PROMOTION RECOMMENDATION
The University of Michigan
School of Public Health
Department of Biostatistics

Xu Shi, assistant professor of biostatistics, School of Public Health, is recommended for promotion to associate professor of biostatistics, with tenure, School of Public Health.

Academic Degrees:
Ph.D.   2017   University of Washington, Seattle, WA
B.S.   2012   Zhejiang University, Hangzhou, Zhejiang, China

Professional Record:
2022-Present   John G. Searle Professor of Biostatistics, Department of Biostatistics, School of Public Health, University of Michigan, Ann Arbor, MI
2019-Present   Assistant Professor, Department of Biostatistics, School of Public Health, University of Michigan, Ann Arbor, MI
2017-2019   Post-doctoral Fellow, Data Science Initiative and Department of Biostatistics, Harvard University, Cambridge, MA

Summary of Evaluation:
Teaching: Professor Shi has taught two courses since 2019: BIOS 650: Theory and Application of Linear Regression, a core course in the master's program (2020-2021), and BIOS 830: Advanced Topics in Biostatistics (2020-2023). For BIOS 650, Professor Shi updated the teaching materials to transition from SAS to R-based instruction. Additionally, she introduced a group project component that provides students in BIOS 650 with hands-on data analysis and reporting experience. Professor Shi developed and now teaches BIOS 830, a special topics course on the analysis of electronic health records (EHR) data. She also offered a course on EHR data analysis in the School of Public Health Summer Institute for Epidemiology in 2023. Professor Shi has consistently received positive teaching evaluations, with ratings from 4.8 to 5.0 across all evaluation items. She has provided lectures and participated in several short courses for the School of Public Health Big Data Summer Institute, Johns Hopkins University, Harvard University, the Deming Conference on Applied Statistics, and the 2023 Joint Statistical Meetings.

Professor Shi has served as a dissertation chair or co-chair for five doctoral students at rank. Among these, one is now an associate manager at Regeneron Pharmaceuticals, and another joined Boston University as an assistant professor of biostatistics. She also has served on 16 dissertation committees. Professor Shi's mentees have submitted or published 17 manuscripts (six as first author) in peer reviewed journals and one received the Distinguished Student Paper Award from Eastern North American Region International Biometric Society (ENAR) in 2021.

Research: Professor Shi's first research area focuses on causal inference and its application in comparative effectiveness and safety research leveraging negative control variables, increasingly recognized in EHR-based research and observational studies to detect and control for

unmeasured confounding. She has developed causal inference methods leveraging negative controls and proxies of unmeasured confounders across several settings (point exposure and univariate outcome setting, longitudinal and time-series setting, and outcome-dependent sampling). Professor Shi's second research theme involves the development of scalable and automated pipelines for multi-institutional EHR data quality control and data harmonization under privacy constraints to reduce heterogeneity across diverse healthcare systems. In this area, she developed a new method to facilitate the integration of heterogeneous EHR data from different institutions. Moreover, her sample-efficient sampling strategy for selective phenotyping is a cost-effective approach that has practical implications for EHR-based studies. Professor Shi's work has had a translational impact in the policy arena. Her double negative control method was written into the U.S. Food and Drug Administration (FDA) Prescription Drug User Fee Act VII commitment in response to the growing stakeholder interest to understand how methodological advances with negative controls can improve real-world studies using EHR and claims data. As part of the PDUFA commitment, a one-day public workshop was held on March 8, 2023 with over 800 participants from academia, government, and industry. In addition to the workshop, there will be two FDA demonstration projects, of which Professor Shi will lead one on data-driven identification of and estimation with negative controls.

Professor Shi has demonstrated excellent productivity, authoring a total of 45 papers, of which 38 were published at rank since 2019. Of the 38 published at rank, she was first or corresponding author on seven papers and second author on three manuscripts. She also has contributed 13 preprints, one of which received the 2021 Distinguished Student Paper Award from the ENAR scientific meeting. She has published in leading and high-impact journals in the field including two papers in the *Journal of the American Statistical Association (JASA)* and one paper in the *Journal of the Royal Statistical Society Series B (JRSS-B)*. According to Google Scholar, her publications have been cited over 1,800 times, with an h-index of 16 and an i10-index of 22. Professor Shi also received the 2022 Outstanding Statistical Application Award from the American Statistical Association (ASA) in recognition of her contributions.

Professor Shi has garnered substantial external and competitive internal funding for her research at rank. She is currently a multiple principal investigator (MPI) on two major grants from the FDA and a National Institutes of Health (NIH) R01 grant. She also received a $200,000 University of Michigan Precision Health Investigator award for which she is the sole principal investigator (PI). She is a subcontracted MPI on a Moody Endowment/University of Texas Medical Branch award. Professor Shi is also an active collaborator, serving as a co-investigator at rank on four R01 grants funded by the NIH.

