

Address

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Employment

2012– *Professor of Statistics, University of Washington*
2011-12 *Professor of Statistics, University of Chicago*
2009-11 *Associate Professor of Statistics, University of Chicago*
2005-09 *Assistant Professor of Statistics, University of Chicago*
2007 *Visiting Faculty, Institute for Mathematics and its Applications, University of Minnesota*
Annual Program: Applications of Algebraic Geometry, Jan-March 2007
2004-05 *Postdoc in Mathematics and Biostatistics, University of California, Berkeley*
Sponsors: Lior Pachter, Bernd Sturmfels (Mathematics)
Sandrine Dudoit, Mark van der Laan (Biostatistics)

Education

2001-04 *University of Washington — Ph.D. in Statistics*
Advisors: Michael D. Perlman, Thomas S. Richardson
1994-00 *Universität Augsburg, Germany — Diplom in Applied Mathematics*
Advisor: Friedrich Pukelsheim
1998-99 *Université Paul Sabatier–Toulouse III, France — DEA in Applied Mathematics*
Advisor: Jean-Marc Azaïs

Grants and Awards

2016 Fellow of the Institute of Mathematical Statistics (IMS)
2016 NSF grant, “Statistical Methods for Differential Network Biology With Applications to Aging”, Co-PI with A. Shojaie, D. Promislow
2014 Medallion Lecture, Institute of Mathematical Statistics (IMS)
2014 Best paper award, Bayesian Analysis
2013-16 NSF grant, “Bayesian Information Criteria and Problems of Parameter Identifiability”
2014-15 NSA grant, “Bayesian Information Criteria”
2013-14 RRF grant, University of Washington
2009-13 Sloan Research Fellowship
2008-13 NSF CAREER grant, “Statistical Inference in Algebraic Models with Singularities”
2005-08 NSF grant, “Graphical and Algebraic Models for Multivariate Categorical Data”
2004 Best Student Paper Award, Conference on Uncertainty in Artificial Intelligence
1997-03 As student: Scholarships from Universität Augsburg, DAAD (German Academic Exchange Service) and Friedrich-Ebert-Foundation, Germany. Birnbaum Award, Department of Statistics, University of Washington. Laha Travel Award, Institute of Mathematical Statistics.

Editorial Activities

2012– Associate editor, *Electronic Journal of Statistics*

- 2007–15 Associate editor, *Annals of Statistics*
- 2007–11 Associate editor, *Journal of the Royal Statistical Society Series B*
- 2013–15 Guest editor, Special Issue on Statistics, *Linear Algebra and Its Applications*
- 2007 Guest editor, Issue on “Algebraic Statistics and Computational Biology,” *Statistica Sinica*
- 2007– Editorial board, *Metrika*
- 2004– Referee for most major Statistics journals including *Ann. Statist.*, *Bernoulli*, *Biometrika*, *Electron. J. Stat.*, *J. Amer. Statist. Assoc.*, *J. Mach. Learn. Res.*, *J. R. Stat. Soc. Ser. B*, *Statist. Sci.*

Other Professional Activities

- 2016 Organizer, AMS Math Research Communities on “Algebraic Statistics,” Snowbird, UT
- 2013 Organizer, Invited session on “Singular Learning Theory,” SIAM Conference on “Applied Algebraic Geometry,” Fort Collins, CO
- 2012 Program Chair of the Institute of Mathematical Statistics for the 2012 WNAR Conference
- 2011 Organizer, Invited session on “Graphical Statistical Models,” SIAM Conference on “Applied Algebraic Geometry,” Raleigh, NC
- 2010/11 Chair, “Committee on Special Lectures,” Institute of Mathematical Statistics
- 2010 Co-organizer, Workshop on “Parameter Identification in Graphical Models,” American Institute of Mathematics, Palo Alto
- 2008–10 Member, “Committee on Special Lectures,” Institute of Mathematical Statistics
- 2008 Co-organizer, Seminar on “Algebraic Statistics,” Mathematisches Forschungsinstitut Oberwolfach, Germany
Organizing committee member, Program on “Algebraic Methods in Systems Biology and Statistics,” Statistical and Applied Mathematical Sciences Institute (SAMSI)
- 2007 Organizer, Invited session on “Graphical Models,” Annual Meeting of the Western North American Region (WNAR) of the International Biometric Society
- 2004– Program committee member, Conf. on Uncertainty in Artificial Intelligence (’04-’06, ’09)

