Yizhe Xu - CV

Last update: July 22, 2023

Contact Details

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Internal Medicine - Division of Epidemiology
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Research Interests

I am interested in causal inference, semiparametric models, and machine learning. I am passionate about applying advanced methods in statistics and machine learning to answer meaningful questions in biomedical research. My recent research has focused on deriving and evaluating risk stratification tools, estimating heterogeneous treatment effects, and identifying individualized treatment rules using data from randomized controlled trials or insurance claims and electronic health records.

Research appointments

Internal Medicine, Division of Epidemiology 2023 – present
University of Utah, Utah, USA
Assistant Professor.

Huntsman Cancer Institute 2023 – present
University of Utah, Utah, USA
Assistant Professor.

Center for Biomedical Informatics Research (BMIR) 2020 – 2023
Stanford University, California, USA
Postdoctoral fellow, funded by the NHLBI R01 grant 'applying statistical learning tools to personalize cardiovascular treatment'.

Department of Population Health Sciences (PHS) 2018 – 2020
University of Utah, Utah, USA
Graduate assistant, funded by the R01 grant 'Optimize-SPRINT study'.

Value and Epidemiology Research Using Causal Inference and Data 2017 - 2020
Veteran Affairs, Salt Lake City, Utah, USA
Research assistant in the group of Dr. Brian Sauer

Study Design and Biostatistics Center (SDBC) 2016 - 2019
University of Utah, Utah, USA
Research assistant in the group of Prof. Tom Green.

Department of Family and Preventive Medicine (FPMD) 2014 - 2016
University of Utah, Utah, USA
Research assistant in the group of Prof. Joseph Stanford.

Education

Stanford University Stanford, California, USA

- **Postdoctoral scholar in Biomedical Informatics** 11/2020 – 05/2023
  Advisor: Nigam Shah

University of Utah Salt Lake City, Utah, USA

- **Ph.D. in Population Health Sciences (Emphasis in Biostatistics)** 08/2016 – 08/2020
  Thesis advisor: Jincheng Shen and Tom Greene
  Thesis paper I title: Estimating the optimal individualized treatment rule from a cost-effectiveness perspective.
  Thesis paper II title: An Efficient Approach for Optimizing the Cost-effective Individualized Treatment Rule Using Conditional Random Forest.
- **M.Sc. Statistics** 08/2014 - 12/2016
  Thesis advisors: Nan Hu

Liaoning Medical University Liaoning, China

- **B.Sc. Nursing** 03/2008 - 07/2012

Awards

Joint Statistical Meeting, Student Paper Award 2021
Health Policy Statistics Section, Virtual Conference
American Statistical Association, Student Travel Award 2019
Biopharmaceutical Section Regulatory-Industry Statistics Workshop Program, Washington D.C., USA.
Student of the Year, Master of Statistics, University of Utah 2017
Phi Kappa Phi Inductee, Division of Public Health, University of Utah 2017
Student of the Year, Liaoning Medical University 2011

Skills

1. Statistical programming in R, Python, SAS, and Stata
2. Statistical software building and sharing using GitHub
3. High-performance computing using SLURM
4. Manage (using BigQuery/SQL) and analyze (using virtual machine instances) large databases in Google Cloud Platform (GCP)
5. Cohort extraction from claims data and electronic health records (EHRs) using standard concepts, e.g., SNOMED, ICD9/10, and LONIC codes
6. Formal scientific writing and presentations
7. Formal mathematical writing using LaTeX
8. Collaborate with diverse groups, e.g., physicians, epidemiologists, computer scientists, etc.

Book Chapter

1. **Yizhe Xu**, Nikolaos Ignatiadis, Erik Sverdrup, Scott Fleming, Stefan Wager, Nigam Shah (2022). **Handbook of Matching and Weighting Adjustments for Causal Inference. Chapter 21: Treatment Heterogeneity with Survival Outcomes.** Edited by José R. Zubizaretta, Elizabeth A. Stuart, Dylan S. Small, Paul R. Rosenbaum. Chapman & Hall/CRC Press. ArXiv.

