

Matthew W. Wheeler – Curriculum Vitae

Address	104 Airedale Dr, Holly Springs, NC 27540	Phone	+1 (919) 986 6860
		Email	matt.wheeler@nih.gov

Education

2007-2013 Ph.D in Biostatistics - The University of North Carolina, Chapel Hill
2000-2002 MS in Statistics - Miami University, Oxford OH
1996-2000 BAS in Systems Analysis and Computer Science - Miami University, Oxford OH

Thesis **Bayesian Nonparametric Differential Equation Models for Functions**

Supervisors

David Dunson & Amy Herring

Description

This thesis explored novel Bayesian nonparametric approaches that incorporate Bayesian prior information on regression functions using differential equations.

Research Interests

- **Functional Data Analysis.**
- **Quantitative Structure Activity Relationship (QSAR) models.**
- **Bayesian nonparametric methods.**
- **Bayesian hypothesis testing.**
- **Machine learning.**
- **Statistical computing.**
- **Constrained nonparametric function estimation.**
- **Bayesian methods.**
- **Parametric and nonparametric dose-response modeling applied to risk estimation.**
- **Chemical risk assessment.**

Employment History

March 2020 - NIH/NIEHS Biostatistics and Computational Biology Branch

Present *Staff Scientist*

Continued work as a research statistician developing novel methods for toxicological risk assessment.

Sep 2003 - National Institute for Occupational Safety and Health/ Centers for Disease Control and Prevention

Feb 2020 *Senior Statistician*

- Pioneered model averaging methods for dose-response analyses in quantitative risk assessment.
- Led world committee with partners from the US Environmental Protection Agency, Health Canada, US Food and Drug Administration, European Food Safety Authority, Centers for Disease Control, and the World Health Organization to rewrite the dose-response chapter of the ECH 240 guidance document.
- Initiated an effort between world agencies and NGO stake holders to harmonize chemical risk assessment.
- Developed the first of its kind methods to predict dose-response relationships for chemical toxicity using QSAR information. This methodology uses machine learning techniques to soft cluster new dose-response curves base upon chemical structural information. Future work with Drs Grace Patlewicz and Imran Shah of the US EPA and Dr Scott Auerbach of NIEHS is planned.
- Principal developer of the US Environmental Protection Agency's Benchmark dose software. Rewrote the statistical interface in a C++ library and developed interfaces for MS Excel as well as the R programming language. Future updates will include a Python library interface.
- Developed machine learning methods to correlate large libraries of diverse chemical information and predict dose-response information of unobserved chemicals. This methodology has uses an any regression space where a subject has an individual trajectory and one wishes to predict a new subjects trajectory based upon some regression information.
- Developed Bayesian parametric survival stacking methodology with application to food allergen risk.
- Developed multiple R packages.
- Mentored multiple students.
- Finishing development, with Ph.D student Kelly Moran of Duke University, of a fast extremely accurate Gaussian Process Gibbs Sampling methodology (it is $\mathcal{O}(n \log^2 n)$ with $\mathcal{O}(n \log n)$ storage complexity). This method allows for some Bayesian machine learning problems previously unsolvable on cluster computing to be tractably computed on a modern desktop computer.
- Developing, with Ph.D student Sarah Davidson of the University of Cincinnati, machine learning tools to cluster Toxicogenomic dose-response data. This work is with Scott Auerbach at NIEHS/NTP.

Nov, 2018 - Institute for Advanced Analytics

Feb, 2019 *Data Science Instructor*

- Taught clustering class to data science masters students. Focused on text and function clustering algorithms using Hierarchical, K-means, and mixture model clustering methods.
- Taught design of experiments class. Focused on experimental design, power analysis for AB testing scenarios, and other more advanced experimental design topics (e.g., factorial experiments and non-continuous data analysis using logistic and Poisson regression).)
- Worked to ensure that students had real world open ended problems that would prepare them for careers as data scientists.

August 2002 -MarketVision Research

Sep 2003 *Research Associate*

Market research associate -

- Conducted conjoint analyses on market studies.
- Developed software for market product segmentation.
- Prepared market segmentation analyses for clients, which compared the client's product to competing products.
- Developed sampling based algorithms to accurately compute the clients needs while allowing the deliverable to be completed in a reasonable time frame. This algorithm replaced an exact combinatorial algorithm estimated to complete in 13 years; the algorithm ran in 10 minutes.

