

# Robert J. Erhardt

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## Employment

### Wake Forest University

Assistant Professor, Department of Mathematics and Statistics, 2012 - present  
Sterge Faculty Fellow, 2016 - present  
Faculty, Sustainability Graduate Programs, CEES, 2016 - present

### University of North Carolina at Chapel Hill

Teaching/Research Fellow, Dept. of Statistics and Operations Research, 2008 - 2012

### American Family Mutual Insurance Company

Senior Actuarial Analyst, 2007 - 2008  
Actuarial Analyst, 2005 - 2007

## Education

Ph.D. in Statistics, University of North Carolina at Chapel Hill, 2012

Thesis: Approximate Bayesian Computing for Spatial Extremes. Advisor Richard L. Smith.

M.S. in Statistics, University of Wisconsin-Madison, 2006

B.A. in Physics, *Summa Cum Laude*, State University of New York College at Geneseo, 2003

A.C.A.S. (Associate of the Casualty Actuarial Society) 2010

## Honors

American Risk and Insurance Association (ARIA) 2016 Patrick Brockett & Arnold Shapiro Actuarial Journal Award. (Awarded for Erhardt, R., Smith, R. (2014). Weather derivative risk measures for extreme events. *North American Actuarial Journal* 18:3, 379-393.)

Wake Forest Teaching and Learning Center Teaching Innovation Award, 2016

Wake Forest University Student Government Faculty Appreciation Award, 2013 (one given annually)

University of North Carolina Statistics and Operations Research Excellence in Teaching Award, 2011

Society of Actuaries James C. Hickman Scholar (2009 - 2012; \$60,000)

Best Graduate Student Presentation, 46<sup>th</sup> Actuarial Research Conference, 2011

Jerry D. Reber Outstanding Teaching Assistant Award, SUNY Geneseo, 2003

SUNY Geneseo Physics Alumnae Award (highest physics GPA in class of 2003)

## Research

### Research Interests

Environmental risk measurement, climate statistics, computational statistics, extreme values, statistical ecology, and the connections between environmental risk and actuarial science.

### Working Papers

Jin<sup>†</sup>, Z. and **Erhardt, R.** Incorporating climate change projections into risk measures of index-based insurance (*submitted*).

### Refereed Journal Articles

Hepler, S.A., **Erhardt, R.**, Anderson, T.M. (2018). Identifying drivers of spatial variation in occupancy with limited replication camera trap data. *Ecology* (*accepted*).

**Erhardt, R.**, Engler, D. (2018). An extension of spatial dependence models for estimating short-term temperature portfolio risk. *North American Actuarial Journal* (*accepted*).

Anderson, T.M., White, S., Davis<sup>†</sup>, B., **Erhardt, R.**, Palmer, M., Swanson, A., Kosmala, M., and Packer, C. (2016). The spatial distribution of African savannah herbivores: species associations and habitat occupancy in a landscape context. *Philosophical Transactions of the Royal Society B*, 371:1702.

Johnson\*, D., **Erhardt, R.** (2016). Projected impacts of climate change on wind energy density in the United States. *Renewable Energy*, 85, 66-73.

**Erhardt, R.** (2015). Incorporating spatial dependence and climate change trends for measuring long-term temperature derivative risk. *Variance* 9:2, pp. 213-226.

**Erhardt, R.**, Shuman, M. (2015). Assistive technologies for second-year statistics students who are blind. *Journal of Statistics Education* 23:2, 1-28.

Steel\*, A., **Erhardt, R.**, Phelps, R., Upham, P. (2015). Estimates of enhanced outcomes in employment, income, health and volunteerism for the association of boarding schools member school graduates. *Journal of Advanced Academics* 26.3, 227-245.

**Erhardt, R.**, Smith, R., Lopes, B., Band, L. (2015). Statistical downscaling of precipitation on a spatially dependent network using regional climate models. *Stochastic Environmental Research and Risk Assessment* 29:7, 1835-1849.

**Erhardt, R.** (2015). Mid-twenty-first-century projected trends in North American heating and cooling degree days. *Environmetrics* 26(2), 133-144.

**Erhardt, R.**, Smith, R. (2014). Weather derivative risk measures for extreme events. *North American Actuarial Journal* 18:3, 379-393.

Cooley, D., Cisewski, J., **Erhardt, R.**, Jeon, S., Mannshardt, E., Omolo, B., Ying, S. (2012). A survey of spatial extremes: measuring spatial dependence and modeling spatial effects. *REVSTAT* 10:1, 135-165.

**Erhardt, R.**, Smith, R. (2012). Approximate Bayesian computing for spatial extremes. *Computational Statistics and Data Analysis* 56:6, 1468-1481.