Conference and Workshop Presentations

- 2016 Royal Statistical Society, Read Paper, London, UK
Workshop on Computationally and Statistically Efficient Inference for Complex Large-scale Data, Oberwolfach, Germany
Celebration of 60th Year of the University of Chicago’s Department of Statistics
- 2015 Mathematical Society of Japan Seasonal Institute, Osaka
Working Group on Model-Based Clustering, Seattle
- 2014 Joint Statistical Meetings, Boston
Prague Stochastics, Czech Republic
Abel Symposium on Statistical Analysis for High-Dimensional Data, Norway
World Meeting of International Society for Bayesian Analysis (ISBA), Cancun, Mexico
- 2013 Joint Statistical Meetings, Montreal, Canada
SIAM Conference on “Applied Algebraic Geometry,” Fort Collins, CO
Working Group on Model-Based Clustering, Bologna, Italy
UW-Microsoft Research Machine Learning Day, Seattle
- 2012 NIPS 2012 (Neural Information Processing Systems), Lake Tahoe
Algebraic Statistics in the Alleghenies, Penn State University
NSF Workshop on High-Dimensional Data, Yale University
Midwest Statistics Research Colloquium, University of Wisconsin, Madison
Statistics Winter Workshop, University of Florida

- 2011 Workshop on “Singular Learning Theory,” American Institute of Mathematics (AIM), Palo Alto
 SIAM Conference on “Applied Algebraic Geometry,” Raleigh, NC
 ISI World Statistics Congress, Dublin, Ireland
 Humboldt Kolleg, Gothenburg, Sweden
 International Indian Statistical Association Conference, Raleigh, NC
 Workshop on “Solving Polynomial Equations”, Stockholm, Sweden
- 2010 Lecturer at 3^e cycle romand de statistique et de probabilités appliquées (3 lectures), Switzerland
 Special session on “Applications of Algebraic Geometry,” AMS Joint Math Meetings, San Francisco
 NIPS 2010 (Neural Information Processing Systems), Vancouver
 DREAM 5 (Dialogue for Reverse Engineering Assessments and Methods), New York
- 2008 Opening workshop, Program on “Algebraic Methods in Systems Biology and Statistics,” Statistical and Applied Mathematical Sciences Institute, NC
 COMPSTAT 2008, Porto, Portugal
 Workshop on “Methods for Analyzing Longitudinal Data,” Gothenburg, Sweden
 7th World Congress in Probability and Statistics, Singapore
 Symposium on “Mathematical Aspects of Graphical Models,” Durham, UK
- 2007 Special session on “Combinatorial Enumeration, Optimization, Geometry, and Statistics,” AMS Fall Southeastern Section Meeting, Murfreesboro, TN
 Special session on “Numerical and Symbolic Techniques in Algebraic Geometry and Its Applications,” AMS Fall Central Section Meeting, Chicago
 Workshop on “Theoretical Effectivity and Practical Effectivity of Groebner Bases,” Research Institute for Mathematical Sciences, Kyoto, Japan
 Workshop on “Applications in Biology, Dynamics, and Statistics,” Institute for Mathematics and its Applications, Minneapolis
- 2006 Bayesian Focus Week, Statistical and Applied Mathematical Sciences Institute, NC
 Prague Stochastics, Czech Republic
 Annual Meeting of the Institute of Mathematical Statistics, Rio de Janeiro, Brazil
 European Meeting of Statisticians, Torun, Poland
 Session on “Algebraic Statistics,” Joint Mathematics Meetings, San Antonio
- 2005 Workshop on “Algebraic Statistics and Computational Biology,” Clay Mathematics Institute, Boston
 Workshop on “Multivariate Systems with Independence Structures,” Gothenburg, Sweden
 RECOMB 2005, Boston
- 2004 20th Conference on Uncertainty in Artificial Intelligence, Banff, Canada (plenary talk)
 6th Bernoulli World Congress, Barcelona, Spain
 Workshop on “Algorithmic, Combinatorial and Applicable Real Algebraic Geometry,” Mathematical Sciences Research Institute (MSRI), Berkeley
 Workshop on “Analysis and Design of Electoral Systems,” Oberwolfach, Germany
- 2003 Workshop on “Computational Algebraic Statistics,” American Institute of Mathematics (AIM), Palo Alto
 Workshop on “Computational Aspects of Graphical Models,” Aalborg, Denmark
 19th Conference on Uncertainty in Artificial Intelligence (UAI), Acapulco, Mexico
 Joint Statistical Meetings, San Francisco
 First Joint Meeting of the Institute of Mathematical Statistics and the International Society for Bayesian Analysis, Puerto Rico
- 2002 Annual Meeting of the Institute of Mathematical Statistics, Banff, Canada