Awards

2018	Awarded "NIOSH Early Careers Scientist Award."
2017	Awarded "US Presidential Early Career Award for Scientists and Engineers."
2014	CDC Charles C. Shepard award for statistical excellence in data methods and study design.
2012	ENAR student paper award.
2011	JSM Risk Section student paper award.
2007	Risk Analysis - best paper award in health sciences.
2007	CDC honor award for work on model averaging.

Invited Presentations

Jun. 2007	Invited panelist presenting on model averaging in dose response at the US EPA's Computation Toxicology Conference.
Aug. 2014	Gave invited presentation on Nonparametric quantile estimators for Benchmark Dose at the 2014 Joint Statistical Meetings.
Dec. 2015	Gave invited presentation on a "Quantile Impairment Threshold" methodology for continuous dose-response modeling at the Society of Risk Analysis annual conference.
Apr. 2016	Invited to give a talk on quantitative structural activity relationships for dose-response curves, with applications to risk assessment at the Toxicology and Risk Assessment Conference.
Aug. 2016	Presented a talk on machine learning methods for QSAR and dose-response analysis using the US EPA's ToxCast platform at the Joint Statistical Meetings.
Mar. 2017	Presented a talk to the European Food Safety Authority on the harmonization of risk assessment between Governments, NGOs, and Industry.
Mar. 2017	Presented a presentation at the Department of Biostatistics at the Ohio State University.
Oct. 2017	Invited Presenter for the European Food Safety Authority on Risk Assessment methods.
Jul. 2019	Continuing education provider IUTOX 15 on dose-response methods.
Nov. 2019	Presenting a continuing education course on smoothing at Miami University.
Nov. 2019	Invited to train Health Canada on Bayesian Dose-response modeling.
Mar. 2020	Invited to speak on the harmonization efforts on dose-response modeling between world agencies.

Software Engineering Skills

■ Programming Languages

<i>R</i>	Proficient in R package development with RCpp back end.
<i>C/C++</i>	Proficient in working with numerical programming with C++ using LAPACK/BLAS/Armadillo as well as MCMC.
<i>SAS</i>	
<i>Python SQL</i>	

■ Miscellaneous

Linux Proficient with single CPU and high throughput systems.
git Source version control.
LATEX Scientific writing.

Professional Affiliations

International Statistical Institute Elected Member
American Statistical Association
Society of Risk Analysis

Professional Service

2019 Rapporteur for the update of WHO 240 chapter 5 rewrite on dose-response.
2017 ASA Section on Risk Analysis, Chair
2015 JSM 2015 Program Chair - Section on Risk Analysis
2015 Lead Discussant on the US EPA's expert panel investigating model averaging for dose response estimation in risk assessment.
2016 Panelist on the 83rd joint FAO/WHO expert committee on food additives.

Referee

Journal of the American Statistical Association.
Statistics in Medicine.
The Annals of Applied Statistics.
Journal of Computational and Graphical Statistics.
Biometrics.
Bayesian Analysis.
Environmental Health Perspectives.
Risk Analysis.
Nanotoxicology.
Toxicology and Applied Pharmacology.

Professional Mentorship

(2015) **Tarah Cole**, Miami University, Masters Project
(2020) **Kelly Moran**, Duke University, Doctoral Paper "Fast increased fidelity approximate Gibbs samplers for Bayesian Gaussian Process regression"
(2021) **Sarah Davidson**, University of Cincinnati, Doctoral Paper "Aloha: Aggregated local extrema splines for high-throughput dose-response analysis"

Publications

- [1] Matthew W Wheeler, Joost Westerhout, Baumer Joe L., and Remington Benjamin C. Bayesian stacked parametric survival with frailty components and interval censored failure times. *In-Press, Risk Analysis*, 2020.
- [2] Geert F Houben, Joseph L Baumert, W Marty Blom, Astrid G Kruizinga, Marie Y Meima, Benjamin C Remington, Matthew W Wheeler, Joost Westerhout, and Steve L Taylor. Full range of population eliciting dose values for 14 priority allergenic foods and recommendations for use in risk characterization. *Food and Chemical Toxicology*, pages 1–10, 2020.