Stupar, R., Bhaskar, P., Yandell, B., Rensink, W., Hart, A., Ouyang, S., Veilleux, R., Busse, J.,

**Erhardt, R.**, Buell, C., Jiang, J. (2007). Phenotypic and transcriptomic changes associated with potato autopolyploidization. *Genetics* 176, 2055-2067.

De Stasio, G., Rajesh, D., Ford, J., Daniels, M., **Erhardt, R.**, Frazer, B., Tyliczszak, T., Gilles, M., Conhaim, R., Howard, S., Fowler, J., Esteve, F., Mehta, M. (2006), Motexafin-gadolinium taken up in vitro by at least 90% of glioblastoma cell nuclei, *Clinical Cancer Research* 12, 206.

De Stasio, G., Rajesh, D., Casalbore, P., Daniels, M., **Erhardt, R.**, Frazer, B., Wiese, L., Richter, K., Sonderegger, B., Gilbert, B., Schaub, S., Cannara, R., Crawford, J., Gilles, M., Tyliczszak, T., Fowler, J., Larocca, L., Howard, S., Mercanti, D., Mehta, M., Pallini, R. (2005). Are gadolinium contrast agents suitable for gadolinium neutron capture therapy? *Neurological Research* 27:4, 387-398.

Freeman, C., Burke, D., **Erhardt, R.**, DeCiantis, J., Padalino, S., Knauer, J. (2003). Thin foil calorimeter calibration using a 2 MV Van de Graaff accelerator. *Rev. Sci. Instrum.* 74, 1921

### Other Refereed Publications

**Erhardt, R** and Von Burg, R. (2018). How do they know and what could we do? The science of 21st century climate projections and opportunities for actuaries. The Society of Actuaries. A 44 page white paper on climate model projections.

**Erhardt, R.** (2017). Climate, Weather and Environmental Sources for Actuaries. The Society of Actuaries. A 78 page white paper on sources for actuarial environmental risk measurement.

<https://www.soa.org/research-reports/2017/climate-weather-environmental-sources/>.

**Erhardt, R.**, Sisson, S. (2015). Modelling extremes using approximate Bayesian Computation. Book chapter in *Extreme Value Modeling and Risk Analysis: Methods and Applications*. Edited by Dey, D. and Yan, J. Chapman Hall/CRC.

Godfrey, A.J.R., **Erhardt, R.** (2013). Addendum to statistical software from a blind persons perspective. *The R Journal* 5(1), 7380.

\*Undergraduate student

† Master's degree student

## Grants

### Funded

2018-19 NSF SES DRMS 1824394 WORKSHOP: The Nexus of Climate Data, Insurance, and Adaptive Capacity. Role: PI;  
WFU Amount \$44,190.

2016-18 "How Do They Know, and What Could We Do? The Science of 21st Century Climate Projections and Opportunities for Actuaries", Society of Actuaries Research Executive Committee under the Research Expansion (REX) Pool. Role: PI;  
WFU Amount \$41,196

2016-17 "Climate, Weather and Environmental Sources for Actuaries", Society of Actuaries Climate & Environmental Sustainability Research Committee. Role: PI;  
WFU amount \$17,217

2014-15 “Spatial Dependence and Climate Change Impacts on Weather Risk Pricing”, Society of Actuaries and Casualty Actuarial Society. Role: PI;  
WFU amount \$14,442

2013-14 Casualty Actuaries of the Southeast;  
WFU amount \$1,500

## Pending

DOE 0000238199 Quantifying Sources of Uncertainty in Climate Extremes: Multi-Model Differences in Forced Response, Large-Scale Variability, Downscaling, and Predictability. Role: PI.

## Teaching

### Wake Forest University

MST 767 Generalized Linear Models: Fa17, Fa18

MST 369/669 Time Series and Forecasting: Fa16

MST 367/667 Linear Models: Sp15, Sp17, Fa17

MST 362/662 Multivariate Statistics: Sp16, Fa16, Sp18

MST 256/656 Statistical Models: Fa13, Sp14, Sp15, Fa15, Fa18

MST 358/658 Mathematical Statistics: Sp13, Sp14, Sp17

MST 353/653 Probability Models: Sp13, Sp16

MST 109 Introduction to Probability and Statistics: Fa12, Fa15

SUS 602 Scientific Literacy (co-taught): Ja15, Ja16, Su16, Su17

### University of North Carolina at Chapel Hill

STOR 155 Introduction to Statistics: Fa11, Fa10, Sp10

## Presentations

### Invited Seminars and Colloquia

An Extension of Spatial Dependence Models for Estimating Short-Term Temperature Portfolio Risk, Purdue University, 2/2018

Insurance as Adaptive Capacity, SAMSI Working Group on Risk, 9/2017.

An Extension of Spatial Dependence Models for Estimating Short-Term Temperature Portfolio Risk. NC State Environmental Seminar, 10/2016.