Department Seminars

- 2016 Cornell University; Duke University
- 2015 Princeton University; University of Kentucky
- 2013 Georgia Tech; Universität Augsburg, Germany
- 2012 Universität Wien, Austria; Universität Regensburg, Germany; University of Washington
- 2011 University of Washington; Universität Stuttgart, Germany; Universität Mannheim, Germany; University of Perugia, Italy
- 2010 University of California, Davis; University of Chicago (Business School)
- 2009 North Carolina State University (Math); Ohio State University
- 2008 University of California, Berkeley; University of Washington; University of Illinois at Chicago; Max-Planck Institute Leipzig, Germany; Research Institute for Symbolic Computation, Linz, Austria
- 2007 Northern Illinois University; Purdue University; University of Kentucky; University of Illinois at Urbana-Champaign; Université de Montréal & McGill University
- 2006 York University, Toronto; University of Wisconsin, Madison (Biostatistics)
- 2005 Universität Heidelberg, Germany; ETH Zürich, Switzerland; University of California, Berkeley (Biostatistics), University of Illinois at Chicago
- 2004 University of Pennsylvania; University of California, Davis; University of Minnesota; University of Chicago; Carnegie Mellon; University of Michigan; University of California, Irvine; Harvard University; Columbia; University of Toronto; Stanford University; University of British Columbia, Vancouver
- 2003 University of Washington (Electrical Engineering); Universität Augsburg, Germany
- 2002 Universität Mainz, Germany; University of Washington

Book

- 2009 *Lectures on Algebraic Statistics* (with Bernd Sturmfels, Seth Sullivant). Oberwolfach Seminars, Vol. 39. Birkhäuser Verlag, Basel.

