

## STATISTICS

<https://www.uvm.edu/cems/mathstat> (<https://www.uvm.edu/cems/mathstat/>)

### OVERVIEW

The Statistics Program offers biostatistics, statistics, data science and probability courses for the entire university community along with traditional degree programs and individually designed degree programs emphasizing statistics applied to other fields. The degree programs are designed primarily for students who plan careers in data science, business, actuarial science, industry, and government or advanced training in disciplines that make extensive use of statistical methods and data science. The program faculty is deeply involved in consulting and collaborative research in a wide variety of fields, including industry, agriculture, and in the basic and clinical medical sciences. These research activities along with the research of other quantitative UVM faculty offer students unique opportunities to apply their classroom training to "real world" problems. Qualified students with the goal of learning statistics to use in a specialized area of application are especially encouraged to take advantage of these cooperative arrangements.

Program faculty have active statistics research efforts in areas such as bioinformatics, statistical genetics, Bayesian models, survival data analysis, discriminant analysis, bootstrap methods, machine learning, predictive modeling, networks, categorical data analysis, measurement error models, and experimental design. Students seeking the traditional graduate degree in statistics (along with course work in mathematics and computer science, if desired) have excellent opportunities to participate in the faculty's research.

### DEGREES

- Statistics AMP (<http://catalogue.uvm.edu/graduate/statistics/statisticsamp/>)
- Statistics M.S. (<http://catalogue.uvm.edu/graduate/statistics/statisticsms/>)

### FACULTY

**Bagrow, James;** Associate Professor, Department of Mathematics and Statistics; PHD, Clarkson University

**Buzas, Jeff Sandor;** Professor, Department of Mathematics and Statistics; PHD, North Carolina State University Raleigh

**Chaudhuri, Paramita Saha;** Assistant Professor, Department of Mathematics and Statistics; PHD, University of Washington

**Cole, Bernard;** Professor, Department of Mathematics and Statistics; PHD, Boston University

**Jefferys, William;** Adjunct Professor, Department of Mathematics and Statistics; PHD, Yale University

**Single, Richard M.;** Associate Professor, Department of Mathematics and Statistics; PHD, SUNY Stony Brook

**Young, Jean-Gabriel;** Research Assistant Professor, Department of Computer Science, PHD, Université Laval

### Courses

#### **STAT 200. QR: Med Biostat&Epidemiology. 3 Credits.**

Introductory design and analysis of medical studies. Epidemiological concepts, case-control and cohort studies. Clinical trials. Students evaluate statistical aspects of published health science studies. Prerequisite: STAT 111, STAT 141, STAT 143, or STAT 211.

#### **STAT 201. QR:Stat Computing&Data Anlysis. 3 Credits.**

Fundamental data processing, code development, graphing and analysis using statistical software packages, including SAS and R. Analysis of data and interpretation of results. Project-based. Prerequisite: STAT 141 or STAT 143 or STAT 211; or STAT 111 with Instructor permission.

#### **STAT 211. QR: Statistical Methods I. 3 Credits.**

Fundamental concepts for data analysis and experimental design. Descriptive and inferential statistics, including classical and nonparametric methods, regression, correlation, and analysis of variance. Statistical software. Prerequisite: Minimum Junior standing or STAT 141 or STAT 143 and Instructor permission.

#### **STAT 221. QR: Statistical Methods II. 3 Credits.**

Multiple regression and correlation. Basic experimental design. Analysis of variance (fixed, random, and mixed models). Analysis of covariance. Computer software usage. Prerequisite: STAT 143 or STAT 211 with a grade of C or better; or STAT 141 and Instructor permission.

#### **STAT 223. QR:Appld Multivariate Analysis. 3 Credits.**

Multivariate normal distribution. Inference for mean vectors and covariance matrices. Multivariate analysis of variance (MANOVA), discrimination and classification, principal components, factor and cluster analysis. Prerequisite: STAT 221, matrix algebra recommended.

#### **STAT 224. QR:Stats for Quality&Productvty. 3 Credits.**

Statistical process control; Shewhart, cusum and other control charts; process capability studies. Total Quality Management. Acceptance, continuous, sequential sampling. Process design and improvement. Case studies. Prerequisite: STAT 141, STAT 143, or STAT 211.

#### **STAT 229. QR:Survivl/Logistic Regression. 3 Credits.**

Models and inference for time-to-event and binary data. Censored data, life tables, Kaplan-Meier estimation, logrank tests, proportional hazards models. Logistic regression-interpretation, assessment, model building, special topics. Prerequisite: STAT 221.

#### **STAT 231. QR: Experimental Design. 3 Credits.**

Randomization, complete and incomplete blocks, cross-overs, Latin squares, covariance analysis, factorial experiments, confounding, fractional factorials, nesting, split plots, repeated measures, mixed models, response surface optimization. Prerequisite: STAT 221; or STAT 211 and STAT 201.