An Extension of Spatial Dependence Models for Estimating Short-Term Temperature Portfolio Risk. University of Montreal, 10/2016.

Assistive Technologies for Second-Year Statistics Students who are Blind, *CAUSE* Webinar, 09/2015  
<https://www.causeweb.org/webinar/jse/2015-09/index.php>

Was 2014 the Hottest Year on Record? Wofford College Mathematics, 02/2015

Weather Derivatives and Degree Day Trends. Middlebury College Mathematics, 04/2014

Weather Derivatives and Degree Day Trends. Brigham Young University Statistics, 03/2014

Regional Climate Models and Mid-Twenty-First-Century North American Projected Energy Impacts. WFU Biology Department, 09/2013

Weather Derivative Risk Measures for Extreme Events. SAMSI, 04/2013

Measuring Climate Change. Davidson College Mathematics, 04/2013

Measuring Climate Change. St. Olaf College Mathematics, 04/2013

Weather Derivative Risk Measures for Extreme Events. NC State University Statistics, 03/2013

Measuring Climate Change. WFU Ecolunch, 03/2013

Measuring Climate Change. WFU Math Club, 03/2013

Approximate Bayesian Computing for Spatial Extremes. Bowdoin College Mathematics, 01/2012

Approximate Bayesian Computing for Spatial Extremes. Wake Forest University Mathematics, 01/2012

Approximate Bayesian Computing for Spatial Extremes. Clemson University Mathematical Sciences, 01/2012

Approximate Bayesian Computing for Spatial Extremes. Penn State University Statistics, 01/2012

Approximate Bayesian Computing for Spatial Extremes. University of Illinois Urbana Champaign Mathematics, 01/2012

### **Conferences (invited, contributed, poster)**

52<sup>nd</sup> Actuarial Research Conference, Atlanta, GA, 08/2017 (contributed)

The 2017 Casualty Actuarial Society Spring Meeting, Toronto, ON, 5/2017 (invited)

International Conference on Advances in Interdisciplinary Statistics and Combinatorics, Greensboro, NC, 10/2016 (invited)

51<sup>st</sup> Actuarial Research Conference, Minneapolis, MN, 7/2016 (contributed)

The 26<sup>th</sup> International Environmetrics Society Annual Meeting, Edinburgh, U.K., 7/2016 (invited)

Southern Regional Council of Statistics Summer Conference, Wilmington, NC 2015 (contributed)

Joint Statistical Meetings, Boston, MA, 8/2014 (invited)

TechXploration, Wake Forest University, 4/2014 (contributed)

Joint Statistical Meetings, Montreal, QC, 8/2013 (invited)

The 23<sup>rd</sup> International Environmetrics Society Annual Meeting, Anchorage, AK, 6/2013 (contributed)

US Conference on Teaching Statistics, Raleigh, NC, 5/2013 (poster)

Workshop on Environmentrics, Raleigh, NC, 10/2012 (poster)

Joint Statistical Meetings, San Diego, CA, 7/2012 (topic-contributed)

46<sup>th</sup> Actuarial Research Conference, Storrs, CT, 8/2011 (contributed, won conference best graduate student presentation award)

SAMSI Transition Workshop of Space-Time Processes, Research Triangle Park, NC, 10/2010 (poster)

Joint Statistical Meetings, Vancouver, BC, 8/2010 (contributed)

Spatial Extremes Working Group, Research Triangle Park, NC, 4/2010 (contributed)

SAMSI Workshop of Climate Change, Research Triangle Park, NC, 2/2010 (poster)

## Public and Media

Society of Actuaries Research Insights Podcast, October 2017

<https://www.soa.org/research-reports/2017/climate-weather-environmental-sources/>

Warming May Boost Wind Energy in Plains States. Climate Central, July 29, 2015

<http://www.climatecentral.org/news/warming-may-boost-wind-energy-19290>

Was 2014 the Hottest Year on Record? North Carolina Governor's School, 7/2015

North Carolina Sea Level Rise. Public lecture at Temple Emanuel, Winston-Salem, 10/2014

Measuring Climate Change. North Carolina Governor's School, 6/2014

Economics of Climate and Weather Risk. Public lecture at Temple Emanuel, Winston-Salem, 4/2014

Senate candidates in denial about climate change. Charlotte Observer Op/Ed, April 29, 2014

<http://www.charlotteobserver.com/opinion/op-ed/article9117962.html>

## Advising and Theses

### Graduate Theses

#### Thesis Advisor:

Yiwei Wang, M.A. Mathematical Statistics (current)

Yutong Yang, M.A. Mathematical Statistics (current)

Zhuoli Jin, M.A. Mathematical Statistics (current)

Leland Kent, M.A. Mathematical Statistics, 2017. Incorporating the Southern Oscillation Index into Weather Risk Models. (Data Analyst, Agilent Technologies)