Journal Publications

- 2017 58. A Bayesian information criterion for singular models (with Martyn Plummer). *Journal of the Royal Statistical Society Series B*, discussion paper, to appear.
57. Structure learning in graphical modeling (with Marloes Maathuis). *Annual Review of Statistics and Its Application*, to appear.
56. Covariate-adaptive clustering of exposures for air pollution epidemiology cohorts (Joshua Keller, Timothy Larson, Joel Kaufman, Dale Sandler, Adam Szpiro). *Annals of Applied Statistics*, to appear.
55. Marginal likelihood and model selection for Gaussian latent tree and forest models (with Shaowei Lin, Luca Weihs, Piotr Zwiernik). *Bernoulli*, to appear.
- 2016 54. Large-sample theory for the Bergsma-Dassios sign covariance (Preetam Nandy, Luca Weihs). *Electronic Journal of Statistics* **10**(2): 2287–2311.
53. Generic identifiability of linear structural equation models by ancestor decomposition (with Luca Weihs). *Scandinavian Journal of Statistics* **43**: 1035–1045.
52. Estimation of high-dimensional graphical models using regularized score matching (with Lina Lin, Ali Shojaie). *Electronic Journal of Statistics* **10**(1): 806–854.
51. Identifiability of directed Gaussian graphical models with one latent source (with Dennis Leung, Hisayuki Hara). *Electronic Journal of Statistics* **10**(1): 394–422.
50. Order-invariant prior specification in Bayesian factor analysis (with Dennis Leung). *Statistics & Probability Letters* **111**: 60–66.

49. Efficient computation of the Bergsma-Dassios sign covariance (with Luca Weihs, Dennis Leung). *Computational Statistics* **31**(1): 315–328.
48. Laplace approximation in high-dimensional Bayesian regression (with Rina Foygel Barber, Kean Ming Tan). *Statistical Analysis for High-Dimensional Data: The Abel Symposium 2014*, Springer International Publishing, Cham, pp. 15–36.
47. Maximum likelihood estimates for Gaussian mixtures are transcendental (with Carlos Amendola, Bernd Sturmfels). In *MACIS 2015*, LNCS 9582, Springer International Publishing Switzerland.
46. Wald tests of singular hypotheses (with Han Xiao). *Bernoulli* **22**(1): 38–59.
- 2015 45. High-dimensional Ising model selection with Bayesian information criteria (with Rina Foygel Barber). *Electronic Journal of Statistics* **9**: 567–607.
44. Adaptive rhythm sequencing: A method for dynamic rhythm classification during CPR (with Heemun Kwok, Jason Coult, Thomas Rea, Lawrence Sherman). *Resuscitation* **91**: 26–31.
43. On the causal interpretation of acyclic mixed graphs under multivariate normality (with Chris Fox, Andreas Käuffl). *Linear Algebra and Its Applications* **473**: 93–113.
- 2014 42. Robust Bayesian graphical modeling using Dirichlet t-distributions (with Michael Finegold). *Bayesian Analysis* **9**(3): 521–550, with discussion, rejoinder pp. 591–596.
- 2013 41. PC algorithm for Gaussian copula graphical models (with Naftali Harris). *Journal of Machine Learning Research* **14**: 3365–3383.
- 2012 40. Half-trek criterion for generic identifiability of linear structural equation models (with Rina Foygel, Jan Draisma). *Annals of Statistics* **40**(3): 1682–1713.
39. Maximum likelihood degree of variance component models (with Elizabeth Gross, Sonja Petrovic). *Electronic Journal of Statistics* **6**: 993–1016.
38. Wisdom of crowds for robust gene network inference (as part of the ‘DREAM5 Consortium’). *Nature Methods* **9**: 796–804.
37. SPIn: model selection for phylogenetic mixtures via linear invariants (with Anna Kedzierska, Roderic Guigo, and Marta Casanellas). *Molecular Biology and Evolution* **29**(3): 929–937.
- 2011 36. Global identifiability of linear structural equation models (with Rina Foygel, Seth Sullivant), *Annals of Statistics* **39**(2): 865–886.
35. Robust graphical modeling of gene networks using classical and alternative t-distributions (with Michael Finegold). *Annals of Applied Statistics* **5**(2A): 1057–1080.
34. Quantifying the failure of bootstrap likelihood ratio tests (with Ben Williams). *Biometrika* **98**(4): 919–934.
- 2010 33. On a parametrization of positive semidefinite matrices with zeros (with Josephine Yu), *SIAM Journal on Matrix Analysis and Applications* **31**(5): 2665–2680.
32. A geometric interpretation of the characteristic polynomial of reflection arrangements (with Carly Klivans). *Proceedings of the American Mathematical Society* **138**: 2873–2887.
31. Smoothness of Gaussian conditional independence models (with Han Xiao). In *Algebraic Methods in Statistics and Probability II*, (Eds. M. Viana and H. Wynn), Contemporary Mathematics, vol. 516, Amer. Math. Soc., Providence, RI, 2010, pp. 155–177.
30. Finiteness of small factor analysis models (with Han Xiao). *Annals of the Institute of Statistical Mathematics* **62**(4): 775–783.
- 2009 29. Discrete chain graph models. *Bernoulli* **15**(3): 763–753.
28. Likelihood ratio tests and singularities. *Annals of Statistics* **37**(2): 979–1012.
27. Computing maximum likelihood estimates in recursive linear models (with Michael Eichler, Thomas S. Richardson). *Journal of Machine Learning Research* **10**: 2329–2348.
- 2008 26. Moments of minors of Wishart matrices (with Hélène Massam, Ingram Olkin). *Annals of Statistics* **36**(5): 2261–2283.