- [3] Matthew W Wheeler, Todd Blessinger, Kan Shao, Bruce C Allen, L Olszyk, Allen J Davis, and Jeffery S Gift. Quantitative risk assessment: Developing a Bayesian approach to dichotomous dose-response model averaging. *Risk Analysis*, 40(9):1706–1722, 2020.
- [4] Marc Aerts, Matthew W Wheeler, and José Cortiñas Abrahantes. An extended and unified modeling framework for benchmark dose estimation for both continuous and binary data. *Environmetrics*, 2020.
- [5] Benjamin C Remington, Joost Westerhout, Marie Y Meima, W Marty Blom, Astrid G Kruizinga, Matthew W Wheeler, Steve L Taylor, Geert F Houben, and Joseph L Baumert. Updated population minimal eliciting dose distributions for use in risk assessment of 14 priority food allergens. *Food and Chemical Toxicology*, 2020.
- [6] Matthew W Wheeler. Bayesian additive adaptive basis tensor product models for modeling high dimensional surfaces: an application to high-throughput toxicity testing. *Biometrics*, 75(1):193–201, 2019.
- [7] Matthew W Wheeler, Walter W Piegorsch, and Albert John Bailer. Quantal risk assessment database: A database for exploring patterns in quantal dose-response data in risk assessment and its application to develop priors for bayesian dose-response analysis. *Risk Analysis*, 39(3):616–629, 2019.
- [8] Matthew W. Wheeler, David. Dunson, and Amy H Herring. Bayesian local extremum splines. *Biometrika*, 2017.
- [9] Matthew W Wheeler, AJ Bailer, T Cole, R Park, and K Shao. Bayesian quantile impairment threshold benchmark dose estimation for continuous endpoints. *Risk Analysis*, 2017.
- [10] Sudha P Pandalai, Matthew W Wheeler, and Ming-Lun Lu. Non-chemical risk assessment for lifting and low back pain based on bayesian threshold models. *Safety and Health at Work*, 2016.
- [11] Kan Shao, Bruce C Allen, and Matthew W Wheeler. Bayesian hierarchical structure for quantifying population variability to inform probabilistic health risk assessments. *Risk Analysis*, 2016.
- [12] Matthew W Wheeler, Kan Shao, and A J Bailer. Quantile benchmark dose estimation for continuous endpoints. *Environmetrics*, 26(5):363–372, 2015.
- [13] Matthew W Wheeler, RM Park, AJ Bailer, and C Whittaker. Historical context and recent advances in exposure-response estimation for deriving occupational exposure limits. *Journal of Occupational and Environmental Hygiene*, 12(sup1):S7–S17, 2015.
- [14] Matthew W Wheeler, David B. Dunson, Sudha P. Pandalai, Brent A. Baker, and Amy H Herring. Mechanistic hierarchical Gaussian processes. *Journal of the American Statistical Association*, 109:894–904, 2014.
- [15] Matthew W Wheeler and A John Bailer. An empirical comparison of low-dose extrapolation from points of departure (pod) compared to extrapolations based upon methods that account for model uncertainty. *Regulatory Toxicology and Pharmacology*, 67(1):75–82, 2013.
- [16] Matthew W Wheeler and A John Bailer. Monotonic Bayesian semiparametric benchmark dose analysis. *Risk Analysis*, 32(7):1207–1218, 2012.
- [17] Dana Loomis, Michael D Schulman, A John Bailer, Kevin Stainback, Matthew W Wheeler, David B Richardson, and Stephen W Marshall. Political economy of us states and rates of fatal occupational injury. *American Journal of Public Health*, 99(8):1400, 2009.
- [18] Matthew W Wheeler and A John Bailer. Benchmark dose estimation incorporating multiple data sources. *Risk Analysis*, 29(2):249–256, 2009.
- [19] Matthew W Wheeler and A John Bailer. Comparing model averaging with other model selection strategies for benchmark dose estimation. *Environmental and Ecological Statistics*, 16(1):37–51, 2009.
- [20] Matthew W Wheeler and A John Bailer. Model averaging software for dichotomous dose response risk estimation. *Journal of Statistical Software*, 26(5):1–15, 2008.
- [21] David Dankovic, Eileen Kuempel, and Matthew W Wheeler. An approach to risk assessment for TiO₂. *Inhalation Toxicology*, 19(S1):205–212, 2007.

