- Delivered seven presentations as the primary presenter on concepts in *information-directed methods*, including about the *information-theoretic Thompson sampling analysis* and *information-directed sampling algorithms*.

- Guided discussions and actively developed research project ideas during presentations, fostering a collaborative and innovative environment.

## Optimal Production Planning and Water Saving Decision under Sticky Prices     USTC
*Advisor: Prof. Lijun Bo (Department of Mathematical Sciences, USTC)*     *Jun. 2022 – May 2023*
- Developed a company production and water rights trading model with sticky prices, seeking to address slow price adjustments in the face of market dynamics.
- Derived Hamilton-Jacobi-Bellman equation solutions, creating optimal feedback strategies for production planning and water- rights trading decisions.
- Conducted numerical simulations, analyzing value function structural properties and enhancing decision-making through parameter sensitivity analysis.
- Uncovered valuable insights for companies, providing actionable recommendations for informed production planning and water rights trading strategies.

## Recursive Partitioning and Applications     USTC
*Advisor: Prof. Bo Zhang (Department of Finance and Statistics, USTC)*     *Sept. 2022 – Jan. 2023*
- Led an in-depth study of recursive partitioning methods in machine learning during a semester-long seminar. Conducted extensive literature reviews to gain comprehensive knowledge of the field.
- Assumed the role of the primary presenter over the course of the semester, delivering ongoing presentations elucidating the intricacies of tree-based recursive partitioning methods.
- Pioneered the experimental integration of hypothesis testing using *tree-based p-value* into random forest analysis. Introduced an effective tree-node-partitioning criterion based on statistically significant inter-node differences, leading to a notable reduction in random forest tree partitioning error.

## Model Selection in Linear Regression Based on Coefficient of Determination     USTC
*Advisor: Prof. Bo Zhang (Department of Finance and Statistics, USTC)*     *Jun. 2022 – Jul. 2022*
- Developed an innovative approach to variable selection problem in linear regression models. Quantified the impact of independent variables on dependent variable variance and identified influential factors.
- Employed a novel estimation method for explained variance that transcends the normality assumption and covariate sparsity constraints. Leveraged insights from estimation equation techniques used in high-dimensional linear modeling.
- Validated the algorithm's efficacy with synthetic datasets, showcasing its robustness and practical applications in various scenarios.

## High Dimensional Statistics Reading Group     USTC
*Advisor: Prof. Bo Zhang (Department of Finance and Statistics, USTC)*     *Nov. 2022 – Present*
- Initiated an in-depth project after conducting a literature review of high-dimensional statistics. Participated in seminars, explaining complex concepts to peers and instructors.
- Conducted collaborative literature reviews of statistical theory articles related to tensors, gaining a comprehensive understanding of this tool and generating potential project ideas.
- Conducted presentations on articles related to change-point problems and Gaussian mixture models, contributing to the dissemination of knowledge and facilitating discussions in the academic community.

## Honors

- China Optics Valley Award (top 2%), 2023
- Huawei Scholarship (top 3%), 2022
- Outstanding Student Scholarship, 2021
- Outstanding Freshman Scholarship, 2020

## Skills

**English**: TOEFL: 108 (R: 29; L: 29; S: 22; W: 28); GRE: 320 (Q: 170; V:150); GRE Subject (Mathematics): 880 (90%).
**Programming**: C, Python, R, LaTeX, MATLAB, Mathematica.

## Leadership / Extracurricular Activities

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|---|---|
| **Running Association Contribution** | *2020 – Present* |
| **Dedicated Volunteering** | *2021* |
| **Completed Grueling Half Marathons and Hikes** | *2021 – 2023* |