

STATISTICS

Overview and Contact Information

Statistics is used in most professions, in most sectors of the economy, and in a great many academic areas. Each year some students enter graduate programs in statistics, or in allied fields (business, economics, education, or psychology). Many students enter the job market and later pursue advanced degrees.

Contact Information

Gary Gillis, Chair
Connell Heady, Academic Department Coordinator

415A Clapp Laboratory
 413-538-2162
<https://www.mtholyoke.edu/academics/find-your-program/statistics>
 (https://www.mtholyoke.edu/academics/find-your-program/statistics/)

Learning Goals

We welcome all students into the Statistics major, and we aim to create an inclusive, supportive environment for everyone. Statistics majors have the following learning goals:

- Communicate statistical concepts and their interpretation, with statistical colleagues and with a wider audience
- Describe key statistical methods and the reasoning behind them
- Use appropriate statistical and computational methods to explore data and draw conclusions
- Ask questions about new methods and applications, learn new techniques, and make new discoveries
- Incorporate “big picture” reasoning, including ethics, practicality, and creativity, into statistical practice
- Develop the independence to approach new problems, and the ability to collaborate effectively.

Faculty

This area of study is administered by the Department of Mathematics and Statistics:

Margaret Robinson, Julia and Sarah Ann Adams Professor of Mathematics, Teaching Fall Only

Timothy Chumley, Associate Professor of Mathematics on the John Stewart Kennedy Foundation

Alanna Hoyer-Leitzel, Associate Professor of Mathematics

Jennifer Paulhus, Associate Professor of Mathematics

Dylan Shepardson, Robert L. Rooke Associate Professor of Mathematics

Laura Tupper, Associate Professor of Statistics, On Leave 2024-2025

Isabelle Beaudry, Assistant Professor of Statistics

Chassidy Bozeman, Clare Boothe Luce Assistant Professor of Mathematics

Victoria Day, Assistant Professor of Mathematics

Laura Lyman, Clare Booth Luce Assistant Professor of Statistics

Lidia Mrad, Assistant Professor of Mathematics

Derek Young, Assistant Professor of Mathematics

Benjamin Pittman-Polletta, Visiting Assistant Professor in Statistics

Robert Quarles, Visiting Assistant Professor in Mathematics and Statistics

Cristian Rodriguez Avila, Visiting Assistant Professor in Mathematics

Arie Shaus, Visiting Assistant Professor in Data Science

Sean Hart, Visiting Instructor in Mathematics

Ishfaaq Mohammed Imtiyas, Visiting Instructor in Statistics

Requirements for the Major

A minimum of 36 credits:

Code	Title	Credits
As a prerequisite for MATH-203:		
MATH-101	Calculus I	
MATH-102	Calculus II	
MATH-203	Calculus III	4
MATH-211	Linear Algebra	4
As a prerequisite for STAT-242:		
STAT-140	Introduction to the Ideas and Applications of Statistics	
STAT-242	Intermediate Statistics	4
STAT-340	Applied Regression Methods	4
MATH-342	Probability	4
STAT-343	Mathematical Statistics	4
12 additional credits in mathematics or statistics at the 200-level or above ¹		12
Total Credits		36

¹ A 300-level course that contains substantial mathematical or statistical content in another discipline may be used to fulfill at most 4 credits toward the major with prior departmental approval.

Students considering developing a special major in statistics and economics should consult the Special Major (<http://catalog.mtholyoke.edu/areas-study/special-major/>) chapter.

Requirements for the Minor

A minimum of 16 credits:

Code	Title	Credits
At least one 200-level course in statistics		4
At least one 300-level course in statistics		4
Two additional courses in mathematics or statistics at the 200 level or above		8
Total Credits		16

Additional Specifications

Substitutions are possible with the permission of the department. Students planning a minor in statistics should consult one of the statistics advisors.

With departmental permission, students who have already completed one 100-level exploration course may elect to enroll in a second exploration course at the 200-level so that it may be counted toward the minor.

Course Advice

Beginning the Study of Statistics

A natural way to begin if you have not studied statistics is with STAT-140, Introduction to the Ideas and Applications of Statistics.

A 200-level course in statistics is a good choice if you have taken an advanced placement statistics course or have taken the equivalent of a 100-level statistics course.

Advice to Students with Special Interests

Actuarial science

Students interested in this area should plan to cover the material that is included in the first two actuarial exams as part of their undergraduate program. This material is included in Calculus I (MATH-101), Calculus II (MATH-102), Calculus III (MATH-203), Probability (MATH-342), and Mathematical Statistics (STAT-343), along with Macroeconomic Theory (ECON-211), Microeconomic Theory (ECON-212), and Economics of Corporate Finance (ECON-215). Students are also encouraged to obtain experience through an internship.