Recent and Significant Publications:
Li Q, Shi X., Miao W, Tchetgen Tchetgen EJ. (2023). Double Negative Control Inference in Test-Negative Design Studies of Vaccine Effectiveness. *Journal of the American Statistical Association: Theory and Methods*, in press.
Shi X, Li Q, Mukherjee B. (2023). Current Challenges with the Use of Test-Negative Designs for Modeling COVID-19 Vaccination and Outcomes. *American Journal of Epidemiology*, 192(3):328-33.

Shi X, Li X, and Cai T. (2021). Spherical regression under mismatch corruption with application to automated knowledge translation. *Journal of the American Statistical Association Theory and Methods*, 116(536):1953-1964.

Shi X, Miao W, and Tchetgen Tchetgen EJ. (2020). Multiply robust causal inference with double negative control adjustment for categorical unmeasured confounding. *Journal of the Royal Statistical Society: Series B (Statistical Methodology)*, 82(2):521-540.

Shi X, Wellman R, Heagerty PJ, Nelson JC, and Cook AJ. (2020). Safety surveillance and the estimation of risk in select populations: flexible methods to control for confounding while targeting marginal comparisons via standardization. *Statistics in Medicine*, 39(4):369-386.

Service: Professor Shi has an excellent and well-established record of service at the rank of assistant professor. At the departmental level, she has been a member of the Diversity, Equity, and Inclusion (DEI) Committee for three years, and she co-organized the departmental DEI seminar series. She also served on the Curriculum Committee, Cohort Advising Committee, and the department's 60/70 Year Celebration Committee. Within the School of Public Health, Professor Shi was a member of the Anti-Racism Working Group.

Among her external service activities, Professor Shi is an associate editor for the *Journal of Computational and Graphical Statistics*. She is an active peer reviewer for 25 journals, including *Nature*, *JAMA Oncology*, *JASA*, and *Annals of Statistics*. She additionally has served in an ad hoc capacity reviewing grant proposals for NIH/National Institute of Neurological Disorders and Stroke, FDA, Patient-Centered Outcomes Research Institute (PCORI), Medical Research Council (MRC) of UK, Mitacs Accelerate Research of Canada, as well as internally for Michigan Institute for Clinical and Health Research Pilot Grant program. Professor Shi has been an invited session organizer for three statistical conferences, served as the chair for an invited session for one statistical conference, and was a member of the program committee for three artificial intelligence and healthcare informatics conferences and the Student Paper Competition Committee for the International Chinese Statistical Association Applied Statistics Symposium. She also served as a member of the data safety and monitoring board for the grant "Sympatho-inhibition with mindfulness in chronic kidney disease" from 2019 to 2021.

External Reviewers:

Reviewer A: "Dr. Shi has clearly established herself as an expert for developing statistical methods for real world data such as electronic health records (EHR) and claims data. ... The quality and quantity of her published work is outstanding. Indeed, I confidently believe that Dr. Shi is a highly deserved candidate to be offered Associate Professor with Tenure in my own department"

Reviewer B: "Dr. Shi's work is very strong, impressive and unique...she is bringing a rigorous statistical perspective to a field [HER data] that has been somewhat ignored by statisticians. Based on Dr. Shi's scholarly work, funding history, teaching expertise and service to the field, she would be a very strong candidate for tenure [at my institution]."
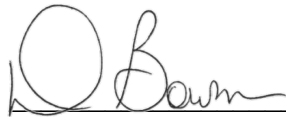
Reviewer C: "Dr. Shi's work is highly impactful and of impeccable quality. She brings a unique combination of theoretical rigor and care for applications to her work, which addresses some of

the most pressing issues in biostatistics and public health. I am confident that Dr. Shi would be promoted to Associate Professor in my department."

Reviewer D: "I do believe that her work would meet the requirements for tenure in my department. ... Overall, Dr. Shi has made significant research contributions to the development of methods for novel causal inference methods that utilize negative controls in observation studies and harness the full potential of EHR data."

Reviewer E: "Dr. Shi has an amazing record of successfully competing for grant funding. ... Dr. Shi's success demonstrates that she is working on compelling and important problems. In summary, Dr, Shi is doing great. She seems to have a fabulous career ahead of her. I...recommend her for promotion to Associate Professor with tenure."

Summary of Recommendation: Professor Shi is a distinguished researcher in the field of statistical methods whose work has garnered recognition in the fields of biostatistics, epidemiology and medical informatics. She has an excellent record in research, teaching, and service. It is with the support of the School of Public Health Executive Committee that I recommend Xu Shi for promotion to associate professor of biostatistics, with tenure, School of Public Health.

F. DuBois Bowman, Ph.D.
Dean, School of Public Health

May 2024