



## DEPARTMENT OF BIostatISTICS AND COMPUTATIONAL BIOLOGY

### About the University of Rochester

The University of Rochester is a private, co-educational institution founded in 1850. With almost 10,000 full-time undergraduate, graduate, and professional students, and over 1,360 tenure-track faculty members, the University provides the close student-faculty interactions usually associated with smaller institutions. The University consistently ranks among the top colleges and universities nationwide in federally financed science, engineering, medical, and other research.

### About the Department

The Department of Biostatistics and Computational Biology at the University of Rochester has a long record of excellence in methodologic and collaborative research and in the education of professionals in and users of statistics. The Department currently has 16 faculty who are eligible to advise students with research interests spanning traditional biostatistics, stochastic modeling, bioinformatics, and computational biology.

The Department offers masters and doctoral degrees and has an active postdoctoral program supported by research and training grants. We have strong collaborative relationships with Anesthesiology, Biomedical Genetics, the Cancer Center, Cardiology, Environmental Medicine, Microbiology and Immunology, Neurology, Orthopedics, Pediatrics, Psychiatry, Public Health Sciences and many other departments, centers, and units throughout the School. We are also an important contributor to the Clinical and Translational Science Institute of the University of Rochester, and several faculty have affiliations with the Goergen Institute for Data Science.

### About Our Faculty

Faculty of the Department have played major roles in important breakthroughs in medical research at Rochester. Examples include the better understanding of the role of calcium channel blockers in treating patients who have had a heart attack, demonstration of both the clinical effectiveness and the cost effectiveness of implantable defibrillators in reducing mortality among certain heart disease patients, demonstration of the effectiveness of deprenyl in slowing onset of disability in early Parkinson's disease, demonstration of the benefit of surfactant therapy for respiratory distress syndrome in premature infants, demonstration of the benefits and risks of early surgical therapy for drug-resistant temporal lobe epilepsy, and an ongoing epidemiologic study of the assessment of the effects of low levels of dietary mercury intake on childhood development. Methodologic and collaborative interests of our graduate research advisors are shown below.

#### Professors

*Robert Strawderman, ScD, Harvard University (Department Chair).* Survival analysis; statistical inference for point process data (e.g., recurrent events); statistical methods for risk and outcome prediction in medicine, epidemiology and public health; statistical and computational methods for high dimensional data; statistical methods for evaluating the cost and quality of health care; asymptotics (theory and approximation); statistical computing.

*Changyong Feng, PhD, University of Rochester.* Multivariate survival analysis; empirical processes theory; longitudinal data analysis; statistical methods in epidemiology and clinical trials.

*Brent Johnson, PhD, North Carolina State University.* Semi-parametric methods for missing data problems with specific applications to causal inference, survival and longitudinal data; dynamic treatment regimes in therapeutic HIV and AIDS studies, infusion trials, neurological and behavioral disorders; pattern analysis in HIV prevention; statistical methods for epidemiology.

*Michael McDermott, PhD, University of Rochester (Director, Statistics PhD Program).* Order-restricted inference; receiver operating characteristic (ROC) curves and surfaces; methods for combining p-values; meta-analysis; missing data problems; clinical trials methodology; applications in neurological disease.

*David Oakes, PhD, London University.* Survival analysis, including multivariate survival data and frailty models; semiparametric inference; clinical trials; applications in environmental medicine and neurological disease.

*Derick Peterson, PhD, University of California, Berkeley.* Construction of prognostic gene expression profiles from high-dimensional microarray data; model selection; nonparametric estimation and inference; data-driven smoothing methods; analysis of censored survival data.

*Xing Qiu, PhD, University of Rochester.* High-dimensional omics data pre-processing, analyses, modeling, and integration; diffusion tensor imaging analysis; dynamic network analysis based on ordinary differential equations and state-space models; differential geometry and its applications to hypothesis testing procedures based on correlation/covariance.

### **Associate Professors**

*Anthony Almudevar, PhD, University of Toronto.* Genetics and bioinformatics, especially in the area of graphical modelling, with applications to cellular networks and population biology; optimization and control theory, particularly in the area of Markov decision processes; analysis of technological motion data, particularly data collected from home monitoring systems.

*Christopher Beck, PhD, University of Rochester.* Inference concerning receiver operating characteristic (ROC) curves and surfaces; change-point problems; clinical trials; applications in orthopedics and neurological disease.

*Ashkan Ertefaie, PhD, McGill University.* Causal inference; dynamic treatment regimes; sequential multiple assignment randomized trials; comparative effectiveness studies using electronic health records; instrumental variable analyses; high-dimensional data analysis; post selection inference; survival analysis.

*Tanzy Love, PhD, Iowa State University.* Clustering and latent variable models; mixed membership models and model choice; normalization and preprocessing issues relating to gene expression and proteomics data; Bayesian models for QTLs and growth curves; hierarchical Bayesian models for gene expression data; scalable parallel model-based clustering.

*Matthew McCall, PhD, Johns Hopkins University (Associate Director, Statistics PhD Program).* Statistical genomics; systems biology; bioinformatics; methods to estimate gene regulatory networks involved in cancer; within-subject genomic heterogeneity; methods for preprocessing and analysis of genomic data; effect of cellular composition on tissue-level gene expression.

*Sally Thurston, PhD, Harvard University.* Modeling multiple outcomes; methods of correcting for measurement error bias; exposure assessment; non-parametric smoothing; Bayesian inference; informative prior specification; latent variable models; applications in environmental health.

*Tongtong Wu, PhD, University of California, Los Angeles (Director, Master's Programs).* High-dimensional data analysis; survival analysis; machine learning; computational statistics; computational biology and statistical genetics; longitudinal data analysis.

### **Assistant Professors**

*Andrew McDavid, PhD, University of Washington.* Single cell gene expression; zero-inflated models; high dimensional estimation; convex optimization; applied Bayesian modeling; immunology; bioinformatics and computing.

*Samuel Norman-Haignere, PhD, Massachusetts Institute of Technology.* Joining program in Spring 2022. Dr. Norman-Haignere's research develops computational and experimental methods to understand the representation of complex, natural stimuli in the human brain and applies these methods to understand the neural and computational mechanisms that underlie human hearing.

*Michael Sohn, PhD, University of Arizona.* Mediation analysis; causal inference; high-dimensional data analysis; statistical machine learning; compositional data analysis; multivariate data analysis; statistical genomics and metagenomics.

## **Degree Programs**

### **PhD DEGREE**

#### **Program for the Degree of Doctor of Philosophy in Statistics (Traditional)**

The department administers the doctoral program in statistics. The department interprets the term “statistics” very broadly. The program permits specialization in probability, statistical theory and analysis, biostatistics, and interdisciplinary areas of application. Students have opportunities for supervised teaching and supervised consulting experience, requiring approximately 12 to 15 hours of effort per week.

A candidate for admission to the PhD program should have a strong background in mathematics, including three semesters of calculus (through multivariable calculus), a course in linear and/or matrix algebra, and a year of probability and mathematical statistics. A course in real analysis is encouraged; a course in statistical methods is also recommended. While some background in biology may be helpful for pursuing certain avenues of research, it is not required for admission to the program.

All MA/PhD students take a comprehensive (basic) examination at the beginning of the second year. PhD students take another written (advanced) examination at the beginning of the third year. Both examinations cover material in the areas of probability, inference, and data analysis.

After beginning research on a dissertation topic, PhD students take an oral qualifying examination, consisting largely of a presentation of a thesis proposal to a faculty committee, the student's Thesis Committee. Upon completion of the dissertation, doctoral candidates present their work at a public lecture followed by an oral defense of the dissertation before the Thesis Committee.

Prior to completing degrees, most students have some publications underway, including some work related to their dissertation research, possibly other methodological work done in collaboration with other members of the faculty, and often some applied papers with scientific researchers in other fields. In general, the PhD program requires a minimum of four years of study, with five years of study being more common.

### Course Requirements

Course work in statistics is concentrated in three areas – probability, inference, and data analysis. Beginning students should expect to spend all of their first year, most of their second year, and some of their third year taking formal courses. The balance of time is spent on reading and research. Students entering with advanced training in statistics may transfer credits at the discretion of their advisors and in accordance with University policy.