25. Graphical methods for efficient likelihood inference in Gaussian covariance models (with Thomas S. Richardson). *Journal of Machine Learning Research* **9**: 893–914.
24. Binary models for marginal independence (with Thomas S. Richardson). *Journal of the Royal Statistical Society Series B* **70**(2): 287–309.
23. Multiple solutions to the likelihood equations in the Behrens-Fisher problem. *Statistics & Probability Letters* **78**(18): 3288–3293.
22. A SINful approach to Gaussian graphical model selection (with Michael D. Perlman). *Journal of Statistical Planning and Inference* **138**(4): 1179–1200.
- 2007 21. Multiple testing and error control in Gaussian graphical model selection (with Michael D. Perlman). *Statistical Science* **22**(3): 430–449.
20. Algebraic statistical models (with Seth Sullivant). *Statistica Sinica* **17**: 1273–1297.
19. Algebraic factor analysis: Tetrads, pentads and beyond (with Bernd Sturmfels, Seth Sullivant). *Probability Theory and Related Fields* **138**(3/4): 463–493.
18. Estimation of a covariance matrix with zeros (with Sanjay Chaudhuri, Thomas S. Richardson). *Biometrika* **94**(1): 199–216.
17. A mutagenetic tree hidden Markov model for longitudinal clonal HIV sequence data (with Niko Beerenwinkel). *Biostatistics* **8**(1): 53–71.
- 2006 16. Maximum likelihood estimation in Gaussian chain graph models under the alternative Markov property (with Michael Eichler). *Scandinavian Journal of Statistics* **33**(2): 247–257.
15. Seat excess variances of apportionment methods for proportional representation (with Udo Schwingenschlögl). *Statistics & Probability Letters* **76**(16): 1723–1730.
14. Computing all roots of the likelihood equations of seemingly unrelated regressions. *Journal of Symbolic Computation* **41**(2): 245–254.
13. Conditional independence models for seemingly unrelated regressions with incomplete data (with Steen A. Andersson, Michael D. Perlman). *Journal of Multivariate Analysis* **97**(2): 385–411.
- 2005 12. Asymptotic seat bias formulas (with Udo Schwingenschlögl). *Metrika* **62**(1): 23–31.
11. Mutagenetic tree models (with Niko Beerenwinkel). In L. Pachter and B. Sturmfels, editors, *Algebraic Statistics for Computational Biology*, chapter 14. Cambridge University Press.
10. Ultra-conserved elements in vertebrate and fly genomes (with Nick Eriksson, Garmay Leung). In L. Pachter and B. Sturmfels, editors, *Algebraic Statistics for Computational Biology*, chapter 22. Cambridge University Press.
- 2004 9. Model selection for Gaussian concentration graphs (with Michael D. Perlman). *Biometrika* **91**(3): 591–602.
8. Multimodality of the likelihood in the bivariate seemingly unrelated regressions model (with Thomas S. Richardson). *Biometrika* **91**(2): 383–392.
7. Surface volumes of rounding polytopes (with Udo Schwingenschlögl). *Linear Algebra and Its Applications* **378**: 71–91.
6. Seat allocation distributions and seat biases of stationary apportionment methods for proportional representation (with Udo Schwingenschlögl). *Metrika* **60**(2): 191–202.
5. Simulation of aphasic naming performance in non-brain-damaged adults (with JoAnn P. Silkes, Malcolm R. McNeil). *Journal of Speech, Language and Hearing Research* **47**(3): 610–623.
4. A rediscovered Lull tract and the Augsburg web edition of Lull’s electoral writings (with Günter Hägele, Dominik Haneberg, Friedrich Pukelsheim, Wolfgang Reif). *Le Médiéviste et l’Ordinateur* **43**, online.
- 2003 3. A Markov chain model of tornadic activity (with Caren Marzban, Peter Guttorp, Joseph T. Schaefer). *Monthly Weather Review* **131**(12): 2941–2953.
2. Seat biases of apportionment methods for proportional representation (with Karsten Schuster, Friedrich Pukelsheim, Norman R. Draper). *Electoral Studies* **22**(4): 651–676.