Journal Publications

1. Michael Wornow, **Yizhe Xu**, Rahul Thapa, Birju Patel, Ethan Steinberg, Scott Fleming, Michael A. Pfeffer, Jason Fries, Nigam H. Shah (2023). **The Shaky Foundations of Clinical Foundation Models: A Survey of Large Language Models and Foundation Models for EMRs.** *npj* Digital Medicine. ArXiv.
2. **Yizhe Xu**, Katelyn Bechler, Alison Callahan, and Nigam Shah (2023). **Principled Estimation and Evaluation of Treatment Effect Heterogeneity: A case study application to dabigatran for patients with atrial fibrillation.** Journal of Biomedical Informatics. https://doi:10.1016/j.jbi.2023.104420.
3. **Yizhe Xu**, Agata Foryciarz, Ethan Steinberg, and Nigam H. Shah (2023). **Clinical Utility Gains from Incorporating Comorbidity and Geographic Location Information into Risk Estimation Equations for Atherosclerotic Cardiovascular Disease.** Journal of the American Medical Informatics Association, Volume 30, Issue 5, Pages 878–887, https://doi.org/10.1093/jamia/ocad017.
4. **Xu, Y.**, Greene, T.H., Bress, A.P., Sauer, B.C., Bellows, B.K., Zhang, Y., Weintraub, W.S., Moran, A.E. and Shen, J. (2022). **Estimating the optimal individualized treatment rule from a cost-effectiveness perspective.** Biometrics, 78(1), pp.337-351.
5. **Xu, Y.**, Greene, T.H., Bress, A.P., Bellows, B.K., Zhang, Y., Zhang, Z., Kolm, P., Weintraub, W.S., Moran, A.S. and Shen, J. (2022). **An Efficient Approach for Optimizing the Cost-effective Individualized Treatment Rule Using Conditional Random Forest.** Statistical Methods in Medical Research. https://doi.org/10.1177/09622802221115876.
6. Pfohl, S.R., Zhang, H., **Xu, Y.**, Foryciarz, A., Ghassemi, M. and Shah, N.H. (2022). **A comparison of approaches to improve worst-case predictive model performance over patient subpopulations.** Scientific reports, 12(1), pp.1-13.
7. Jonathan Lu, Amelia Sattler, Samantha Wang, Ali Raza Khaki, Alison Callahan, Scott Fleming, Rebecca Fong, Benjamin Ehlert, Ron C. Li, Lisa Shieh, Kavitha Ramchandran, Michael F. Gensheimer, Sarah Chobot, Stephen Pfohl, Siyun Li, Kenny Shum, Nitin Parikh, Priya Desai, Briththa Seevaratnam, Melanie Hanson, Margaret Smith, **Yizhe Xu**, Arjun Gokhale, Steven Lin, Michael A. Pfeffer, Winifred Teuteberg, Nigam H. Shah (2022). **Considerations in the Reliability and Fairness Audits of Predictive Models for Advance Care Planning.** Frontiers in Digital Health. https://doi.org/10.3389/fdgth.2022.943768
8. Bress, A.P., Greene, T., Derington, C.G., Shen, J., **Xu, Y.**, Zhang, Y., Ying, J., Bellows, B.K., Cushman, W.C., Whelton, P.K. and Pajewski, N.M. (2021). **Patient selection for intensive**

blood pressure management based on benefit and adverse events. Journal of the American College of Cardiology, 77(16), pp.1977-1990.