A typical program for an entering student without previous advanced training is as follows:

#### *Year 1 Fall*

Probability Theory  
Statistical Inference I  
Introduction to Statistical Computing  
Biostatistical Methods I

#### *Year 1 Spring*

Bayesian Inference  
Statistical Inference II  
Linear Models  
Biostatistical Methods II

#### *Year 2 Fall*

High Dimensional Data Analysis  
Generalized Linear Models  
Seminar in Statistical Literature  
Advanced Bayesian Inference (or Causal Inference)  
Supervised Teaching  
Ethics in Research

#### *Year 2 Spring*

Reading Course(s) at the PhD Level  
Analysis of Longitudinal and Dependent Data (or Survival Analysis)  
Seminar in Statistical Literature  
Elective(s)

#### *Year 3+*

Mostly reading and research, with some 400- and 500-level courses

Recent examples of advanced elective courses include:

Functional Data Analysis	Model Selection and Validation
Introduction to Spatial Data Analysis	Missing Data
Statistical Analysis of Cell Mixtures	The Bootstrap, the Jackknife, and Resampling Methods
Smoothing Methods	Semiparametric Inference
ROC Curve Analysis	

### Program for the Degree of Doctor of Philosophy in Statistics with Concentration in Bioinformatics and Computational Biology

The Bioinformatics and Computational Biology (BCB) concentration is designed to educate the next generation of biostatisticians with the knowledge required to address critical scientific and public health questions, and in particular, equip them with the skills necessary to both develop and use quantitative and computational methodologies and tools to manage, analyze, and integrate massive amounts of complex biomedical data. Students learn core statistical methods and obtain training in data analysis methodologies and computational skills and techniques necessary for handling “Big Data” in the biomedical and public health sciences. In addition to this training in core methods, the program also places great emphasis on cross-training to prepare students to work as part of interdisciplinary teams that require expertise in statistical data science: 1) training students with quantitative/computational science backgrounds to enhance their understanding of biological questions and biological interpretation; and 2) training students with biomedical science backgrounds to proficiently use bioinformatics and computational methods and tools to address scientific questions.

Entering PhD students should have a strong background in mathematics, including three semesters of calculus (through multivariable calculus), a course in linear and/or matrix algebra, and a year of probability and mathematical statistics. Basic courses in computer science and/or biology are also required. A course in real analysis is encouraged; a course in statistical methods is also recommended.

### Course Requirements

Formal course and examination requirements for students in the BCB concentration are essentially the same as those for students in the traditional program, with the main differences being in some required and elective courses related to bioinformatics and computational biology. Beginning students should expect to spend all of their first year, most of their second year, and some of their third year taking formal courses. The balance of time is spent on reading and research. Students entering with advanced training in statistics, bioinformatics, or computational biology may transfer credits at the discretion of their advisors and in accordance with University policy.

A typical program for an entering student without previous advanced training is as follows:

#### *Year 1 Fall*

Probability Theory  
Statistical Inference I  
Introduction to Statistical Computing  
Biostatistical Methods I

#### *Year 1 Spring*

Bayesian Inference  
Statistical Inference II  
Linear Models  
Biostatistical Methods II

#### *Year 2 Fall*

High Dimensional Data Analysis  
Generalized Linear Models  
Seminar in Statistical Literature  
Advanced Bayesian Inference (or Causal Inference)  
Supervised Teaching  
Ethics in Research

#### *Year 2 Spring*

Genomic Data Analysis (or Introduction to Quantitative Biology)  
Analysis of Longitudinal and Dependent Data (or Survival Analysis)  
Seminar in Statistical Literature  
Elective(s)  
Reading Course(s) at the PhD Level

#### *Year 3+*

Mostly reading and research, with some 400- and 500-level courses

## MASTER'S DEGREES

### Master of Arts in Statistics

The requirements for entry into the MA program in statistics are the same as those for entry into the PhD program. The MA degree requires satisfactory completion of at least 32 credits and a final comprehensive written examination; no thesis is required. Of the 32 credits, at least 24 must be in departmental courses primarily at the 400-level or above. Appropriate substitutions may be made as long as the spirit (distribution and level) of the requirements is met. A balanced program is worked out with the student's advisor. A typical program for the MA consists of PhD-level courses taken in Semesters 1 (three courses), 2 (three courses), and 3 (two courses); however, MA students have the option of completing the program in two semesters (four courses per semester).

Students in the PhD program receive an MA degree upon satisfactory completion of the requirements for this degree.

### Master of Science in Biostatistics

The MS program in biostatistics is primarily intended for students who wish to follow careers in health-related professions such as those in the pharmaceutical industry and biomedical or clinical research organizations. For entry into the program, three semesters of calculus, a course in linear and/or matrix algebra, a course in probability, a course in mathematical statistics, and a course in applied statistics are required.

The MS program in biostatistics consists of one core year (two semesters) of coursework as well as an capstone project, which is normally done in the summer after the core program. The degree requires 32 credit hours consisting of the courses listed below; substitutions may be made with approval of the faculty program advisor. A comprehensive oral examination to determine the student's qualifications for the MS degree will be administered upon completion of coursework and the capstone project.

A typical program for an entering student without previous advanced training is as follows:

<i>Fall</i>	<i>Spring</i>	<i>Summer</i>
Statistical Inference I	Design of Clinical Trials	Capstone Project
Introduction to Statistical Computing	Biostatistical Methods II	
Biostatistical Methods I	Elective (e.g., Linear Models)	

## About Our Students

Students have opportunities for supervised teaching and statistical consulting experience. The department gives individual attention to each student through intensive advising, extensive small seminars, and research collaboration. Prior to completing their degrees, most doctoral students have several publications underway based on research done in collaboration with faculty members in biostatistics/statistics and in various medical departments.

PhD program graduates have found employment at Georgetown University, State University of New York at Buffalo, Carnegie Mellon University, Case Western Reserve University, Harvard University, Emory University, University of Florida, University of Illinois – Chicago, Johns Hopkins University, Lehigh University, Medical University of South Carolina, University of Rochester, Rochester Institute of Technology, University of Pittsburgh, Southern Methodist University, other state universities, numerous companies such as Google, Merck, Novartis, AbbVie, DuPont, and Bell Laboratories, and governmental agencies. MA and MS graduates are in various academic programs and in industrial, government, research, and consulting positions.

Recent PhD graduates with their advisors and thesis titles:

2021	Corsetti, Matthew	Dr. T. Love	A Series of Novel Ensemble Procedures with Tree Learners
2021	Yang, Luoying	Dr. T. Wu	Model-Based Clustering of Longitudinal Data in High Dimensions
2021	Zavez, Alexis	Dr. S. W. Thurston	Bayesian Latent Variable Models for Multiple Exposures with Unknown Group Memberships
2021	Sui, Jiatong	Dr. X. Qiu	Generalized Reduced Rank Correlation Structure in Statistical Inference and Multi-Type Data Integration
2019	Wang, Bokai	Dr. C. Feng	A Novel Variable Selection Procedure in Biomedical Research
2019	Lu, Xiang	Dr. T. Love	Model Selection and Variable Selection for Mixtures of Factor Analyzers
2019	Ma, Shiyang	Drs. M. P. McDermott and D. Oakes	Methods for Improving Efficiency in Clinical Trials
2019	Sun, Hao	Drs. B. A. Johnson and A. Ertefaie	Statistical Methods for Treatment Evaluation with Application to Longitudinal Studies
2019	Sherina, Valeriia	Drs. M. N. McCall and T. Love	Statistical Methods for qPCR Data Near the Limit of Detection
2018	Majumder, Madhurima	Dr. M. P. McDermott	Conditional Tests for Multivariate One-sided Hypotheses with Missing Data
2018	Zhang, Yun	Drs. X. Qiu and J. Thakar	Novel Statistical Methods for Gene Set Enrichment Analysis with Empirical Memberships for Overlapping Genes
2017	Chen, Chongshu	Drs. S. W. Thurston and O. Hyrien	Finite Mixtures of Nonlinear Mixed-Effects Models for Longitudinal Data
2017	Ciminelli, Joseph	Dr. T. Love	Mixed-Membership and Spatial Models for Social Network Data
2017	LaLonde, Amy	Dr. T. Love	Bayesian Model-Based Clustering Methods: Procedures for Data with Unknown Numbers of Clusters
2017	Grzesik, Katherine	Dr. D. Peterson	Local Cross-Validated Smoothing Parameter Estimation for Linear Smoothers
2017	Liu, Chang	Dr. S. W. Thurston	Bayesian Semiparametric Measurement Error Models: Estimation, Variable Selection and Fast Algorithms
2016	Hebert, Donald	Dr. M. P. McDermott	Global Tests for Multiple Outcomes in Randomized Trials
2016	Singh, Kyra	Dr. T. Love	Variable Selection Methods for Model-Based Clustering: Procedures for Functional Data and Bayesian Inference
2016	Yu, Ziji	Dr. G. S. Mudholkar	Theory and Application of the Mode Centric M-Gaussian Distribution
2016	Chowdhry, Amit	Dr. M. P. McDermott	Missing Data in Meta-Analysis
2015	Chen, Tian	Dr. X. M. Tu	A New Class of Functional Response Models for Robust Regression Analysis