#### **STAT 235. QR: Categorical Data Analysis. 3 Credits.**

Measures of association and inference for categorical and ordinal data in multiway contingency tables. Log linear and logistic regression models. Prerequisite: STAT 211.

**STAT 241. QR: Statistical Inference. 3 Credits.**

Introduction to statistical theory: related probability fundamentals, derivation of statistical principles, and methodology for parameter estimation and hypothesis testing. Prerequisites: A grade of C or better in one of STAT 151, STAT 153, or STAT 251; STAT 141 or equivalent; MATH 121.

**STAT 251. QR: Probability Theory. 3 Credits.**

Distributions of random variables and functions of random variables. Expectations, stochastic independence, sampling and limiting distributions (central limit theorems). Concepts of random number generation. Prerequisite: MATH 121; STAT 151 or STAT 153 recommended.

**STAT 253. QR: Appl Time Series&Forecastng. 3 Credits.**

Autoregressive moving average (Box-Jenkins) models, autocorrelation, partial correlation, differencing for nonstationarity, computer modeling. Forecasting, seasonal or cyclic variation, transfer function and intervention analysis, spectral analysis.

**STAT 261. QR: Statistical Theory. 3 Credits.**

Point and interval estimation, hypothesis testing, and decision theory. Application of general statistical principles to areas such as nonparametric tests, sequential analysis, and linear models. Prerequisite: STAT 251.

**STAT 287. QR: Data Science I. 3 Credits.**

Data harvesting, cleaning, and summarizing; working with non-traditional, non-numeric data (social network, natural language textual data, etc.); scientific visualization using static and interactive infographics; a practical focus on real datasets, and developing good habits for rigorous and reproducible computational science; Project-based. Prerequisites: CS 020 or CS 021; STAT 141 or STAT 143 or STAT 211; CS 110 and MATH 122/124 recommended. Cross-listed with: CS 287, CSYS 287.

**STAT 288. QR: Statistical Learning. 3 Credits.**

Statistical learning methods and applications to modern problems in science, industry, and society. Topics include: linear model selection, cross-validation, lasso and ridge regression, tree-based methods, bagging and boosting, support vector machines, and unsupervised learning. Prerequisites: STAT 143, STAT 183 or STAT 211. Cross-listed with: CS 288.

**STAT 330. Bayesian Statistics. 3 Credits.**

Introduction to Bayesian inference. Posterior inference, predictive distributions, prior distribution selection. MCMC algorithms. Hierarchical models. Model checking and selection. Use of computer software. Pre/co-requisite: STAT 241 or STAT 251 or Instructor permission.

**STAT 360. Linear Models. 3 Credits.**

Theory of linear models, least squares and maximum likelihood estimation, fixed, random and mixed models, variance component estimation, introduction to generalized linear models, bootstrapping. Prerequisites: STAT 261 and knowledge of matrix algebra or Instructor permission.

**STAT 369. Applied Geostatistics. 3 Credits.**

Introduction to the theory of regionalized variables, geostatistics (kriging techniques): special topics in multivariate analysis; Applications to real data subject to spatial variation are emphasized. Prerequisites: STAT 223; CS 020 or CS 021; or Instructor permission. Cross-listed with: CE 369, CSYS 369.

**STAT 381. Statistical Research. 1-3 Credits.**

Methodologic or data analytic research culminating in oral and written reports to the faculty. Prerequisite: Instructor permission.

**STAT 385. Consulting Practicum. 1-3 Credits.**

Supervised field work in statistical consulting. Experiences may include advising UVM faculty and students or clients in applied settings such as industry and government agencies. Prerequisites: Second year Graduate standing in Statistics or Biostatistics and permission of Statistics Program Director.

**STAT 387. Data Science II. 3 Credits.**

Advanced data analysis, collection, and filtering; statistical modeling, monte carlo statistical methods, and in particular Bayesian data analysis, including necessary probabilistic background material; a practical focus on real datasets and developing good habits for rigorous and reproducible computational science. Prerequisite: STAT 287 or CS 287 or CSYS 287 or Instructor permission. Cross-listed with: CS 387, CSYS 387.

**STAT 391. Master's Thesis Research. 1-6 Credits.****STAT 392. Independent Study. 1-18 Credits.**

A course which is tailored to fit the interests of a specific student, which occurs outside the traditional classroom/laboratory setting under the supervision of a faculty member, for which credit is awarded. Offered at department discretion.

**STAT 395. Advanced Special Topics. 1-18 Credits.**

Lectures or directed readings on advanced and contemporary topics not presently included in other statistics courses. Prerequisites: As listed in schedule of courses.