HENGRUI CAI

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EMPLOYMENT

July, 2022 - **Assistant Professor** Department of Statistics, University of California Irvine

EDUCATION

May, 2022 **Ph.D. in Statistics** North Carolina State University (NCSU)
Thesis: On Optimal Decision Making and Policy Evaluation with Complex Data
Co-Advisors: Dr. Wenbin Lu and Dr. Rui Song

June, 2017 **B.S. in Statistics** Zhejiang University
Minor: Advanced Honor Class of Engineering Education, Chu Kochen Honors College

AWARDS AND HONORS

2023 The Information and Computer Sciences (ICS) Research Award
2023 Academic Senate Council on Research, Computing and Libraries (CORCL) Award
2022 Amazon Web Services Cloud Research Award, Amazon
2020 ENAR Distinguished Student Paper Award, The International Biometric Society
2019, 2020 Nominated for the Outstanding Teaching Assistant Award, NCSU
2017 - Mu Sigma Rho, National Statistics Honor Society, NCSU
2017 National Undergraduate Research Fund, China
2016 Meritorious Winner in American Mathematical Contest

RESEARCH INTEREST

- Causal Inference and Causal Structure Learning
- Reinforcement / Deep Learning

RESEARCH SUPPORT/GRANT

UC Irvine The Information and Computer Sciences Research Award, 2023-24, $75,000, "Heterogeneous Statistical Learning for Precise Mobile Health", **co-PI**.

UC Irvine Academic Senate CORCL Award, 2022-23, $5,400, "Causal Discovery and Individualized Policy Optimization for Human Text Data", **PI**.

Amazon Amazon Web Services Cloud Research Award, 2022-23, $18,500, "Causal Reinforcement Learning for Precision Medicine", **PI**.

PUBLICATIONS

(* co-first author, ___ advised graduate student)

12. Zhang, W., Wu, T., Wang, Y., Cai, Y., & **Cai, H.** (2023). Towards Trustworthy Explanation: On Causal Rationalization In *International Conference on Machine Learning (ICML) 2023.*

11. Watson, RA., **Cai, H.**, An, X., McLean, S., & Song, R. (2023). On Heterogeneous Treatment Effects in Heterogeneous Causal Graphs. In *International Conference on Machine Learning (ICML) 2023.* **[JSM 2023 Mental Health Statistics Section Student Paper Award.]**

10. **Cai, H.***, Shi, C.*, Song, R., & Lu, W. (2023). Jump Q-Learning for Individualized Decision Making with Continuous Treatments. *Accepted at Journal of Machine Learning Research.*

9. **Cai, H.**, Lu, W., Marceau West R., Mehrotra DV., & Huang, L. (2022). CAPITAL: Optimal Subgroup Identification via Constrained Policy Tree Search. *Statistics in Medicine*. 2022;1-14. DOI:10.1002/sim.9507.

8. Gates, T.A., **Cai, H.**, Hu, Y., Han, X., Griffith, E., Burgener, L., Hyland, E. & Zanno, L.E. (2022). Estimating ancient biogeographic patterns with statistical model discrimination. *The Anatomical Record.*

7. **Cai, H.***, Shi, C.*, Song, R., & Lu, W. (2021). Deep Jump Learning for Off-Policy Evaluation in Continuous Treatment Settings. *Advances in Neural Information Processing Systems, 34,* 15285-15300. [**Distinguished Student Paper Awards for the 2021 ENAR Spring Meeting.**]

6. **Cai, H.**, Song, R., & Lu, W. (2021). ANOCE: Analysis of Causal Effects with Multiple Mediators via Constrained Structural Learning. In *International Conference on Learning Representations.*

5. **Cai, H.**, Song, R., & Lu, W. (2021). GEAR: On Optimal Decision Making with Auxiliary Data. *Stat*, 10(1):e399.

4. **Cai, H.**, Cen, Z., & Song, R. (2021). MAGNET: Multi-Agent Graph Cooperative Bandits. In *NeurIPS-21 Causal Inference Challenges in Sequential Decision Making: Bridging Theory and Practice Workshop (Oral).*

3. **Cai, H.**, Cen, Z., Leng, L., & Song, R. (2021). Periodic-GP: Learning Periodic World with Gaussian Process Bandits. In *IJCAI-21 Reinforcement Learning for Intelligent Transportation Systems Workshop (Spotlight).*

2. **Cai, H.**, Lu, W., & Song, R. (2020). On Validation and Planning of An Optimal Decision Rule with Application in Healthcare Studies. In *International Conference on Machine Learning* (pp. 1262-1270). PMLR.

1. Yuan, Y., Zhou, Q. M., Li, B., **Cai, H.**, Chow, E. J., & Armstrong, G. T. (2018). A Threshold-free Summary Index of Prediction Accuracy for Censored Time to Event Data. *Statistics in Medicine*, 37(10), 1671-1681.