2015	Xia, Changming	Drs. H. Liang and S. W. Thurston	Generalized Semiparametric Linear Mixed-Effects Models
2015	Tran, Thanh Van	Dr. A. Almudevar	Threshold Boolean Network Inference and Experimental Design
2015	Ma, Fei	Drs. O. Hyrien and X. M. Tu	Composite Likelihood Inference for Multivariate Finite Mixture Models and Application to Flow Cytometry
2014	Han, Yu	Drs. C. Feng and X. M. Tu	New Semiparametric Methods for Clustered Time-to-Event Data
2014	Morrisette, Jason	Dr. M. P. McDermott	Order Restricted Analysis of Covariance with Interactions
2014	Zhang, Xiao	Drs. M. P. McDermott and G. S. Mudholkar	Hypothesis Testing Problems Involving Order Restricted Parameters
2014	Yang, Hui	Dr. H. Liang	Model Selection and Model Averaging for Longitudinal Data with Applications in Personalized Medicine
2014	Evans, Katie	Drs. T. Love and S. W. Thurston	Extensions to Model-Based Clustering for Mixed-Type Data: A New Model Framework, Variable Selection, and Outlier Identification
2013	Yu, Yao	Dr. H. Liang	Single-index Model with Application in Estimation of ODE and Gene Regulatory Network
2013	Wu, Pan	Dr. X. M. Tu	A New Class of Structural Functional Response Models for Causal Inference and Mediation Analysis
2013	Chen, Juofan	Dr. H. Wu	State Space Models and Differential Equations for Dynamic Gene Regulatory Network Identification
2013	Chen, Zhen	Drs. D. Oakes and O. Hyrien	A Flexible Copula Model for Bivariate Survival Data
2012	Awadalla, Saria	Drs. G. S. Mudholkar and M. P. McDermott	Some Contributions to the Theory and Applications of R-Symmetry
2012	Liu, Xiang	Dr. H. Liang	Penalized Variable Selection for Semiparametric Regression Models
2011	Gunzler, Douglas	Dr. X. M. Tu	A Class of Distribution-free Models for Longitudinal Mediation Analysis
2011	Lu, Tao	Dr. H. Wu	ODE Based Statistical Models for Dynamic Gene Regulatory Network Identification
2011	LaCombe, Jason	Dr. A. Almudevar	Non-Informative Priors for Structural Inference in Bayesian Networks
2011	Lynch, Miranda	Dr. S. W. Thurston	Estimation, Model Checking and Diagnostics, and Identifiability in Finite Mixture Models for Point Mass Data: Methods in a Bayesian Framework

Recent MS graduates with their advisors and project titles:

2018	Catalfamo, Kayla	Dr. M. P. McDermott	Evaluation of Baseline Predictors of One-Year Change in Outcomes in Myotonic Dystrophy Type 1 in Preparation for Clinical Trials
2017	Maletz-Novick, Kristina	Dr. D. Peterson	Identification of Patients at High Risk for Sub-Optimal Bladder Filling During Radiation Therapy for Prostate Cancer
2017	Lee, Charles	Dr. T. Love	Hospital Charges: The Elephant in the Doctor's Office
2016	Tran, Lam	Dr. C. Feng	Structured Deep Learning on Medical Image Segmentation
2016	Kang, Hongyi	Dr. X. Qiu	The Change in Neuronal Dendritic Volume from Wakefulness to Sleep
2016	Chapman, Benjamin	Dr. A. Almudevar	A False Discovery Rate Upper Bound For Two-Stage Testing
2014	Bandyopadhyay, Sanjukta	Drs. H. Yang and H. Miao	Identifying Factors Affecting Treatment Success in Adult Drug Treatment Court Clients
2013	Boselli, Danielle	Dr. D. Peterson	Assessment of Left and Right Ventricular Volume Reduction to Identify Clinical Responders to CRT-D Among Non-LBBB Patients: A MADIT-CRT Sub-study
2011	Xia, Yinglin	Dr. X. M. Tu	Modeling HIV Risk Reduction Intervention: The Zero-inflated Negative Binomial and Zero-inflated Poisson Regression Models
2010	Miao, Hongyu	Dr. H. Liang	Understanding B Cell Kinetics in Humans via Heavy Water Labeling Using Nonlinear Mixed Effects Models and Stochastic Approximation EM Algorithms
2009	Rollins, Nicholas	Dr. X. M. Tu	Predictors of Depression in Pregnant Women and New Mothers Six Weeks Post-Partum
2009	Berry, Andrea	Dr. C. Beck	Evaluation of Influenza Vaccine Effectiveness Among the Rochester Population: 2008-2009 Season

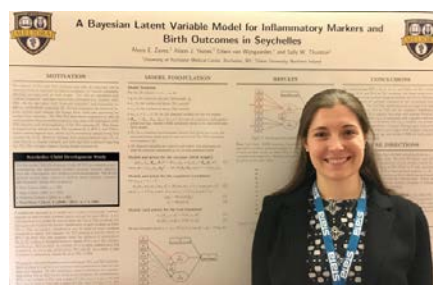


## Training in Environmental Health Biostatistics

Our T32 training grant “Training in Environmental Health Biostatistics” (T32ES007271) has been renewed by the National Institute of Environmental Health Sciences at NIH for an additional 5 years, starting July 1, 2020. The grant was first awarded in 1992, was successfully led by Dr. David Oakes for 20 years, and is now led by Dr. Sally W. Thurston. T32 trainers include Drs. Thurston, Oakes, Brent Johnson, Tanzy Love, Matthew McCall, Michael McDermott and Rob Strawderman from Biostatistics, and Drs. Emily Barrett from Rutgers (formerly from OB/GYN in Rochester), Deborah Cory-Slechta, Marissa Sobolewski, and Martha Susiarjo from Environmental Medicine, and Drs. Elaine Hill, David Rich, Todd Jusko, and Edwin van Wijngaarden from Public Health Sciences. The grant supports three predoctoral students and one postdoctoral fellow each year. In accordance with NIEHS requirements, trainees must be a US citizen or permanent resident.

The training environment is achieved by a collaboration between biostatisticians and Environmental Health Sciences (EHS) researchers. The training program a) uses Biostatistics courses for the core curriculum; b) provides additional course work in environmental epidemiology and toxicology to introduce trainees to EHS research; c) provides trainees with experience in statistical issues in EHS; d) promotes doctoral-level research in statistical theory and methodology related to environmental health studies; and e) recruits minorities and women into environmental health biostatistics.

Each trainee works on one or more research projects in EHS. Initially this consists of more routine data analysis under the direction of a biostatistician as primary preceptor and an EHS researcher as cosponsoring preceptor. This activity provides valuable experience and potentially assists the student in selecting a dissertation topic. More advanced trainees work on more difficult projects and will be asked to present their research at national meetings using travel funds partially provided by this grant. Trainees are generally supported on the training grant for the duration of their traineeship, up to three years, subject to satisfactory progress.