Biostatistics, public health, or natural resources

Students interested in these areas should include substantial work in biology, chemistry, geology, and/or environmental studies in their programs.

Economics or business

Many students with these interests design a special major (<http://catalog.mtholyoke.edu/areas-study/special-major/>) in mathematics and economics or a special major (<http://catalog.mtholyoke.edu/areas-study/special-major/>) in statistics and economics.

Engineering

Students interested in engineering often double-major in mathematics and physics and/or participate in one of the College's five-year, dual-degree programs with Dartmouth's Thayer School of Engineering, or California Institute of Technology, or the University of Massachusetts (see the Other Degree and Certificate Programs chapter).

Graduate school

Students preparing for graduate school in statistics or mathematics often participate in an undergraduate research program in the summer after the junior year and continue with an honors thesis in the senior year. Students considering graduate work in statistics at the level of a Ph.D. are encouraged to include abstract algebra and especially MATH-301.

Teaching certification

Students interested in pursuing certification for middle school or secondary school should major in mathematics rather than statistics. However, there is increasing emphasis on statistics in secondary school, and any of the applied courses would provide good preparation.

Course Offerings

STAT-140 Introduction to the Ideas and Applications of Statistics

Fall and Spring. Credits: 4

This course provides an overview of statistical methods, their conceptual underpinnings, and their use in various settings taken from current news, as well as from the physical, biological, and social sciences. Topics will include exploring distributions and relationships, planning for data production, sampling distributions, basic ideas of inference (confidence intervals and hypothesis tests), inference for distributions, and inference for relationships, including chi-square methods for two-way tables and regression.

Applies to requirement(s): Math Sciences

I. Imtiyas, B. Pittman-Polletta

Advisory: 2 years of high school algebra

STAT-242 Intermediate Statistics

Fall and Spring. Credits: 4

In this course, students will learn how to analyze data arising from a broad array of observational and experimental studies. Topics covered will include exploratory graphics, description techniques, the fitting and assessment of statistical models, hypothesis testing, and communication of results. Specific topics may include multiple regression, ANOVA, and non-linear regression. Statistical software will be used.

Applies to requirement(s): Math Sciences

I. Beaudry, L. Lyman

Prereq: STAT-140 or equivalent.

STAT-244 Intermediate Topics in Statistics

STAT-244MP Intermediate Topics in Statistics: 'Survey Sampling'

Not Scheduled for This Year. Credits: 4

In this course, students will explore statistical techniques for designing and analyzing complex survey designs. Sample surveys are used to obtain data on demography, health, and development; to measure attitudes and beliefs; to estimate natural resources; to evaluate the impact of social programs; along with many other uses. The proper design and analysis of these surveys is crucial to their utility. We will cover topics including survey design, estimation, poststratification, imputation, and survey error. We will also apply these methods by frequently using real (and often messy) survey data through assignments and projects. The analysis of the data will be performed through R programming. Background should include estimation, confidence intervals and hypothesis testing.

Applies to requirement(s): Math Sciences

I. Beaudry

Prereq: STAT-140.

Notes: No prior knowledge of the statistical software R is required.

STAT-244NF Intermediate Topics in Statistics: 'Infectious Disease Modeling'

Not Scheduled for This Year. Credits: 4

Infectious disease has plagued humanity since time immemorial. Statistical models serve a critical role in improving understanding of the progression and proliferation of infection in a population, as well as the impact of interventions in stopping the spread of disease. In this course, we will explore regression and compartmental model-based approaches, which will be motivated by some of the most impactful epidemics and pandemics in recent history, including HIV/AIDS, Ebola, Zika, and COVID-19. R statistical software will be used.

Applies to requirement(s): Math Sciences

M. Ozanne

Prereq: STAT-140.

STAT-244NP Intermediate Topics in Statistics: 'Nonparametric Statistics'

Not Scheduled for This Year. Credits: 4

The methods taught in traditional statistics courses are based on assumptions that are often not satisfied by real data sets. In this course we will learn about approaches that require fewer assumptions, known as nonparametric methods. After taking this course, students will be able to examine assumptions for different approaches to statistical inference, compare nonparametric statistical tests such as sign and Wilcoxon tests to their parametric equivalents, and implement nonparametric approaches using R. In addition, the course will incorporate computational techniques for statistical analysis, including simulation, permutation tests, and bootstrapping.

Applies to requirement(s): Math Sciences

The department

Prereq: STAT-140.

Advisory: Students should have experience with the programming language R.

STAT-244SC Intermediate Topics in Statistics: 'Computational Statistics'

Spring. Credits: 4

Computation is now an essential component of several modern statistical methods. This course will introduce students to computationally intensive techniques in statistics and explore the role of computation as a tool for discovery. Specifically, it will emphasize simulation-based, rather than calculus-based, approaches in statistical theory. Topics may include sampling algorithms, numerical analysis, and missing data. All data analysis in the course will be performed using R software. Research applications will be emphasized through assignments and student-defined projects.

