

# Michael J. Higgins

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Department of Statistics  
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**POSITIONS**      *Assistant Professor*      2015-  
Department of Statistics  
Kansas State University, Manhattan, KS

*Postdoctoral Research Associate*      2013-2015  
Program for Quantitative and Analytical Political Science  
Department of Politics  
Princeton University, Princeton, NJ

**EDUCATION**      *Ph.D.*, Statistics.      2013  
University of California at Berkeley, Berkeley, CA  
*Applications of Integer Programming Methods to Solve Statistical Problems*  
Dissertation Co-chairs: Jasjeet Sekhon and Deborah Nolan

*B.S.*, Mathematics and Statistics.      2006  
Kansas State University, Manhattan, KS  
*Summa cum laude.*

## ACTIVE RESEARCH AREAS

### *Causal Inference:*

- Experimental design: Blocking of experiments, design and analysis of cluster-randomized experiments, design of experiments with sampling and experimental components.
- Post-stratification, matching, and related problems, and their relationship to optimal partitioning problems in graph theory.
- Estimation of and statistical inference for treatment effects under Neyman-Rubin Causal Model.
- Causal inference under treatment interference.

### *Computational Statistics:*

- Development of computationally efficient statistical methods under massive data settings.
- Instance selection with applications to clustering, prediction, and classification.

### *Statistics on Networks:*

- Automated detection of communities and statistical inference on networks.
- Applying networks to problems including statistical blocking, causal inference under treatment interference, and redistricting,

### *Quantitative Social Science:*

- Applying statistical techniques to solve a variety of problems including automated redistricting and election auditing.

**PRIMARY  
PUBLICATIONS**

1. Higgins, J.J., Higgins M.J., Lin, J. (2020) “From one environment to many: The problem of replicability of statistical inferences.” Accepted to *The American Statistician*.
2. Moradijamei, B., Shakeri, H., Poggi-Corradini, P., Higgins, M.J. (2020). “A new method for quantifying network cyclic structure to improve community detection.” Accepted to *Physica A: Statistical Mechanics and its Applications*.
3. Sävje, F., Higgins, M.J., Sekhon, J.S. (2020). “Generalized Full Matching”. Accepted to *Political Analysis*.
4. Fifield, B., Higgins, M.J., Imai, K., Tarr, A. (2020). “Automated Redistricting Simulation Using Markov Chain Monte Carlo.” *Journal of Computational Graphics and Statistics*. To Appear.
5. Higgins, M.J., Sävje, F., Sekhon, J. S. Sekhon. (2016). “Improving Massive Experiments with Threshold Blocking.” *Proceedings of the National Academy of Sciences* 113(27), 7369-7376.
6. Higgins, M.J., R.L. Rivest, and P.B. Stark. (2011). “Sharper  $p$ -values for stratified post-election audits,” *Statistics, Politics, and Policy*, 2(1), Article 7.

**CONSULTING  
PUBLICATIONS**

1. Erickson, L., Newmark, G., Higgins, M.J., Wang, Z., (2020). “Nitrogen Oxides and Ozone in Urban Air: A Review of More than 50 Years of Progress” *Environmental Progress & Sustainable Energy*, e13484.
2. Wang, Zixian, Anthony, Jennifer L., Erickson, Larry E., Higgins, Michael J., Newmark, Gregory L., (2020). “Nitrogen Dioxide and Ozone Pollution in the Chicago Metropolitan Area” *Journal of Environmental Protection*. 11(8).
3. Schumm, W. R., Crawford, D. W., Higgins, M.J., Lockett, L., AlRashed, A., & bin Ateeq, A. (2018). Estimating the Standard Deviation From the Range: a Replication of Analysis of Demographic Data Reported in Marriage & Family Review, 2016-2017. *Marriage & Family Review*, 54(8), 777-792.
4. Schumm, W.R., Higgins, M.J., Lockett L., Huang S., Abdullah N., Asiri A., Clark K., & McClish K. (2017). “Does Dividing the Range by Four Provide an Accurate Estimate of a Standard Deviation in Family Science Research? A Teaching Editorial.” *Marriage & Family Review*. 53(1).

**SUBMITTED  
MANUSCRIPTS**

“The Benefits of Probability-Proportional-to-Size Sampling in Cluster-Randomized Experiments” (with Yeng Xiong). Submitted to *Journal of Statistical Planning and Inference*.

“SeMA: Extending and Analyzing Storyboards to Develop Secure Android Apps” with Joydeep Mitra, Venkatesh-Prasad Ranganath, and Torben Amtoft. Submitted to *Transactions on Software Engineering and Methodology*.

“Hybridized Threshold Clustering for Massive Data” (with Jianmei Luo, Chandrayya Annakula, Aruna Sai Kannamareddy, Jasjeet S. Sekhon, and William Henry Hsu).

## SELECTED WORKS IN PROGRESS

“Finding common support using largest connected components” (with Sharif Mahmood, Sanjeevani Weesaringha, and Hongyuan Lu).

“The Lady Tasting Tea Revisited: Insights on SUTVA Violations from a Canonical Example” (with Linus Addae).