Examples of projects that have involved T32 trainees include studies of: a) the developmental effects of prenatal exposure to methylmercury from maternal fish consumption in the Seychelles Child Development Study, which now consists of three cohorts with multiple outcomes measured at multiple ages; b) the associations between air pollution exposure and biomarkers thought to indicate increased risk of future cardiac events; c) the joint effects of lead and stress on multiple neurotransmitters in five brain regions in rats; d) the effects of perfluorinated alkyl substances on ovarian hormone concentrations in fertile women; e) RNA sequencing to quantify the effect of dioxin exposure on CD8+ T-cell gene expression accounting for an unknown mixture of responders and non-responders, and f) methods to quantify morphologic changes in microglia in response to pharmacological alterations of noradrenergic signaling in the brain. These projects have led to methodological research on topics such as multiple longitudinal outcomes, structural equation models, causal inference, and exposure effects on mixtures of hormone trajectories, and has been the basis of a number of PhD theses.

T32 graduates have found employment at D’Youville College, Harvard University, University of Illinois – Chicago, University of Rochester, Rochester Institute of Technology, Roswell Park Cancer Institute, the National Institutes of Health, the EMMES Corporation, and companies such as Biogen, DuPont, and Google.

For more information: <https://www.urmc.rochester.edu/biostat/training-grant.aspx>

# Student Perspectives



## Living in Rochester, New York

“Rochester is an incredibly friendly city with tons of diverse delicious food. The surrounding area has numerous beautiful hikes and fun little cities to visit around the Finger Lakes. You also don't have to leave the city for things to do. Rochester is full of parks, trails, breweries, wineries, and even a beach!”

[Read more student thoughts about living in Rochester](#)



## Favorite thing about the program

“I feel like our department really nurtures us to get through graduate school, to get to the point where we feel that we are ready to go to the real world and feel comfortable in academia or feel comfortable in industry.”

[Hear from more students about being in the program](#)



## Studying at the University of Rochester

“Our program is unique in the way that it is a degree in statistics, but it's also a biostatistics and computational biology department. For me, that was very important. Being able to have the flexibility to work in an applied medical center setting but also making sure you learn and take those really theoretical and fundamental courses that can open doors to a large variety of places.”

[Learn why our students chose the University of Rochester](#)



## What to expect in your first year and beyond

“My first semester was extremely rewarding. The content was very intriguing to struggle with, and in the end, I was able to see how much I had learned in one semester. It's incredible that you can learn so much in such a short period of time if you have the right resources and professors around you.”

[Read how students describe their experiences](#)



## Advice for prospective students

“Come into the program with an open mind regarding what you ultimately want your research focus to be.”

[Find more advice from our students](#)



## Applying to Our Programs

Prospective students apply for admission online at

<https://www.urmc.rochester.edu/education/graduate/phd/statistics/apply.aspx>

### Application Requirements

- Online application
- Statement of purpose
- 3 letters of recommendation
- Transcripts
- GRE test scores
- English language test scores (most international applicants; TOEFL/IELTS/DuoLingo)
- The \$60 application fee is automatically waived for all PhD applications submitted on/before December 1. Applicants requesting a manual fee waiver should email the code “Math Alliance” to [URBiostat@urmc.rochester.edu](mailto:URBiostat@urmc.rochester.edu).

### For more information

Karin Gasaway  
Graduate Program Administrator  
[URBiostat@urmc.rochester.edu](mailto:URBiostat@urmc.rochester.edu)

### Application Timeline for PhD Program

We prefer to receive PhD applications by December 15, but we will give full consideration to any completed PhD application received by January 1.

By January 1: All application materials must be received

January-February: Interviews scheduled

February-March: Admission offers sent

April 15: Deadline to reply to admission offer

### Application Timeline for Master’s Programs

By May 1: All application materials must be received

March-June: Offer of admission notices mailed

Department of Biostatistics and Computational Biology  
University of Rochester School of Medicine and Dentistry  
265 Crittenden Boulevard, CU 420630  
Rochester, New York 14642-0630

Fellowships and scholarships are awarded for full-time graduate study at the PhD level. All full-time PhD students receive a full tuition scholarship, single health insurance, and a 10-month stipend (\$26,147 for September 2022-June 2023), with summer support possible depending on availability. PhD students are expected to assist with teaching duties and consulting projects. A training grant in Environmental Health Biostatistics funded by the NIEHS supports three PhD students each year; trainees must be US citizens or permanent residents.

Masters students generally rely on need-based financial aid. The School’s Financial Aid Office web site ([www.urmc.rochester.edu/education/financial-aid/](http://www.urmc.rochester.edu/education/financial-aid/)) provides information about the aid programs that students use most frequently.

[www.urmc.rochester.edu/biostat](http://www.urmc.rochester.edu/biostat)

[www.urmc.rochester.edu/education/graduate/phd/statistics](http://www.urmc.rochester.edu/education/graduate/phd/statistics)



# Living in Rochester

## If you're looking for a great place to live, learn, work and play, take a look at Rochester.

As the third-largest city in New York, Rochester is big enough to offer an array of cultural, recreational and leisure activities, and small enough to live affordably and navigate easily. Thanks to a cost of living significantly below the national average and proximity to the state's beautiful Finger Lakes region, many who come to Rochester to study choose to stay.



### Rochester Rankings

- #14 [National Quality of Life \(US News & World Report\)](#)
- #1 [Affordable Housing Market \(Investor's Business Daily\)](#)
- #19 [Most Innovative Cities \(USA Today\)](#)
- #1 [Northeastern City to Live in After Coronavirus \(Business Insider\)](#)

### Art and Culture

Rochester's long list of museums, theatres, galleries and special events gives city dwellers year-round cultural experiences to enjoy. Here are a few favorites:

#### Festivals

- [Park Ave. Summer Art Festival](#)
- [Clothesline Arts Festival](#)
- [Lilac Festival](#)
- [Rochester International Jazz Festival](#)

#### Museums

- [Memorial Art Gallery](#)
- [George Eastman Museum](#)
- [The Strong National Museum of Play](#)

#### Theatre & Music

- [Eastman Theatre](#)
- [Geva Theatre Center](#)
- [The Little Theatre](#)

### Food & Drink

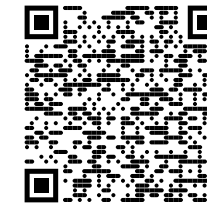
Whether you're in the mood for specific international cuisine or a place to enjoy drinks with friends, Rochester's dining scene has something for you. From Italian fare at [Grappa](#) in nearby College Town to house-brewed beers and small bites at [Swiftwater Brewery Company](#) down the road to Cajun classics downtown at [French Quarter Cafe](#)—the options are endless.

### Outdoor Activities

Just steps away from campus, you'll find historic areas to explore, a diverse array of events and activities, and scenic gardens—as in Highland Park, home of Rochester's famous Lilac Festival. In a short drive, you can be on the shore of Lake Ontario, touring one of many wineries or craft breweries, taking in a concert, meandering through a museum, gathering farm-fresh foods at the Public Market, bicycling along the Erie Canal or hiking in the "Grand Canyon of the East"—Letchworth State Park. Rochester truly has something for everyone, every season of the year.

### Sports

Rochester is home for many popular sports teams such as [Red Wings baseball](#), [Amerks hockey](#), and [Rhinos soccer](#). Fair warning: for better or for worse, Rochesterians love the Buffalo Bills. Rochester is also one of the Northeast's premier golf destinations; golf.com has ranked Rochester as the #10 Best Golf City in the US, and #1 for Golf Affordability.



For just a taste of what Rochester and the Finger Lakes region have to offer, check out this interactive map with a few selected attractions. (Scan the QR code)

### Where We're Located

Rochester is located within 400 miles of 14 states and is within driving distance to major cities, including Toronto and New York City.



### How far does my stipend go?

We know how important financial considerations are when you're weighing your grad school options.

Compared to these cities,	Rochester's cost of living is:
New York City	62% lower
San Francisco	51% lower
Washington, DC metro	41% lower
Seattle	39% lower
Los Angeles	34% lower
Chicago	20% lower
Denver	14% lower



Resource: See how far your stipend goes compared to other cities with these cost-of-living calculators by [CNN Money](#) or [NerdWallet](#).

# Graduate Student Clubs & Additional Resources

## Alliance for Diversity in Science and Engineering

Alliance for Diversity in Science and Engineering (ADSE)'s mission is to increase the participation of underrepresented groups in academia, industry, and government through graduate student organizations that reach out to students and scientists of all ages and backgrounds. The local chapter is working to establish a diversity lecture series to bring underrepresented faculty from other universities to Rochester. ADSE provides a space where underrepresented graduate students in STEM fields from across the University can meet, network, and hold workshops and panels to openly discuss the issues they face.

