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| CONTACT DETAILS    | <p>Stanford University<br/> <a href="#">Center for Biomedical Informatics Research</a><br/>           453 Quarry Rd.,<br/>           Palo Alto, CA 94304, USA</p>   | <p>Telephone: +1 (801) 433-7346<br/>           E-mail: <a href="mailto:yizhex@stanford.edu">yizhex@stanford.edu</a><br/>           Website: <a href="https://crystalxur.github.io/">https://crystalxur.github.io/</a><br/>           Google Scholar: <a href="#">user=_H8BKfMAAAAJ</a></p> |
| RESEARCH INTERESTS | <p>I am interested in causal inference, semiparametric and nonparametric statistics, and machine learning methods. 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 the estimation of heterogeneous treatment effects in clinical trials or observational studies and identification of individualized treatment rules.</p>  |  |
| EDUCATION          | <p><b>Stanford University</b> <span style="float: right;">Stanford, California, USA</span><br/> <ul style="list-style-type: none"> <li><b>Postdoctoral fellow in Biomedical Informatics</b> <span style="float: right;">11/2020 – present</span><br/>               Advisor: Nigam Shah</li> </ul> </p> <p><b>University of Utah</b> <span style="float: right;">Salt Lake City, Utah, USA</span><br/> <ul style="list-style-type: none"> <li><b>Ph.D. in Population Health Sciences (Emphasis in Biostatistics)</b> <span style="float: right;">08/2016 – 08/2020</span><br/>               Thesis advisor: Jincheng Shen and Tom Greene<br/>               Thesis paper I title: Estimating the optimal individualized treatment rule from a cost-effectiveness perspective.<br/>               Thesis paper II title: An Efficient Approach for Optimizing the Cost-effective Individualized Treatment Rule Using Conditional Random Forest.</li> <li><b>M.Sc. Statistics</b> <span style="float: right;">2014 - 2016</span><br/>               Thesis advisors: Nan Hu</li> </ul> </p> <p><b>Liaoning Medical University</b> <span style="float: right;">Liaoning, China</span><br/> <ul style="list-style-type: none"> <li><b>B.Sc. Nursing</b> <span style="float: right;">2008 - 2012</span></li> </ul> </p> |  |
| AWARDS             | <p><b>Joint Statistical Meeting, Student Paper Award</b> <span style="float: right;">2021</span><br/>           Health Policy Statistics Section, Virtual Conference</p> <p><b>American Statistical Association, Student Travel Award</b> <span style="float: right;">2019</span><br/>           Biopharmaceutical Section Regulatory-Industry Statistics Workshop Program, Washington D.C., USA.</p> <p><b>Student of the Year</b>, Master of Statistics, University of Utah <span style="float: right;">2017</span></p> <p><b>Phi Kappa Phi Inductee</b>, Division of Public Health, University of Utah <span style="float: right;">2017</span></p> <p><b>Student of the Year</b>, Liaoning Medical University <span style="float: right;">2011</span></p>  |  |
| SKILLS             | <ol style="list-style-type: none"> <li>1. Statistical programming in R, SAS, Stata, and Python</li> <li>2. Statistical software building and sharing using GitHub</li> <li>3. High-performance computing using SLURM</li> <li>4. Manage (using BigQuery/SQL) and analyze (using virtual machine instances) large database in Google Cloud Platform (GCP)</li> <li>5. Cohort extraction from claims data and electronic health records (EHRs) using SNOMED, ICD9/10, and LONIC codes</li> <li>6. Formal scientific writing and presentations</li> <li>7. Formal mathematical writing using LaTeX</li> <li>8. Collaborate with diverse groups, e.g., physicians, epidemiologists, computer scientists, etc.</li> </ol>  |  |
| BOOK CHAPTER       | <ol style="list-style-type: none"> <li>1. Yizhe Xu, Nikolaos Ignatiadis, Erik Sverdrup, Scott Fleming, Stefan Wager, Nigam Shah (2022). <b>Handbook of Matching and Weighting Adjustments for Causal Inference. Chapter: Treatment Heterogeneity with Survival Outcomes.</b> <a href="#">Chapman &amp; Hall/CRC Press</a> (forthcoming).</li> </ol>   |  |

2. 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.
3. 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>.
4. 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.
5. Jonathan Lu, Amelia Sattler, Samantha Wang, Ali Raza Khaki, Alison Callahan, Scott Fleming, Rebecca Fong, Benjamin Ehler, Ron C. Li, Lisa Shieh, Kavitha Ramchandran, Michael F. Genheimer, 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>
6. 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.
7. 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.
8. 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.
9. 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.
10. 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.
11. 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.
12. 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.
13. 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.
14. 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.
15. 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.
16. 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.
17. 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.