9. Corbett, K.L., Presson, A.P., Zhang, C., **Xu, Y.**, Bratton, S.L. and Dixon, R.R. (2021). **Does Non-Neurologic Multiorgan Dysfunction After Out-of-Hospital Cardiac Arrest among Children Admitted in Coma Predict Outcome 1 Year Later?** Journal of Pediatric Intensive Care, 10(03), pp.188-196.
10. Sauer, B.C., Chen, W., **Xu, Y.**, Shen, J., Accortt, N.A., Collier, D.H. and Cannon, G.W. (2020). **Empirical evidence of disease activity thresholds used to indicate need for major therapeutic change in US veterans with rheumatoid arthritis.** Arthritis research & therapy, 22(1), pp.1-10.
11. Bailey, T.L., Stephens, A.R., Adeyemi, T.F., **Xu, Y.**, Presson, A.P., Aoki, S.K. and Maak, T.G. (2019). **Traction time, force and postoperative nerve block significantly influence the development and duration of neuropathy following hip arthroscopy.** Arthroscopy: The Journal of Arthroscopic & Related Surgery, 35(10), pp.2825-2831.
12. Lucas*, J., Myers, J., Keihani, S., Moses, R., **Xu, Y.**, Morris, B., Majercik, S., Hewitt, T., Burks, F., Schwartz, I. and Elliott, S. (2019). **MP04-03 Treatment Complications Associated with Extraperitoneal Bladder Injuries: Results from the Multi-Institutional AAST Study of Bladder Trauma.** The Journal of Urology, 201(Supplement 4), pp.e30-e31.
13. Kazmers, N.H., Stephens, A.R., Presson, A.P., **Xu, Y.**, Feller, R.J. and Tyser, A.R. (2019). **Comparison of direct surgical costs for proximal row carpectomy and four-corner arthrodesis.** Journal of Wrist Surgery, 8(01), pp.066-071.
14. Bailey, T., Maak, T.G., Stephens, A., Adeyemi, T., **Xu, Y.** and Presson, A. (2018). **The Association of Traction Time, Force and Postoperative Nerve Block on the Development and Duration of Neuropathy Following Hip Arthroscopy.** Arthroscopy, 34(12), p.e18.
15. Kazmers, N.H., Presson, A.P., **Xu, Y.**, Howenstein, A. and Tyser, A.R. (2018). **Cost implications of varying the surgical technique, surgical setting, and anesthesia type for carpal tunnel release surgery.** The Journal of hand surgery, 43(11), pp.971-977.
16. Kazmers, N.H., Stephens, A., Presson, A.P., **Xu, Y.**, Feller, R.J. and Tyser, A. (2018). **Comparison of Direct Surgical Costs for Proximal Row Carpectomy and 4-Corner Arthrodesis: Level 3 Evidence.** Journal of Hand Surgery, 43(9), p.S52.
17. Kazmers, N.H., Judson, C.H., Presson, A.P., **Xu, Y.** and Tyser, A.R. (2018). **Evaluation of factors driving cost variation for distal radius fracture open reduction internal fixation.** The Journal of hand surgery, 43(7), pp.606-614.
18. Kwok, A.C., Edwards, K., Donato, D.P., Tatro, E., **Xu, Y.**, Presson, A.P. and Agarwal, J.P. (2018). **Operative time and flap failure in unilateral and bilateral free flap breast reconstruction.** Journal of Reconstructive Microsurgery, 34(06), pp.428-435.
19. Pirozzi, C.S., Mendoza, D.L., **Xu, Y.**, Zhang, Y., Scholand, M.B. and Baughman, R.P. (2018). **Short-term particulate air pollution exposure is associated with increased severity of respiratory and quality of life symptoms in patients with fibrotic sarcoidosis.** International journal of environmental research and public health, 15(6), p.1077.
20. Workman, J.K., Wilkes, J., Presson, A.P., **Xu, Y.**, Heflin, J.A. and Smith, J.T. (2018). **Variation in adolescent idiopathic scoliosis surgery: implications for improving healthcare value.** The Journal of pediatrics, 195, pp.213-219.
21. Keihani, S., Moses, R., **Xu, Y.**, Putbrese, B., Rogers, D., Luo-Owen, X., Mukherjee, K., Morris, B., Majercik, S., Piotrowski, J. and Dodgion, C. (2018). **MP25-18 Imaging Findings Associated with Renal Bleeding Interventions after High-grade Trauma: Results from the American Association for Surgery of Trauma (AAST) Genito-urinary Trauma Study.** The Journal of Urology, 199(4S), pp.e333-e334.
22. Keihani, S., **Xu, Y.**, Presson, A.P., Hotaling, J.M., Nirula, R., Piotrowski, J., Dodgion, C.M., Black, C.M., Mukherjee, K., Morris, B.J. and Majercik, S. (2018). **Contemporary management of high-grade renal trauma: Results from the American Association for the Surgery of Trauma Genitourinary Trauma study.** Journal of Trauma and Acute Care Surgery, 84(3), pp.418-425.
23. Corbett, K., **Xu, Y.**, Presson, A., Bratton, S. and Dixon, R. (2018). **Multiple Organ Dysfunction Prevalence Following Out-of-hospital Cardiac Arrest in Pediatrics.** Critical Care Medicine, 46(1), p.220.
24. Awad, A.W., Karsy, M., Sanai, N., Spetzler, R., Zhang, Y., **Xu, Y.** and Mahan, M.A. (2017).

Impact of removed tumor volume and location on patient outcome in glioblastoma. Journal of neuro-oncology, 135(1), pp.161-171.