## Brain Awareness Campaign

The University of Rochester's Brain Awareness Campaign is a community outreach program sponsored by the Rochester Chapter of the Society for Neuroscience.

## Chinese Student Scholar Association

The [CSSAUR: Chinese Student Scholar Association - UR](#) is a non-profit organization, aiming to offer academic, living, and entertainment help for UR students, postdocs, visiting scholars and their family members coming from People's Republic of China.

## Daybreakers Toastmasters Club

Toastmasters International is a non-profit educational organization that teaches public speaking and leadership skills through a worldwide network of clubs. The University of Rochester club meets three times per month.

## Graduate Student Society (GSS)

The Graduate Student Society is an organization that supports the graduate students in the School of Medicine & Dentistry and exists to coordinate social events, organize charity/volunteer activities in the community, and honor outstanding faculty and students within the SMD.

## Graduate Students of Color (GSOC) Council

Graduate Students of Color aims to raise awareness in regard to diversity in higher education throughout the community and the University by serving as a voice and advocate for students of color regarding University policies.

## Graduate Students Raising Families (GSRF)

The aim of URMCM Graduate Students Raising Families (GSRF) is to find solutions to alleviate the problems that students have while balancing family life and pursuing their degrees.

## Graduate Women in Science (GWIS)

Graduate Women in Science provides mentoring for the professional and personal development of all graduate women at the University of Rochester Medical Center and College of Arts and Sciences.

## Latino Professional Alliance

The mission of the Latino Professional Alliance (LPA) at the University of Rochester is to build and maintain a positive work environment and to support the growth and development of Latinos/Latinas.



## Meliora Collective

The Meliora Collective for UR Student and Alumni Networking goes beyond what social media networks offer - an exclusive University of Rochester community of alumni, students, parents, and friends who want to make meaningful connections for personal and professional exploration and growth.

## Pre-doctoral Organization for the Neurosciences

The Pre-doctoral Organization for the Neurosciences (PONS) mission is to increase neuroscience awareness in Rochester and Western New York through an integrated organization.

## Postdoctoral Association (PDA)

The Postdoctoral Association was established in 2006 to provide career development and networking opportunities, as well as professional recognition specifically for postdoctoral appointees. Through these efforts the PDA hopes to contribute to the professional advancement of postdoctoral appointees and highlight the contributions of postdoctoral appointees to scientific research at the University of Rochester.

## Rochester Indian Association (RIA)

The Rochester Indian Association serves as a platform for general social mingling and interpersonal interactions among students of Indian origin at the University of Rochester.

## Rochester Medical Orchestra

The University of Rochester is home to the renowned Eastman School of Music. Its community extension, the Eastman Community Music School, invites all members of the biomedical professions to join the Rochester Medical Orchestra.

## Rochester Young Scientists Club

The Rochester Young Scientists Club focus is to engage fifth- and sixth-grade students in science experiences that promote science as a profession.

## Science Policy Initiative

The University of Rochester Science Policy Initiative is a group of graduate students and post-doctoral fellows that are passionate about science and public policy. The group organizes various skill building events and workshops so that trainees can get hands on experience with science policy. In addition,

seminars are held to facilitate discussion about science policy, better understand key issues that the nation and local government is facing and provide an opportunity to explore different career paths.

## Second Friday Science Social

Second Friday Science Social seminars highlight University of Rochester research and recent developments in the life sciences. An informal social hour follows each seminar.

## Society for Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS)

SACNAS is an inclusive organization dedicated to fostering the success of Chicanos/Hispanics and Native Americans, from college students to professionals, in attaining advanced degrees, careers, and positions of leadership in STEM.

## Spectrum

The Spectrum group at the University of Rochester School of Medicine and Dentistry seeks to support, educate, and offer targeted resources to the lesbian, gay, bisexual, and transgender community training at the U of R Medical Center.

## Susan B. Anthony Institute

The Susan B. Anthony Institute, based on the River Campus, supports the research and curricular development of graduate students whose work focuses on gender and women's studies. Graduate students, postdocs and PREP trainees may all take advantage of the Institute's many events and faculty research seminars.

## Thinkers & Drinkers

University of Rochester PhD students sharing their love for science (and drinks) with the people of Rochester. Follow us on Instagram (@urthinkersanddrinkers) to stay up-to-date on upcoming events!

## University of Rochester Veterans Alliance

It is the University of Rochester Veterans Alliance mission to provide military veteran students, staff, faculty, and alumni and their families with the resources, support, and advocacy needed to succeed in higher education.





## Diversity, Equity, and Inclusion at Rochester



The University of Rochester Medical Center aspires to make every person feel safe, welcome, and supported at all times; to be a place where everyone, regardless of identity or challenges they face, is lifted up to become their best and healthiest selves; to serve as a powerful force for eliminating racism, division, and exclusion in our communities and beyond.

As Rochester and other communities across the country grapple with racial justice issues, URMCM views racism as a public health crisis. Our School of Medicine & Dentistry's students and trainees are key contributors to our [Equity & Anti-Racism Action Plan](#) guiding our work to make everyone feel welcome and supported in a richly diverse, inclusive medical center community. We invite you to help research and address health disparities globally and in Rochester.

Learn more about our [Equity & Anti-Racism Action Plan](#) at [actionplan.urmc.edu](https://actionplan.urmc.edu)

### Research

You'll find cutting-edge research on hundreds of topics undertaken by several thousand students, postdocs, and faculty researchers at the University of Rochester, fueled by over \$140M in annual grants from NIH and additional funding from other granting agencies. Visit our [Research Newsroom](#) to catch the latest headlines and check out a few projects below that exemplify our commitment to diversity, equity and inclusion through our collective work.

- Researchers across multiple labs affiliated with our [PhD Toxicology](#) program, currently investigate the impact of environmental contaminants on health and discovering growing evidence that racial disparities contribute to the larger risk assessment picture in relation to exposures and access to health care.
- Recent studies by the [Portman lab](#), affiliated with the PhD programs in [Genetics, Development, and Stem Cells](#) and [Neuroscience](#), suggest that the assignment of biological sex at the molecular and cellular level is dynamic and flexible, rather than binary and static. This work, carried out in the nematode *C. elegans*, was recently published in *Current Biology*. Learn more [here](#).
- [Neuroscience](#) faculty Patricia White conducts research on hearing signaling and restoration. Read about [her projects](#). MD/PhD Neuroscience student Ian DeAndrea-Lazarus holds a grant from the National Center for Deafness and Communication Disorders for his research work. Learn more [here](#).





# THINK YOU KNOW STATISTICS? THINK AGAIN!

Statistics is a fulfilling and rewarding profession. With a career in statistics — the science of learning from data — you can make a difference, have fun, satisfy your curiosity, and make money.



**Make a Difference**



**Have Fun**



**Satisfy Curiosity**



**Make Money**

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## Where Do Statisticians Work and What Do They Do?

### **Sports**

Work with professional or college sports teams using statistics to inform draft picks for the most competitive players.

### **Medicine and Health**

Help medical researchers understand the prevalence of disease among various populations. Work with pharmaceutical companies to develop new drugs that are safe and effective.

### **Data Science**

Contribute to advancements in the computing industry through machine learning, speech recognition and artificial intelligence. Work for companies like Microsoft, Google and Apple.

### **Ecology and the Environment**

Conduct analyses that lead to better management of the earth's natural resources, working for organizations like the National Forest Service and World Resources Institute.

### **Business and Finance**

Help industry improve efficiency in business processes; work with banks to identify risk and opportunity in lending, investing and other areas.

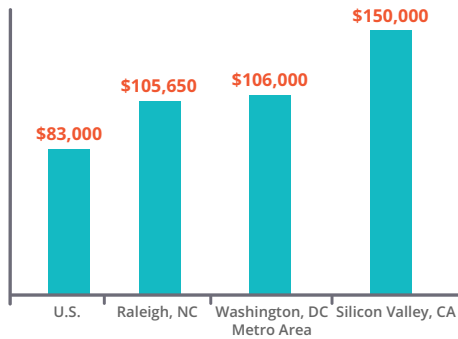
### **Politics and Government**

Improve voter targeting and assess the success of government policies and programs.