Applies to requirement(s): Math Sciences

L. Lyman

Prereq: STAT-140.

Advisory: Students should have experience with the programming language R.

STAT-295 Independent Study

Fall and Spring. Credits: 1 - 4

The department

Instructor permission required.

Advisory: The permission of the department is required for independent work to count toward the major or minor.

STAT-331 Design of Experiments

Not Scheduled for This Year. Credits: 2

How do you get informative research results? By doing the right experiment in the first place. We'll look at the techniques used to plan experiments that are both efficient and statistically sound, the analysis of the resulting data, and the conclusions we can draw from that analysis. Using a framework of optimal design, we'll examine the theory both of classical designs and of alternatives when those designs aren't appropriate. On the applied side, we'll use R to explore real-world experimental data from science, industry, and everyday life; and we'll discuss key principles for working with expert (and not-so-expert) collaborators to help them set up the experiments they need.

Applies to requirement(s): Math Sciences

The department

Prereq: STAT-242.

STAT-340 Applied Regression Methods

Fall and Spring. Credits: 4

This course includes methods for choosing, fitting, evaluating, and comparing statistical models; introduces statistical inference; and analyzes data sets taken from research projects in the natural, physical, and social sciences.

Applies to requirement(s): Math Sciences

I. Imtiyas

Prereq: MATH-211 and STAT-242.

STAT-343 Mathematical Statistics

Spring. Credits: 4

This course is an introduction to the mathematical theory of statistics and to the application of that theory to the real world. Topics include probability, random variables, special distributions, introduction to estimation of parameters, and hypothesis testing.

Applies to requirement(s): Math Sciences

I. Beaudry

Prereq: MATH-102 and MATH-342.

STAT-344 Seminar in Statistics and Scientific Research**STAT-344ND Seminar in Statistics and Scientific Research: 'Analysis of Neural Data'**

Spring. Credits: 4

Neuroscience addresses big questions about the mind by studying the structure and function of the brain – questions like: How do we remember, learn, and make decisions? Why do we feel emotions and experience consciousness? What causes mental illness? This increasingly means analyzing datasets that are large, complex, high dimensional, and time varying. Neural data analysis employs a unique set of concepts and approaches drawing on statistics, mathematics, physics, and computer science. In this course, we will apply these techniques to real neural datasets through hands-on activities and a final independent project. Possible topics include statistical modeling of neuronal spiking data; analysis of high-dimensional data with spatial structure (e.g., EEG, fMRI); and techniques in time series analysis (e.g., autoregressive modeling, time-frequency decomposition, network connectivity, causality).

Crosslisted as: NEURO-309ND

Applies to requirement(s): Math Sciences

B. Pittman-Polletta

Prereq: STAT-242.

Advisory: Students who have completed courses in allied fields on research methods (e.g., PSYCH-204 and NEURO-221) or computational and mathematical techniques (e.g., COMSC-335 and PHYS-205) may also be qualified. Contact the instructor to discuss.

STAT-344TM Seminar in Statistics and Scientific Research: 'Time Series Analysis'

Not Scheduled for This Year. Credits: 4

Time series – data collected across time – show up in a vast range of application areas, from climate to economics to music. But they can have special behaviors, like seasonality, memory, and directionality, that require some special treatment! We'll look at tools for describing, modeling, and predicting time series behavior. Topics include decomposition, ARIMA, exponential smoothing, dynamic regression, and a foray into the frequency domain. We'll apply these concepts using real datasets in R.

Applies to requirement(s): Math Sciences

L. Tupper

Prereq: STAT-242 and MATH-211.

Advisory: Previous or concurrent registration in STAT-340 (or other multiple regression experience) is recommended.

STAT-351 Bayesian Statistics

Fall. Credits: 4

Bayesian statistics refers to a statistical paradigm that has its roots in Bayes' theorem, where prior belief and data can be combined to update our understanding of a particular problem in what is known as the posterior. In this class, you can expect to combine your knowledge of probability and statistics to develop and apply Bayesian thinking to statistical modeling. Possible topics include conjugate families, posterior simulation, regression and classification, and hierarchical modeling. R statistical software will be used.

Applies to requirement(s): Math Sciences

M. Ozanne

Prereq: MATH-342 and STAT-242.

Advisory: Students may substitute another 200-level Statistics course for STAT-242 with instructor permission.

STAT-395 Independent Study

Fall and Spring. Credits: 1 - 8

The department

Instructor permission required.

Advisory: The permission of the department is required for independent work to count toward the major or minor.