25. Matsen, C.B., Fagerlin, A., **Xu, Y.**, Presson, A. and Kaphingst, K.A. (2017). **An Intervention Aimed at Improving Decision Role Concordance in Newly Diagnosed Breast Cancer Patients.** In JOURNAL OF WOMENS HEALTH (Vol. 26, No. 9, pp. 1032-1033).
26. Elkeeb, D., **Xu, Y.**, Presson, A., Petersen, M. and Secrest, A. (2017). **Nonmodifiable patient characteristics as predictors of patient satisfaction in dermatology.** In JOURNAL OF THE AMERICAN ACADEMY OF DERMATOLOGY (Vol. 76, No. 6, pp. AB181-AB181).
27. Keihani, S., **Xu, Y.**, Presson, A.P., Smith, B.P., Reilly, P.M., Luo-Owen, X., Mukherjee, K., Morris, B.J., Majercik, S., Thomsen, P.B. and Erickson, B.A. (2017). **MP79-01 Nephrectomy after High-grade Renal Trauma: Results from the American Association for the Surgery of Trauma (AAST) Genitourinary Trauma Study.** The Journal of Urology, 197(4S), pp.e1072-e1073.

Conference proceedings

28. **Xu, Y.** and Yadlowsky, S. (2022). **Calibration Error for Heterogeneous Treatment Effects.** In International Conference on Artificial Intelligence and Statistics (pp. 9280-9303) (AISTAT 2022)
29. Pfohl, S.R., **Xu, Y.**, Foryciarz, A., Ignatiadis, N., Genkins, J. and Shah, N.H. (2022). **Net benefit, calibration, threshold selection, and training objectives for algorithmic fairness in healthcare.** Accepted by the ACM Conference on Fairness, Accountability, and Transparency (ACM FAccT 2022).

Preprints

30. Ethan Steinberg, Nikolaos Ignatiadis, Steve Yadlowsky, **Yizhe Xu**, and Nigam Shah (2022). **Using Public Clinical Trial Reports to Evaluate Observational Study Methods.** Under review at BMC Medical Research Methodology.
31. Ethan Steinberg, **Yizhe Xu**, Jason Fries, and Nigam Shah (2023). **Self-Supervised Time-to-Event Modeling with Structured Medical Records.** Under review at NeurIPS 2023 conference. ArXiv

Software

R packages:

- survlearners: Metalearerns for estimating heterogeneous treatment effects for survival outcomes.
  - Treatment heterogeneity with survival outcomes: An introduction to five state-of-art metalearners (S-, T, M-, X-, and R-learners)
  - Metalearners selection: A summary of the main considerations and suggestions for choosing metalearners, based on the results from our benchmarking study
  - A case study with metalearners: An illustration of applying metalearners to two large randomized controlled trials (SPRINT and ACCORD)
- CEAOptimalITR: Estimating the optimal individualized treatment rule (ITR) from a cost-effectiveness perspective.
- CEAOptimalITREfficient: An improved version of CEAOptimalITR, and it provides more accurate estimates of the optimal cost-effective ITR with less variability.
- ECETH: Calibration Error for Heterogeneous Treatment Effects.

Talks and Presentations

Metalearners for Heterogeneous Treatment Effects on Survival Outcomes in Experiments. May 2022
American Causal Inference Conference
University of California, Berkeley

Calibration Error for Heterogeneous Treatment Effects. March 2022
International Conference on Artificial Intelligence and Statistics (AISTATS)
Virtual Conference

A Conditional Random Forest Approach to Estimating the Most Cost-effective Individualized Treatment Rule. August 2021
Journal of Statistical Meetings, Health Policy Statistics Section
Virtual Conference

Estimating the Optimal Individualized Treatment Rule from A Cost-Effectiveness Perspective. September 2019
American Statistical Association, Biopharmaceutical Section Regulatory-Industry Statistics Workshop

Program
Washington D.C.

Random-Forest Based Personalized Treatment Rule Optimization from A Cost-Effectiveness Perspective with An Application to the SPRINT Study. September 2019
The 3rd Annual Translational Hypertension Symposium and Early-Stage Investigator Workshop
University of Utah

Was the Effect of Intensive Blood Pressure Intervention on CVD Risk Heterogeneous in the SPRINT Study? September 2018
The 2nd Annual Translational Hypertension Symposium and Early-Stage Investigator Workshop
Salt Lake City, Utah

Optimal Study Design for Diagnostic Accuracy Studies: Differential Verification versus Partial Verification. September 2017
Association for Clinical and Translational Science
Washington D.C.

Teaching

Teaching Assistant (TA) at University of Utah

Math 5010: Introduction to Probability	Fall 2016
Math 5080: Statistics Inference I.	Fall 2017
Math 5090: Statistics Inference II.	Fall 2018

Peer Review

Journals
Journal of Biomedical Informatics
Pharmacoepidemiology and Drug Safety
npj Digital Medicine

Conferences
AISTATS 2022