PREPRINTS

6. **Cai, H.**, Wang, Y., Jordan, M., & Song, R. (2023+). On Learning Necessary and Sufficient Causal Graphs. *arXiv preprint arXiv:2301.12389.*

5. **Cai, H.**, Lu, W., & Song, R. (2023+). CODA: Calibrated Optimal Decision Making with Multiple Data Sources and Limited Outcome. *arXiv preprint arXiv:2104.10554.*

4. Shen, Y.*, **Cai, H.***, & Song, R. (2023+). Doubly Robust Interval Estimation for Optimal Policy Evaluation in Online Learning. *arXiv preprint arXiv:2110.15501.* [**Institute of Mathematical Statistics Hannan Graduate Student Travel Award 2022.**]

3. Ma, T., **Cai, H.**, Qi, Z., Shi, C., & Laber, E. B. (2023+). Sequential Knockoffs for Variable Selection in Reinforcement Learning. *arXiv preprint arXiv:2303.14281.*

2. Shen, Y., Wan, R., **Cai, H.**, & Song, R. (2023+). Heterogeneous Synthetic Learner for Panel Data. *arXiv preprint arXiv:2212.14580.*

1. Price, K.+, **Cai, H.**, Shen, W., Hu, G. (2023+). How much does Home Field Advantage matter in Soccer Games? A causal inference approach for English Premier League analysis. *arXiv preprint arXiv:2205.07193.*

PRESENTATIONS

- Towards Causal Revolution: On Learning Heterogeneity and Non-Spuriousness in Causal Graphs. *UCI Computer Science.* **Invited**. May 2023, Irvine
- Towards Causal Revolution: On Learning Heterogeneity and Non-Spuriousness in Causal Graphs. *San Diego State University.* **Invited**. April 2023, San Diego
- Towards Causal Revolution: On Learning Heterogeneity and Non-Spuriousness in Causal Graphs. *UCSB Computer Science.* **Invited**. Feb 2023, Santa Barbara
- Towards Trustworthy Explanation: On Causal Rationalization. *Reinforcement Learning + X Seminar.* **Invited**. Feb 2023, Virtual
- Towards Explainable Causal Revolution: On Causal Relation, Impact, and Policy Learning. *BrownBag Seminar, University of California Irvine.* **Invited**. Jan 2023, Irvine
- Towards Explainable Causal Revolution: Causal Rationalization. *Capital of Statistics.* **Invited**. Dec 2022, Virtual
- Towards Explainable Causal Revolution: Analysis of Causal Effects. *University of California Riverside.* **Invited**. Nov 2022, Riverside
- On Optimal Decision Making and Policy Evaluation with Complex Data. *Children's Hospital of Orange County.* **Invited**. Oct 2022, Irvine
- Towards Explainable Causal Revolution: Analysis of Causal Effects. *University of California Santa Barbara.* **Invited**. Oct 2022, Santa Barbara
- Optimal Subgroup Identification via Constrained Policy Tree Search. *Children's Hospital of Orange County.* **Invited**. Sep 2022, Irvine
- Calibrated Optimal Decision Making with Multiple Data Sources and Limited Outcome. *Joint Statistics Meeting (JSM) 2022.* **Invited**. Aug 2022, Washington, D.C.
- Doubly Robust Interval Estimation for Optimal Policy Evaluation in Online Learning. *From Statistics to Artificial Intelligence-Reinforcement Learning.* **Invited**. July 2022, Virtual.
- Doubly Robust Interval Estimation for Optimal Policy Evaluation in Online Learning. *The SSC 2022 Annual Meeting.* **Invited**. June 2022, Virtual
- Calibrated Optimal Decision Making with Multiple Data Sources and Limited Outcome. *The 2022 ICSA Applied Statistics Symposium.* **Invited**. June 2022, Gainesville
- Doubly Robust Interval Estimation for Optimal Policy Evaluation in Online Learning. *The 5th International Conference on Econometrics and Statistics (EcoSta).* **Invited**. June 2022, Kyoto
- Deep Jump Learning for Off-Policy Evaluation in Continuous Treatment Settings. *The 35th Conference on Neural Information Processing Systems (NeurIPS).* **Invited**. Dec 2021, Virtual
- Multi-Agent Graph Cooperative Bandits. *NeurIPS-21 Causal Inference Challenges in Sequential Decision Making: Bridging Theory and Practice Workshop.* **Invited**. Dec 2021, Virtual
- Doubly Robust Interval Estimation for Optimal Policy Evaluation in Online Learning. *2021 Computational and Methodological Statistics (CMStatistics).* **Invited**. Dec 2021, Virtual
- Explainable Causal Graph Learning for Hero Feature Discovery. *Explainable AI Workshop at the 9th Amazon Machine Learning Conference.* **Invited**. Oct 2021, Virtual
- Calibrated Optimal Decision Making with Multiple Data Sources and Limited Outcome. *Joint Statistics Meeting (JSM) 2021.* **Invited**. Aug 2021, Virtual