Bryant Davis, M.A. Mathematics, 2016. Constructing a Bayesian Spatial Presence-Absence Model for Animals in the Serengeti National Park. (enrolled PhD Statistics, University of Florida)

**Committees:** Jessica Zanatell (2018 M.A. Mathematics), Richard Harris (2018 M.A. Mathematical Statistics)

**Graduated:** M. J. Carmichael (2017 Ph.D. Biology), Rebecca Kotsonis (2017 M.A. Mathematical Statistics), Nicole Schiro (2016 M.A. Sustainability), Teng Zhang (2016 M.A. Mathematics), Shouwen Wei (2013 M.A. Mathematics), Joe Paat (2013 M.A. Mathematics), Ixavier Higgins (2013 M.A. Mathematics)

**Undergraduate Theses**

Hunter Hale (current)

Meghan Bayne (current)

Abigail Coelho (current)

Hanyue Yang (current)

Lindsay Ricciardelli (current)

2017 Joyce Chen, Pokii and Risk and Ruin. (enrolled M.S. Financial Engineering, Cornell)

2017 Mitch Tague, Comparing Professional and Casual Play Character Selection Trends in League of Legends. (enrolled M.A. Mathematical Statistics, Wake Forest)

2016 Alan Underhill, Applying the Generalized Extreme Value Distribution to Reinsurance of Catastrophic Hurricanes. (Actuary, Lincoln Financial Group)

2016 Alison Zinsli, Multiple Logistic Regression Models in the Serengeti National Park. (enrolled MS Biostatistics, Emory University)

2015 Dana Johnson, Projected impacts of climate change on wind energy density in the United States. (enrolled PhD in Statistics, NC State)

2015 Amy Pushman, Longevity predictions based on health biomarkers. (enrolled MS Statistics, Villanova)

2015 Nick Sterge, Forecasting methods for degree days. (enrolled PhD Statistics, Penn State)

2014 Megan Quinn, Dependence models in actuarial science. (enrolled MS Statistics, UNC-Chapel Hill)

2014 Allison Steel, Statistical modeling for The Association of Boarding Schools. (enrolled MS Statistics, Virginia Tech)

**Independent Studies**

2017 Kathryn Webster, Programming and Statistical Software in Industry

2016 Hunter Denham (URECA Wake Forest Research Fellowship) Climate, Weather and Environmental Sources for Actuaries

2016 Julia Haines, Cooling Tower Efficiency Measurements using the Aquanomix Symphony Water Sensor

2015 - 2016 Will Boyles, Statistical relationship between the El Niño southern oscillation index and North American degree days

2015 Khiry Sutton, Behavioral changes for energy savings at Carolina HealthCare  
<http://fmj.ifma.org/publication/?i=280956&p=24>

2015 - 2016 Celine Olcott, Analyzing the National Center for Education Statistics tri-annual Schools and Staffing Survey

2014 Celine Olcott, Analyzing Calculus I success rates at Wake Forest University

2014 Dana Johnson (URECA Wake Forest Research Fellowship, Interdisciplinary Environmental Pro-

gram Fellowship), Projected impacts of climate change on wind energy density in the United States  
 2013 and Spring 2014 Dana Johnson, R programming and data visualization  
 2013 Kaylee Llewellyn (high school student at Phillips Andover), Data visualization  
 2012 Ann Rogers, Society of Actuaries exam FM  
 2012 Xiaochen Hu, Consulting for The Association of Boarding Schools

## Service

### Refereeing Journals:

*Annals of Applied Statistics, Applied Energy, ASTIN Bulletin, Computational Statistics and Data Analysis (2), Environmetrics (2), International Journal of Climatology, International Journal of Computer Mathematics, Journal of Climate, Journal of Geophysical Research, Journal of Hydrology, Journal of the Royal Statistical Society Series C, North American Actuarial Journal, Stochastic Environmental Research and Risk Assessment (3), Technometrics, Transactions in GIS*

**Refereeing Books:** *The Basic Practice of Statistics 8e Moore/Notz/Fligner, Predictive Modeling in Actuarial Science, Extreme Value Modeling and Risk Analysis: Methods and Applications, STAT2: Building Models for a World of Data.*

### Professional service:

Workshop Chairperson for “The Nexus of Insurance, Climate Data, and Adaptive Capacity” Asheville, NC, November 8-9, 2018.

Society of Actuaries James C. Hickman Scholarship Selection Committee  
 Chair 2017-2018, Member 2015 - 2018

### Non-departmental service:

Chair of the WFU CEES Research committee, 2016 - 2018

WFU M.A. Sustainability Evaluation and Assurance of Learning Committee, 2014 - present

WFU Environmental Program committee, 2015 - 2018

## Memberships

American Risk and Insurance Association 2018 -

Casualty Actuarial Society 2011 -

The International Environmetrics Society 2012 -