## GRANT APPLICATIONS

1. NSF CAREER Program. “CAREER: Towards Scalable, Replicable, and Communicable Data Science.” PI Michael J. Higgins. 2020. Results pending.
2. DOE Early Career Grant. “Threshold clustering to improve the scalability of clustering and prediction algorithms with applications to monitoring air quality.” PI Michael J. Higgins. 2020. Unfunded.
3. DOE Early Career Grant. “Threshold clustering to improve the scalability of prediction and clustering algorithms for massive data.” PI Michael J. Higgins. 2018. Unfunded.
4. NSF TRIPOD Grant. “DNODE: Data and Networks Optimization Design and Experimentation.” PI Pietro Poggi-Corradini, Co-PI’s Nathan Albin, Doina Caragea, Michael J. Higgins, Caterina Scoglio. 2017. Unfunded.

## GRADUATE ADVISING

### *Graduated PhD Students:*

1. Sharif Mahmood. 2016. Dissertation: *Finding common support and assessing matching methods for causal inference*.  
First job: Visiting Assistant Professor, University of Iowa  
Current Job: Assistant Professor, University of Central Arkansas
2. Jianmei Luo. 2019. Dissertation: *Threshold clustering for massive data*.  
First job: Monsanto
3. Behnaz Moradijamei. 2019. Dissertation: *Detecting communities and performing statistical inferences on networks through renewal non-backtracking random walks*.  
First job: Postdoc, University of Virginia
4. Yeng Xiong. 2020. Dissertation: *Design-based efficiency for analyzing cluster-randomized experiments*.  
First job: Mathematical Statistician, United States Census Bureau

### *Current PhD Students:*

Linus Addae  
Sanjeevani Weesaringha  
Samirah Alzubaidi  
Ramlah Albayyat  
Tahany Basir  
Hilda Calderon–Cartagena

### *Graduated MS Students:*

1. Jinguang Lin. 2018. Report: *From One Environment to Many: The Problem of Reproducibility of Experimental Results*.  
First job: PhD Student, Kansas State University.

2. Zhihan Zhang. 2018. Report: *Selected Results from Clustering and Analyzing Stock Market Trade Data.*
3. Jessica Struck. 2019. Report: *An Analysis of Vehicular Emissions at Kansas State University.*  
First job: Instructor, Barton Community College, Fort Riley Campus
4. Hongyuan Lu. 2019. Report: *Finding Common Support through Largest Connected Components and its Implementation.*  
First job: Google
5. Yu Shi. 2020. Report: *Evaluation of optimal clusterings found by cluster validation measures.*

*Current MS Students:*

Yang Yang  
Preston Chovanec

**UNDERGRAD  
SUPERVISING**

1. Andrew Powers. 2017. Supervised Senior Report.
2. Calvin Nelson. 2019. Supervised Kansas State Research for All presentation.

**GRADUATE  
COMMITTEES**

*PhD Students, Statistics:*

- Steephanson Anthonyuthu
- Xi Lu
- Yinhao Du
- Liying Jin

*PhD Students, Other Departments:*

- Nethali Fernando: Mathematics. Graduated 2018.
- Anna Melikyan: Mathematics. Graduated 2019.
- Negar Orangi-Fard: Mathematics. Graduated 2020.
- Congcong Zhang: Human Nutrition
- Noah Miller: Ag. Econ
- Joydeep Mitra: Computer Science
- Kapila Kottegoda: Mathematics
- Priyanka Patel: Life Span Human Development

*MS Students, Statistics:*

- Zhihe Zhuang. Graduated 2018.
- Chengshuang Lu. Graduated 2019.
- Yue Huang

*MS Students, Other Departments:*

- Andrew Young: Regional and Community Planning. Graduated 2019.
- Zixian Wang: Chemical Engineering. Graduated 2020.

*Outside Chair:*

- Christopher Richardson: Mathematics. 2018.
- Jared Hoppis: Mathematics. 2019.

**SELECTED  
INVITED TALKS**

- “Threshold Clustering for Big Data with Applications in Causal Inference.” Oklahoma State University Department of Statistics. 2019.
- “A new method for incorporating cyclic structures in networks to improve community detection.” Annual Meeting of SIAM Central States Section. 2018.
- “Hybridized Threshold Clustering for Massive Datasets.” Annual Meeting of SIAM Central States Section. 2017.
- “Threshold Partitioning Problems and Applications in Statistics.” Annual Meeting of SIAM Central States Section. 2016.
- “Improving Massive Experiments using Threshold Blocking.” Columbia University Department of Political Science. 2015.
- “A new automated redistricting algorithm using MCMC.” Annual Meeting of the Society for Political Methodology. With Ben Fifield and Kosuke Imai. 2014.
- “Improving Experiments by Optimal Blocking: Minimizing the Maximum Within-block Distance.” Kansas State University Statistics Seminar. 2013.
- “Improving Experiments by Optimal Blocking: Minimizing the Maximum Within-block Distance.” Annual Meeting of the Society for Political Methodology. With Jasjeet Sekhon. 2013.