- [22] Matthew W Wheeler, William Fadel, Jacqueline Robertson, and A John Bailer. Confidence interval construction for relative toxicity endpoints such as LD50 or LD90 ratios. *Journal of Economic Entomology*, 100(6):1945–1949, 2007.
- [23] Matthew W Wheeler and A John Bailer. Properties of model-averaged bmdls: A study of model averaging in dichotomous response risk estimation. *Risk Analysis*, 27(3):659–670, 2007.
- [24] Matthew W Wheeler, Robert M Park, and A John Bailer. Comparing median lethal concentration values using confidence interval overlap or ratio tests. *Environmental Toxicology and Chemistry*, 25(5):1441–1444, 2006.
- [25] A John Bailer, Robert B Noble, and Matthew W Wheeler. Model uncertainty and risk estimation for experimental studies of quantal responses. *Risk Analysis*, 25(2):291–299, 2005.
- [26] A John Bailer, Matthew W Wheeler, David Dankovic, and Robert Noble. Incorporating uncertainty and variability in the assessment of occupational hazards. *International Journal of Risk Assessment and Management*, 5(2):344–357, 2005.
- [27] Lance J Schuler, Matthew W Wheeler, A John Bailer, and Michael J Lydy. Toxicokinetics of sediment-sorbed benzo [a] pyrene and hexachlorobiphenyl using the freshwater invertebrates *hyalella azteca*, *chironomus tentans*, and *lumbriculus variegatus*. *Environmental Toxicology and Chemistry*, 22(2):439–449, 2003.
- [28] Matthew W Wheeler and A John Bailer. A simulation study of methods for constructing confidence intervals for bioaccumulation factors. *Environmental Toxicology and Chemistry*, 22(4):921–927, 2003.

Book/Chapters

- [29] WHO/IPCS. *Safety evaluation of certain contaminants in food: prepared by the eighty-third meeting of the Joint FAO/WHO Expert Committee on Food Additives (JECFA)*. World Health Organization, 2018.
- [30] WHO/IPCS. *Principles and methods for the risk assessment of chemicals in food, International Programme on Chemical Safety, Environmental Health Criteria 240, Chapter 5 Update*. World Health Organization, 2021.

Working Papers

- [31] Kelly Moran and Matthew W Wheeler. Fast increased fidelity approximate Gibbs samplers for Bayesian Gaussian process regression. *Invited to Resubmit to JRSS-B*, 2020.
- [32] Skylar W. Marvel, John S. House, Matthew Wheeler, Kuncheng Song, Yihui Zhou, Fred A. Wright1 Wright, Chiu A., Ivan Rusyn, Alison Motsinger-Reif, and David M. Reif. The covid-19 pandemic vulnerability index (pvi) dashboard: monitoring county level vulnerability. *Submitted to Environmental Health Perspectives*, 2020.
- [33] Sarah E. Davidson, Matthew W. Wheeler, Scott S. Auerbach, Siva Sivaganesan, and Mario Medvedovic. ALOHA: Aggregated local extrema splines for high-throughput dose-response analysis. *Submitted BMC Bioinformatics*, 2020.
- [34] Dustin Long, Matthew W. Wheeler, and A. John Bailer. Cox proportional hazard regression and splines: A cautionary tale. *Submitted to International Journal of Epidemiology*, 2020.

In Preparation

- [35] Matthew W. Wheeler, Kelley Moran, Eric Christopher, Sven. Wimberly, Jason Phillips, and Steffen. Börm. *ScH²nelleR*: Fast gaussian process approximations in R. *In Preperation*, 2021.
- [36] Matthew W. Wheeler, Lim Sooyeong, Keith Shockley, John A. Bailer, and Alison Auerbach, Scott S. and Motsinger-Reif. *ToxicR*: Toxicology modeling in R. *In Preperation*, 2021.

- [37] Matthew W. Wheeler, Skylar W. Marvel, John S. House, Fred A. Wright, Alison Motsinger-Reif, and David M. Reif. Latent gaussian process rate models: An application to COVID-19. *In Preperation*, 2021.
- [38] Matthew W. Wheeler, Allen Davis, and Jeff Gift. Continuous model averaging over distributional assumptions. *In Preperation*, 2021.
- [39] Michael Pennell and Matthew W. Wheeler. Shape restricted logistic stick breaking processes: An application correlating genotoxicity testing, high throughput toxicology testing and QSAR models. *In Preperation*, 2021.
- [40] Matthew W Wheeler and Michael Pennel. Simultaneous non-parametric functional models for high throughput toxicity data. *In Preperation*, 2021.