# Jobs in Statistics are Growing Fast and Offer Competitive Salaries

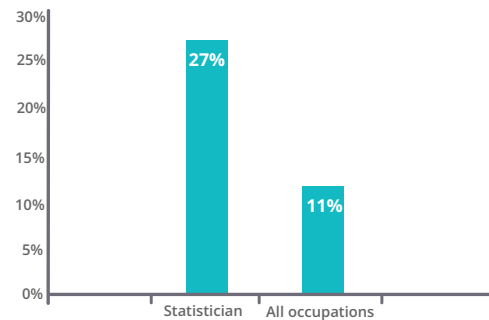
## Mean annual salaries of statisticians in 2014

Source: U.S. Bureau of Labor Statistics.



## Jobs in statistics are expected to grow faster than average for all occupations

Source: U.S. Bureau of Labor Statistics. Covers employment growth from 2012 to 2022.



## Four More Reasons to Study Statistics

- » Statistical analysis and data mining were listed among the “**hottest skills of 2014**” by **LinkedIn**.
- » The **McKinsey Global Institute** predicts a shortage of up to **190,000 people** with the skills needed to run Big Data projects.
- » Online jobs site **CareerCast** named statistician a top job for **women**.
- » **Fortune** magazine ranked statistics and biostatistics among the top graduate degrees based on **salary, growth** and **job satisfaction**.

To learn more about careers in statistics,  
and how to become a statistician,  
go to [www.ThisIsStatistics.org](http://www.ThisIsStatistics.org)

"A significant constraint on realizing value from Big Data will be a shortage of talent, particularly of people with deep expertise in statistics and machine learning ... we project that demand for deep analytical positions in a big data world could exceed the supply being produced on current trends by 140,000 to 190,000 positions."

-McKinsey Big Data report, 2011.

## What is Statistics and what is Big Data?

- Statistics is the science of collecting, analyzing and understanding data, and accounting for the relevant uncertainties. As such, it permeates the physical, natural and social sciences; public health; medicine; business; and policy.
- Big Data is the collection and analysis of data sets that are complex in terms of the volume and variety, and in some cases the velocity at which they are collected. Big Data are especially challenging because some of them were not collected to address a specific scientific question.

## How are Big Data problems being tackled?

- Big data problems usually require multidisciplinary teams by their very nature. At the very least, they typically require subject area (domain) experts, computational experts, machine learning experts, data miners, AND statisticians.

## Why is it important for statistics to be one of the key disciplines for Big Data?

- Statistics is fundamental to ensuring meaningful, accurate information is extracted from Big Data. The following issues are crucial and are only exacerbated by Big Data:
  - Data quality and missing data
  - Observational nature of data
  - Quantification of the uncertainty of predictions, forecasts and models
- Like in any data, one will find bias, false positives and uncertainty through the analysis of big data
- The scientific discipline of statistics brings sophisticated techniques and models to bear on these issues
- Statisticians help translate the scientific question into a statistical question, which includes carefully describing data structure; the underlying system that generated the data (the model); and what we are trying to assess (the parameter or parameters we wish to estimate) or predict

*In Big Data, statistical sciences and domain sciences are more intertwined than ever before, and statistical methodology is absolutely critical to making inferences.\**

## What does statistics bring to Big Data and where are the opportunities?

- Big Data will often not be served well by "off the shelf" methods or black box computational tools that work in low-dimensional and less complicated settings, and therefore require tailored statistical methods.
- Statisticians are skillful at assessing and correcting for bias; measuring uncertainty; designing studies and sampling strategies; assessing the quality of data; enumerating limitations of studies; dealing with issues such as missing data and other sources of non-sampling error; developing models for the analysis of complex data structures; creating methods for causal inference and comparative effectiveness; eliminating redundant and uninformative variables; combining information from multiple sources; and determining effective data visualization techniques.
- See the ASA Whitepaper: [Discovery with Data: Leveraging Statistics with Computer Science to Transform Science and Society](#).

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The American Statistical Association (ASA) is a scientific and educational society of 19,000 members who serve in industry, government and academia in more than 90 countries, advancing research and promoting sound statistical practice to inform public policy and improve human welfare.

\*Roger Peng, Johns Hopkins School of Public Health

# Careers in Statistics & Biostatistics

Statisticians have become so important to so many fields that demand for their skills is leading to strong job growth. Learn more about the role of statistical science and statisticians in

- **Health Care** (<http://www.amstat.org/asa/files/pdfs/StatSig/StatSigHealthCare.pdf>)
- **Health Policy** (<http://www.amstat.org/asa/files/pdfs/StatSig/StatSigHealthPolicy.pdf>)
- **Drug & Device Development** (<http://www.amstat.org/asa/files/pdfs/StatSig/StatSigDrugsDevices.pdf>)
- **The Environment** (<http://www.amstat.org/asa/files/pdfs/StatSig/StatSigEnvironment.pdf>)
- **Agriculture** (<http://www.amstat.org/asa/files/pdfs/StatSig/StatSigAgriculture.pdf>)
- **Energy Policy** (<http://www.amstat.org/asa/files/pdfs/StatSig/StatSigEnergy.pdf>)
- **Economic Productivity** (<http://www.amstat.org/asa/files/pdfs/StatSig/StatSigEconomy.pdf>)
- **Security and Defense** (<http://www.amstat.org/asa/files/pdfs/StatSig/StatSigNationalSecurity.pdf>)
- **Transportation** (<http://www.amstat.org/asa/files/pdfs/StatSig/StatSigTransportation.pdf>)
- **Sports** (<http://www.amstat.org/asa/files/pdfs/StatSig/StatSigSports.pdf>)

**STATISTICS IMPROVES HEALTH CARE**

**STATISTICAL SIGNIFICANCE**

*Statisticians are vital to all forms of health care, from developing treatments to examining regimens for preventing and detecting disease. To deal with the complexity of the human body and its interactions with its surroundings, statisticians collaborate with health-care researchers to extract information from data, leading to treatments and information that reach the public more quickly.*

### Health Care Research

**ASSESSING DISEASE RISK:** The risk of an individual developing a disease or suffering an event such as a heart attack may be related to family history, environment, or behavior. Disentangling these factors requires sophisticated statistical methods. Statisticians have developed powerful risk assessment tools to predict a patient's chance of such adverse occurrences, which guide recommendations for screening for early disease detection and treatment. Early detection can result in better health and lower health costs. Try these risk-assessment tools.

**Breast Cancer:** [www.cancer.gov/bcrisktool](http://www.cancer.gov/bcrisktool)

**Heart Attack:** <http://my30to35adhd.com/epic/calculation.asp>

**Melanoma:** [www.cancer.gov/melanomariskscreen](http://www.cancer.gov/melanomariskscreen)

**INFORMING DECISIONS – HEALTHY MOMS, HEALTHY BABIES:** Many women must consider trade-offs when considering childbearing and career. As women age, fertility declines and the probability of pregnancy complications and some birth defects begins to rise. Statistical models are crucial decision-

**Ensuring Safe and Adequate Blood Supply:** A safe and adequate blood supply is a critical requirement for modern medicine and public health. Because of the various social, demographic and health factors in all the components of realizing this goal, from forecasting supply and demand, and identifying likely donors, to understanding and reducing the risks of transfusion-transmitted infections, advanced statistical analysis and modeling are needed. With this information, public health officials are better prepared to deal with insufficient supply and can better design targeted outreach and education programs on blood donation. Further, this information has been used to significantly reduce the risks of transfusion-transmitted infections.

making tools that help clinicians provide advice to hopeful mothers-to-be about how long to attempt pregnancy naturally before considering in vitro or other reproductive technologies. They also help obstetricians advise women about healthy pregnancy behaviors regarding optimal nutrition and weight gain during pregnancy.

**MEASURING PATIENT AILMENTS – IMPROVING CARE:** Symptoms that require patient reporting, such as pain and fatigue, are hard to measure. Statisticians are helping develop new efficient and consistent clinical measures for self-reported conditions that help adapt questions to each patient while enabling comparisons to broader populations. Tailored questionnaires can leave patients more satisfied with their care, and therefore more likely to return for necessary follow-ups and supervision. Care providers and clinical researchers also benefit by having better patient information and better information about treatment effectiveness.