**SELECTED  
CONTRIBUTED  
TALKS AND  
POSTERS**

- “Mean-Weighted Case Specific Random Forests for Estimating Causal Effects.” Joint Statistical Meetings. 2020.
- “Applications of Bottleneck Optimization Problems in Causal Inference and Big Data.” William Hsu Research Group. Kansas State University. 2019.
- “The Challenges of Using Big Data in Research.” Manhattan High School. 2019.
- “From one environment to many: The problem of replicability of statistical inferences.” Joint Statistical Meetings. 2019.
- “From one environment to many: The problem of replicability of statistical inferences.” Innovations in Design, Analysis and Dissemination: Frontiers in Biostatistical Methods. 2019.
- “The Large Problem of Big Data: Finding solutions to practical problems by combining Mathematics, Statistics, and Computer Science.” Kansas State University Undergraduate Mathematics Seminar. 2017.
- “Finding Common Support Using Largest Connected Components.” Poster presentation. Annual Meeting of the Society for Political Methodology. 2016.
- “Discussion of Ideal-Point Estimation with Correlated Votes.” Annual Meeting of the Society for Political Methodology. 2016.
- “Improving Massive Experiments using Threshold Blocking: Minimizing the Within-Block Distance.” Kansas State University Applied Mathematics Seminar. 2015.
- “The Benefits of Probability Proportional to Size Sampling in Cluster Randomized Experiments.” Annual Meeting of the American Political Science Association. 2014.
- “The Benefits of Probability Proportional to Size Sampling in Cluster Randomized Experiments.” Poster presentation. Annual Meeting of the Society for Political Methodology. 2014.

- “Improving Experiments by Optimal Blocking: Minimizing the Maximum Within-block Distance.” Joint Statistical Meetings. 2013.
- “Sharper  $p$ -values for Stratified Election Audits.” Annual Meeting of the Society for Political Methodology. Poster presentation. 2013.
- “Optimal Blocking by Minimizing the Maximum Within-block Distance.” San Francisco Bay Area Chapter of the American Statistical Association. 2013.
- “Optimal Blocking by Minimizing the Maximum Intra-block Dissimilarity.” U.S. Census Bureau, Center for Statistical Research & Methodology. 2013.
- “Exact Inference using Stratified Random Samples and the 0-1 Knapsack Problem.” Joint Statistical Meetings. 2011.

## TEACHING

*Kansas State University:*

- STAT 350: Business And Economic Statistics 1, Fall 2020.  
Coordinator and Lecturer.  $\approx$  230 students enrolled.
- STAT 703: Introduction to Statistical Methods for the Sciences,  
Summer 2018, Summer 2019, Summer 2020
- STAT 706: Basic Elements of Statistical Theory, Fall 2015, Fall 2016, Fall 2017,  
Fall 2018, Fall 2019.
- STAT 710: Sample Survey Methods, Fall 2016, Fall 2018.
- STAT 716: Nonparametric Statistics, Fall 2019.
- STAT 761: Discrete Optimization and Scalability for Data Science, Spring 2019
- STAT 771: Theory of Statistics II, Spring 2017, Spring 2020.
- STAT 950: Introduction to Causal Inference, Spring 2016, Spring 2018.

- Created and developed courses STAT 761: Discrete Optimization and Scalability for Data Science and STAT 950: Introduction to Causal Inference.

*Princeton University:*

- WWS 404: Quantitative/Qualitative Research Methods Lab, Spring 2014.  
Quantitative lab instructor.

## SOFTWARE PACKAGES

`elec.strat`

- R package that calculates exact  $p$ -values and obtains optimal sampling sizes for stratified election audits.
- Available on CRAN.

## HONORS AND AWARDS

- Travel award to the Sackler Colloquia. 2017.
- College of Arts and Sciences Faculty Enhancement Award. Kansas State University. 2016.

## BOOK REVIEWS

1. Higgins, M.J., (2019). *A Panorama of Statistics: Perspectives, Puzzles and Paradoxes in Statistics* by Eric Sowe and Peter Petocz. *The American Statistician*, 73(1),

## SERVICE

*Kansas State University:*

- Co-Director of Graduate Admissions. 2019–
- Advisor for Undergraduate Program . 2019–

- Co-Director of Undergraduate Program. 2018.
- Director of Teaching Evaluations Committee. 2019–
- Member of department head search committee. 2018.
- Qualifying Exam Committee: Theory Exam. 2016–2019.
- Qualifying Exam Committee: Linear Models Exam. 2015–2016.
- Director of Undergraduate Assessment. 2016–2017.
- Promotion and Tenure Committee (2016).
- Undergraduate Enhancement Committee. 2016–

*Service to the Profession:*

- Treasurer: Kansas–Western Missouri Chapter of the American Statistical Association (2020–)
- Served on an NSF Grant Panel. 2018.
- Reviewer for *Journal of the American Statistical Association*, *The American Statistician*, *Annals of Applied Statistics*, *PLOS-ONE*, *Journal of Statistical Planning and Inference*, *The Journal of Nonparametric Statistics*, and *Political Analysis*.
- Member of the American Statistical Association, the Institute of Mathematical Statistics, and the American Political Science Association.