- Learning Periodic World with Gaussian Process Bandits. *IJCAI-21 Reinforcement Learning for Intelligent Transportation Systems Workshop.* **Invited**. Aug 2021, Virtual
- Analysis of Causal Effects with Multiple Mediators via Constrained Structural Learning. *The 9th International Conference on Learning Representations (ICLR).* **Invited**. May 2021, Virtual
- On Optimal Treatment Decision Making by Auxiliary Data with Application to AIDs Study. *The Duke-Industry Statistics Symposium (DISS) 2021.* **Invited**. April 2021, Virtual
- Deep Jump Q-Evaluation for Offline Policy Evaluation in Continuous Action Space. *The 2021 ENAR Spring Meeting.* **Invited**. March 2021, Virtual
- A Bandit Framework for Dynamic Pricing. *Reinforcement Learning for E-commerce Workshop at the 8th Amazon Machine Learning Conference.* **Invited**. Oct 2020, Virtual
- Marketing Experiment Bridging: Time Inverse Bayesian Learning. *The 8th Amazon Machine Learning Conference.* **Invited**. Sep 2020, Virtual
- On Validation and Planning of An Optimal Decision Rule with Application in Healthcare Studies. *Joint Statistics Meeting (JSM) 2020.* **Self Contributed**. Aug 2020, Virtual
- On Validation and Planning of An Optimal Decision Rule with Application in Healthcare Studies. *The 37th International Conference on Machine Learning (ICML).* **Invited**. July 2020, Virtual

TEACHING & ADVISING EXPERIENCE

University of California Irvine (2022-)

- **Instructor:**
  - STATS 120C/281C: Introduction to Probability and Statistics III (Spring 2023). Two sections, >150 students
- **Advising Students:**
  - Wenbo Zhang (Ph.D. Student) Expect to graduate in 2025
  - Shih Ting Huang (Master Student) Expect to graduate in 2023
  - Louis Chu (Undergraduate Student) Expect to graduate in 2024
  - Miya Wang (Undergraduate Student) Expect to graduate in 2024
  - Guanchen Wu (Undergraduate Student) Expect to graduate in 2024
  - Wang Ma (Undergraduate Student) Expect to graduate in 2024
- **Committee Member:**
  - Hanwen Ye
  - Roy Zawadzki
  - Jenifer Rim

North Carolina State University (Prior to 2022)

- **Lab Instructor for Graduate Course**
  - ST 703: Statistical Methods I (Fall 2019)
  - ST 114: Introduction to Statistical Programming - Python (Spring 2022)
- **Teaching Fellow for Graduate/Undergraduate Courses**

- ST 422: Introduction to Mathematical Statistics II (Fall 2021)
- ST 745: Analysis of Survival Data (Spring 2021)
- ST 405/505: Applied Nonparametric Statistics (Fall 2020)
- ST 311: Introduction to Statistics (Spring 2019)
- ST 790: Financial Statistics (Fall 2018)
- ST 312: Introduction to Statistics II (Spring 2018)
- ST 511: Introduction to Statistics for Biological Sciences (Fall 2018)
- ST 350: Economic and Business Statistics (Fall 2017)

PROFESSIONAL ACTIVITIES AND SERVICES

University Services:

- Alternate Representative to the University-Wide Assembly, UC Irvine 2023-25

Department Services:

- Graduate Admissions Committee, Department of Statistics, UC Irvine 2022-23
- Statistics Seminar, Department of Statistics, UC Irvine Fall 2023

Review Services:

- Conference:
  - The 38th, 39th, 40th International Conference on Machine Learning (ICML) 2021-2023
  - The 35th, 36th Conference on Neural Information Processing Systems (NeurIPS) 2021-2022
  - The 10th, 11th International Conference on Learning Representations (ICLR) 2021-2022
  - The 24th International Conference on Artificial Intelligence and Statistics (AISTATS) 2021
- Journal:
  - The Journal of the American Statistical Association
  - The Journal of the Royal Statistical Society Series B
  - Annals of Statistics
  - The Journal of Machine Learning Research
  - Biometrics
  - Journal of Nonparametric Statistics
  - Stat
  - The Transactions on Machine Learning Research

Professional Services:

- Student Paper Award Committee for Statistical Learning and Data Science (SLDS) of the American Statistical Association (ASA) 2023
- Program Committee (PC) Member for Workshops:
  - The 'Trustworthy and Socially Responsible Machine Learning' Workshop at NeurIPS 2022

  - The 'Causal Inference Challenges in Sequential Decision Making: Bridging Theory and Practice' Workshop at NeurIPS 2021

Professional Memberships

- American Statistical Association (ASA) 2017-
- International Chinese Statistical Association (ICSA) 2019-