18. 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.
19. 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.
20. 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.
21. 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.
22. 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.
23. 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).
24. 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).
25. 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

26. 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)
27. 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

28. Yizhe Xu, Katelyn Bechler, Alison Callahan, and Nigam Shah (2022). **A Careful Estimation and Evaluation Process of Treatment Effect Heterogeneity: A case study application to dabigatran for patients with atrial fibrillation.** Working paper.
29. Yizhe Xu, Agata Foryciarz, Ethan Steinberg, and Nigam H. Shah (2022). **Clinical Utility Gains from Incorporating Comorbidity and Geographic Location Information into Risk Estimation Equations for Atherosclerotic Cardiovascular Disease.** Working paper.
30. Ethan Steinberg, Nikolaos Ignatiadis, Steve Yadlowsky, Yizhe Xu, and Nigam Shah (2022). **Using Public Clinical Trial Reports to Evaluate Observational Study Methods.** [ArXiv](#)

#### SOFTWARE

##### R packages:

- [survlearners](#): Metalearners 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.

#### RESEARCH APPOINTMENTS

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|---|----------------|
| <b>Center for Biomedical Informatics Research (BMIR)</b><br>Stanford University, California, USA<br>Postdoctoral fellow, funded by the NHLBI R01 grant 'applying statistical learning tools to personalize cardiovascular treatment'. | 2020 – Present |
| <b>Department of Population Health Sciences (PHS)</b><br>University of Utah, Utah, USA<br>Graduate assistant, funded by the R01 grant 'Optimize-SPRINT study'.  | 2018 – 2020    |
| <b>Value and Epidemiology Research Using Causal Inference and Data</b><br>Veteran Affairs, Salt Lake City, Utah, USA<br>Research assistant in the group of Dr. Brian Sauer  | 2017 - 2020    |
| <b>Study Design and Biostatistics Center (SDBC)</b><br>University of Utah, Utah, USA<br>Research assistant in the group of Prof. Tom Green.   | 2016 - 2019    |
| <b>Department of Family and Preventive Medicine (FPMD)</b><br>University of Utah, Utah, USA<br>Research assistant in the group of Prof. Joseph Stanford.  | 2014 - 2016    |

#### TALKS AND PRESENTATIONS

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| <b>Metalearners for Heterogeneous Treatment Effects on Survival Outcomes in Experiments.</b><br>May 2022<br>American Causal Inference Conference<br>University of California, Berkeley  |                |
| <b>Calibration Error for Heterogeneous Treatment Effects.</b><br>International Conference on Artificial Intelligence and Statistics (AISTATS)<br>Virtual Conference   | March 2022     |
| <b>A Conditional Random Forest Approach to Estimating the Most Cost-effective Individualized Treatment Rule.</b><br>Journal of Statistical Meetings, Health Policy Statistics Section<br>Virtual Conference   | August 2021    |
| <b>Estimating the Optimal Individualized Treatment Rule from A Cost-Effectiveness Perspective.</b><br>American Statistical Association, Biopharmaceutical Section Regulatory-Industry Statistics Workshop Program<br>Washington D.C.                                  | September 2019 |
| <b>Random-Forest Based Personalized Treatment Rule Optimization from A Cost-Effectiveness Perspective with An Application to the SPRINT Study.</b><br>The 3rd Annual Translational Hypertension Symposium and Early-Stage Investigator Workshop<br>University of Utah | September 2019 |
| <b>Was the Effect of Intensive Blood Pressure Intervention on CVD Risk Heterogeneous in the SPRINT Study?</b><br>The 2nd Annual Translational Hypertension Symposium and Early-Stage Investigator Workshop<br>Salt Lake City, Utah                                    | September 2018 |
| <b>Optimal Study Design for Diagnostic Accuracy Studies: Differential Verification versus Partial Verification.</b><br>Association for Clinical and Translational Science<br>Washington D.C.  | September 2017 |

#### TEACHING

|  |           |
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| <b>Teaching Assistant (TA)</b> at University of Utah<br>Math 5010: Introduction to Probability | Fall 2016 |
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Math 5080: Statistics Inference I.  
Math 5090: Statistics Inference II.

Fall 2017  
Fall 2018

PEER REVIEW

**Journals**

Journal of Biomedical Informatics  
Pharmacoepidemiology and Drug Safety  
npj Digital Medicine

**Conferences**

AISTATS 2022