- 1999 1. Analyse de la variance non-équilibrée hiérarchique: comparaison de cinq logiciels (Unbalanced hierarchical analysis of variance: comparison of five software packages) (with Jean-Marc Azaïs). *Journal de la Société Française de Statistique* **140**(1): 23–40.

Conference Papers, Technical Reports & Commentaries

- 2012 9. Nonparametric reduced rank regression (with Rina Foygel, Michael Horrell, John Lafferty), *Advances in Neural Information Processing Systems* **25**, 1637–1645.
8. Comments on: Sequences of regressions and their independencies (with Chris Fox, Andreas Käuff), *TEST* **21**(2), 255–261.
- 2010 7. Exact block-wise optimization in group lasso for linear regression (with Rina Foygel), arXiv:stat.ML/1010:3320.
6. Extended Bayesian information criteria for Gaussian graphical models (with Rina Foygel), *Advances in Neural Information Processing Systems* **23**, 2020–2028.
- 2009 5. Robust graphical modeling with t-distributions (with Michael Finegold). *Proceedings of the 25th Conference on Uncertainty in Artificial Intelligence*, 169–176.
- 2008 4. Iterative conditional fitting for discrete chain graph models. *COMPSTAT 2008—Proceedings in Computational Statistics*, 93–104.
- 2006 3. Algebraic techniques for Gaussian models. *Prague Stochastics 2006* (Eds., Marie Huskova and Martin Janzura), 81–90.
- 2004 2. Iterative conditional fitting for Gaussian ancestral graph models (with Thomas S. Richardson). *Proceedings of the 19th Conference on Uncertainty in Artificial Intelligence*, 130–137.
- 2003 1. A new algorithm for maximum likelihood estimation in Gaussian graphical models for marginal independence (with Thomas S. Richardson). *Proceedings of the 20th Conference on Uncertainty in Artificial Intelligence*, 184–191.

Ph.D. Students

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| 2016 | Dennis Leung | Testing independence in high dimensions and identifiability of graphical models |
| | Andrew McDavid | Statistical hurdle models for single cell gene expression: Differential expression and graphical modeling (co-advised with Raphael Gottardo) |
| 2014 | Chris Fox | Interpretation and inference of linear structural equation models |
| 2012 | Rina Foygel | Prediction and model selection for high-dimensional data with sparse or low-rank structure (co-advised with Nati Srebro) |
| | Han Xiao | Simultaneous inference on sample covariances (co-advised with Wei-Biao Wu) |
| 2010 | Michael Finegold | Robust network inference with multivariate t -distributions |