"Statistical Significance Health Care" is a part of Statistical Significance, a series from the American Statistical Association demonstrating the contributions of statistics to our society and industry. For more in this series, visit [www.amstat.org](http://www.amstat.org) and search for "Statistical Significance." The American Statistical Association is the foremost professional society of statisticians, representing statisticians in industry, government, and academic environments. The Statistical Significance series is produced under the supervision of the ASA Section on Health Policy Statistics, with support from the ASA Section on Statistics in Epidemiology.

2017 

**STATISTICS INFORMS ENERGY POLICY**

**STATISTICAL SIGNIFICANCE**

*Statisticians provide policymakers with a range of information that covers energy production, consumption, imports, exports, inventories, prices, and environmental effects. They also provide projections for future activities and analyses of the possible effects of changes in technology, regulations, and tax policies. Statistical analyses based on high-quality data promote sound policymaking, efficient markets, and public understanding of energy and its place in the economy and environment.*

### Energy Policy


**TRACKING ENERGY PRODUCTION AND CONSUMPTION:** One of the most basic activities of statisticians in the energy area is tracking energy production and consumption on a global, national and regional basis. This poses many challenges. For example, because it is impractical to measure end-use consumption across millions of homes and businesses, consumption must be estimated from measures such as withdrawals from inventories at fuel storage points. Estimates of production and consumption have implications for the price of energy as well as broader issues such as our national exposure to disruptions in energy supplies.

**PROJECTING FUTURE ENERGY SUPPLY AND DEMAND:** How much energy might we need to satisfy U.S. and global demand in 10, 20, or 30 years? What energy supplies might be available to meet this demand? The answers to these questions have profound implications, ranging from the expected costs of energy to greenhouse gas mitigation to what kinds of industries will be profitable and what kinds of transportation will be economical. Statisticians answer these questions by drawing on projections of resource availability, technological capabilities, and economic activity, all pulled together with sophisticated models of energy production and consumption.

**MODELING EFFECTS OF POLICY INTERVENTIONS:** The complex models used to project energy supply and demand can be used to help determine the potential effects of policy initiatives. Policymakers can ask "what if" questions: What if we change automotive fuel efficiency requirements? What if we mandate that electric utilities use some percentage of renewable energy? What if we invest in developing clean fuel technologies? Statisticians can project the possible effects on variables such as the cost of producing energy (which affects economic activity and household energy costs) and energy-related emissions of greenhouse gases.

**DETERMINING ENERGY EFFICIENCY:** Statisticians design surveys of end users in the residential, manufacturing, and commercial building sectors to learn about differences in energy consumption. These data can be used to identify the best opportunities for energy savings and measure the effects of energy efficiency programs. Statisticians can distinguish the effects of efficiency programs from the effects of other factors by comparing energy usage among groups with and without efficiency program interventions, or by using analyses that statistically control for other differences among groups.

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2017 



# Career Opportunities in Statistics

## ASA RESOURCES

**Careers in Statistics Website**  
[www.amstat.org/careers](http://www.amstat.org/careers)

**Careers in Statistics PowerPoint Presentation**  
[www.amstat.org/careers/presentation.cfm](http://www.amstat.org/careers/presentation.cfm)

**Schools Offering Degrees in Statistics**  
[www.amstat.org/education/sods](http://www.amstat.org/education/sods)

**Center for Statistics Education**  
[www.amstat.org/education](http://www.amstat.org/education)

**Biometrics Section**  
[www.bio.ri.ccf.org/Biometrics](http://www.bio.ri.ccf.org/Biometrics)

**Biopharmaceutical Section**  
[www.amstat.org/sections/SBIOP](http://www.amstat.org/sections/SBIOP)

**Section on Statistics in Epidemiology**  
[www.amstat.org/sections/epi/sie\\_home.htm](http://www.amstat.org/sections/epi/sie_home.htm)

**ASA JobWeb**  
[www.amstat.org/jobweb](http://www.amstat.org/jobweb)

**Placement Service—ASA Annual Meetings**  
[www.amstat.org/meetings](http://www.amstat.org/meetings)

**Statistics Without Borders**  
<http://community.amstat.org/statisticswithoutborders/home>

Jobs for statisticians in the health and medical industries are numerous. Statisticians work in hospitals, research universities, and pharmaceutical companies. They also work in government agencies such as the U.S. Food and Drug Administration, Centers for Disease Control and Prevention, and the National Institutes of Health. Students interested in health and medical statistics should study chemistry, biostatistics, biology, and other natural science courses, as well as statistics, mathematics, and writing.

## FIELDS OF APPLICATION

### BIOMEDICAL RESEARCH

Improved medical treatments and devices rely on careful experiments that compare promising new methods with current techniques. Biostatisticians work on clinical trials and other experiments to formulate scientific questions, determine appropriate sampling techniques, coordinate data-collection procedures, and carry out statistical analyses.

### ANIMAL HEALTH

Animal health statisticians work with people educated in areas such as chemistry, biology, veterinary science, computer science, and business to discover, develop, and market a compound with the overall goal of making animals healthier or food healthy, safe, and efficient to produce.

### PHARMACOLOGY

Statisticians in pharmacology work in all aspects of drug discovery, development, approval, and marketing: pre-clinical research, clinical trials, epidemiology, health economics, market research, and publication in scientific journals.

### GENETICS

Statistics has been used in human genetics to create automated methods of labeling possible indicators of genetic abnormalities, such as birth defects and early aging. Genetics also has been used in breeding to produce desirable characteristics in offspring. Using complex statistical models, statisticians aid in formulating sound decisions by sorting out the environmental effects from the genetic.

# HEALTH & MEDICINE

## OTHER RESOURCES

**International Biometric Society**  
[www.biometricsociety.org](http://www.biometricsociety.org)

**International Biopharmaceutical Association**  
[www.ibpassociation.org](http://www.ibpassociation.org)

**Society for Clinical Trials**  
[www.sctweb.org](http://www.sctweb.org)

**Occupational Outlook Handbook, Bureau of Labor Statistics**  
[www.bls.gov/ooh](http://www.bls.gov/ooh)

### CHEMISTRY

Statisticians in chemistry may design studies to determine variability in a compound or to test mixtures of ingredients. They also may use statistical techniques to discover and replicate compounds for use in medicine. Statisticians work in many areas of chemistry, including analytical, physical, organic, inorganic, biochemical, and formulation.

### EPIDEMIOLOGY

Epidemiological statisticians work on projects such as calculating cancer incidence rates or the rates of chronic and infectious diseases; monitoring and reporting on disease outbreaks; and monitoring changes in health-related behaviors, such as smoking and physical activity. Fields of practice include pharmacoepidemiology and nutritional, environmental, genetic, and social epidemiology.



**AMERICAN STATISTICAL ASSOCIATION**

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**Schools Offering Degrees in Statistics**  
[www.amstat.org/education/sods](http://www.amstat.org/education/sods)

**Statistical Sciences in Government**  
[www.amstat.org/careers/pdfs/CareersinStatistics-Government.pdf](http://www.amstat.org/careers/pdfs/CareersinStatistics-Government.pdf)

**Section on Government Statistics**  
[www.amstat.org/sections/sgovt](http://www.amstat.org/sections/sgovt)

**Section on Health Policy Statistics**  
<http://healthpolicystatistics.wordpress.com>

**Survey Research Methods Section**  
[www.amstat.org/sections/SRMS](http://www.amstat.org/sections/SRMS)

**ASA JobWeb**  
[www.amstat.org/jobweb](http://www.amstat.org/jobweb)

**Amstat News Science Policy**  
[www.amstat.org/outreach/scipolicycolumns.cfm](http://www.amstat.org/outreach/scipolicycolumns.cfm)

**Placement Service—ASA Annual Meetings**  
[www.amstat.org/meetings](http://www.amstat.org/meetings)

**Center for Statistics Education**  
[www.amstat.org/education](http://www.amstat.org/education)

**Committee on Law and Justice Statistics**  
[www.amstat.org/committees/commdetails.cfm?txtComm=CCNARS04](http://www.amstat.org/committees/commdetails.cfm?txtComm=CCNARS04)

# GOVERNMENT

## OTHER RESOURCES

**Council of Professional Associations on Federal Statistics**  
[www.copafs.org](http://www.copafs.org)

**Federal Statistics**  
[www.fedstats.gov](http://www.fedstats.gov)

**Occupational Outlook Handbook, Bureau of Labor Statistics**  
[www.bls.gov/ooh](http://www.bls.gov/ooh)

**Committee on National Statistics**  
[www7.nationalacademies.org/cnstat](http://www7.nationalacademies.org/cnstat)

Jobs for statisticians are found in a variety of local, state, and federal government agencies. Statisticians hold positions in research, survey statistics, computing, survey methodology and design, quality assurance, operations research, and management. Future statisticians interested in government employment should study economics, finance, demography, and operations research, as well as statistics, mathematics, and writing.

## FIELDS OF APPLICATION

### LAW AND JUSTICE

Statisticians analyze data that can help the jury or judge decide whether someone is guilty of a crime. Types of evidence that may require statistical analysis include DNA tests, salary discrepancies, and consumer surveys.

### FORESTRY

Forestry statisticians use a scientific process of measurement, analysis, and deduction to study the effects of climate, weather, animals, and atmospheric conditions. How trees grow, develop, propagate, and interact with other trees and their environments are just some of the issues of interest to the forest biometrician.

### POLICY

Statistical methods are widely used in government regulation, including making rules for trading stocks, setting standards for pure air, and approving new drugs. Statistics are cited in court proceedings, congressional hearings, and lobbying arguments.

### AGRICULTURE

Statisticians in agriculture work to solve problems concerning chemical pesticides, hydrogeology, veterinary sciences, genetics, and crop management. They work with data from a range of biological units, including small-scale organisms, plants, insects, animals, and humans.

### NATIONAL DEFENSE

Statisticians work with other scientists, policymakers, and military personnel to address questions of defense and national security. Activities can be applied, involving collecting data, or theoretical, including developing methods and models.

### ECONOMICS

Statisticians produce and analyze the federal government's key economic indicators. These include measures of unemployment, inflation, and market volumes. Because these indicators are based on sample survey data, skills in sampling and estimation techniques are highly valued.

### ECOLOGY

Statisticians address questions about the Earth's natural environment, including animal populations, agricultural protections, and fertilizer and pesticide safety. Scientific researchers work with statisticians to design experiments that will answer questions about the effects of government policies on the environment.

### DEMOGRAPHY

Through sample surveys and censuses, statisticians produce demographic and economic portraits of the nation. Statisticians carry out research on such topics as time series analysis, estimation, sampling frame comparison, treatment of nonresponse, and statistical approaches to maintaining confidentiality of respondent data.



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### Schools Offering Degrees in Statistics

[www.amstat.org/education/sods](http://www.amstat.org/education/sods)

### Business and Economic Statistics Section

[www.amstat.org/sections/bus\\_econ](http://www.amstat.org/sections/bus_econ)

### Statistical Consulting Section

[www.amstat.org/sections/cnsl](http://www.amstat.org/sections/cnsl)

### Section on Physical and Engineering Sciences

<http://amstat-online.org/spes>

### Quality and Productivity Section

[www.amstat-online.org/sections/qp](http://www.amstat-online.org/sections/qp)

### Section on Risk Analysis

[www.amstat.org/sections/srisk](http://www.amstat.org/sections/srisk)

### Section on Statistics and Marketing

[www.amstat.org/sections/mktg](http://www.amstat.org/sections/mktg)

### ASA JobWeb

[www.amstat.org/jobweb](http://www.amstat.org/jobweb)

### Center for Statistics Education

[www.amstat.org/education](http://www.amstat.org/education)

### Placement Service—ASA Annual Meetings

[www.amstat.org/meetings](http://www.amstat.org/meetings)

Jobs for statisticians in business and industry are found in not-for-profit and for-profit public and private companies. Statisticians work in areas such as market research, quality control, financial planning, insurance, and management. In addition to statistics and mathematics, future statisticians should study economics, finance, marketing, operations management, computer science, and writing.

## FIELDS OF APPLICATION

### INSURANCE

Actuarial statisticians work in pension plans, life tables, risk assessment, customer retention, and operations management. They assist in financial decisions regarding interest, annuities, mortgages, bonds, and determining pricing and product design.

### ENGINEERING

Engineers work in a range of industries, including electronics, chemicals, aerospace, pollution control, and construction. Statistical methods allow engineers to make a consistent product, detect problems early, minimize chemical waste, and predict product life.

### WRITING

Science writers are employed by the mass media, universities, and corporations to produce news briefs, articles, and news releases. Writers with scientific backgrounds are in demand because of their ability to explain complicated data in easy-to-understand terms.

### FINANCE

Financial statisticians build models that help an organization exploit opportunities and avoid risk. Statisticians build prediction models from historic business or economic information. Financial statisticians also work in consumer credit and fraud detection.

### MARKETING

Statistics is used to quantify the extent of variation in customers' needs and wants. Statisticians design experiments for new products, conduct focus groups and sample surveys, and perform field experiments in test markets. Statistics and data mining also are used to analyze sales data and predict future trends.

# BUSINESS & INDUSTRY

## OTHER RESOURCES

### American Society for Quality

[www.asq.org](http://www.asq.org)

### Institute for Operations Research and the Management Sciences

[www.informs.org](http://www.informs.org)

### Society for Industrial and Applied Mathematics

[www.siam.org](http://www.siam.org)



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# Welcome to The World of Statistics

The World of Statistics—the successor to the highly successful International Year of Statistics campaign celebrated in 2013—is a global network of more 2,300 organizations worldwide committed to promoting the contribution of statistics to our global society.

Why is this important? The short answer is that statistics have powerful and far-reaching effects on everyone, yet most people are unaware of their connection to statistics—from the foods we eat to the medicines we take, the air we breathe to the bridges we cross—and how statistics improve all our lives. Statistical sciences have an impeccable impact on our lives and are a key to discoveries and innovation!

Go to [www.worldofstatistics.org](http://www.worldofstatistics.org) to learn more.



## What Is Statistics?

When many people hear the word “statistics,” they think of either sports-related numbers or the college class they took and barely passed. While statistics can be thought about in these terms, there is more to the relationship between you and statistics than you probably imagine.

Several informal definitions are offered in the book *A Career in Statistics: Beyond the Numbers* by Gerald Hahn and Necip Doganaksoy:

- The science of learning from (or making sense out of) data
- The theory and methods of extracting information from observational data for solving real-world problems
- The science of uncertainty
- The quintessential interdisciplinary science
- The art of telling a story with [numerical] data

Statistics are produced around the world by governments, political parties, civil servants, financial companies, opinion-polling firms, campaign groups, social-research entities, scientific groups, news organizations, and so much more.

## How Does Statistics Affect You?

You may not be aware of it, but statistics affects nearly every aspect of your life, including:

- Foods you eat
- Weather forecasts
- Emergency preparedness
- Assessing disease risks
- Protecting your pet’s health
- Improving your health care
- Transportation systems you use
- Assessing your credit worthiness
- Pricing your insurance policies
- Ensuring national security
- Examining economic health
- Prosecuting criminals
- Ensuring the safety of medicine
- Rulemaking by governments
- Assessing teacher effectiveness
- Monitoring climate change

## Statistics—An Excellent Career Choice

Since our world is becoming more quantitative and data-focused, job opportunities in statistics are plentiful and projected to increase worldwide. Many industries depend on statisticians to analyze data, which helps in making critical decisions. Statisticians work on important and challenging problems such as:

- Estimating the safety of nuclear power plants and alternative energy sources
- Evaluating the impact of air, water, and soil pollution
- Estimating the unemployment rate of a country
- Analyzing consumer demand for products and services
- Designing studies for and analyzing data from agricultural experiments to increase crop productivity and yields

## Statistics Education Resources

Demand for statisticians and data analysts is expected to increase by 4.4 million jobs worldwide in the years ahead. To introduce students to careers in statistics and teach them basic statistics literacy, many statistical organizations have developed primary and secondary school statistics education programs and resources, most of which are free of charge. An excellent example is the Census at School program, an international classroom statistical literacy project. To access these resources, go to the Teacher Resources section at [www.worldofstatistics.org](http://www.worldofstatistics.org).