The focus is on preparation for a mathematical study of probability

BASED INTRO TO STATISTICS

and statistical theory and methods should take

Students seeking a foundation for further study of probability theory

is on the elements of data analysis. It is recommended for pre-med

maturity, but who may not have taken a course in calculus, and the focus

Statistics should take

suitable for students seeking to satisfy the Barnard quantitative

REASONING

interested in statistical concepts, who plan on consuming, but not

The Department offers several introductory courses. Students

212-851-2130;

Department Administrator:

212-853-1395;

Statistics:

212-853-1398;

Statistics:

Economics:

Computer Science: Augustin Chaintreau, 610 CEPSR; 212-939-7082;

augustin@cs.columbia.edu (cannon@cs.columbia.edu)

Statistics: Ronald Neath, 612 Watson;

212-853-1398; rcn2112@columbia.edu

Statistics: Gabriel Young, 610 Watson;

212-853-1395; gjy2107@columbia.edu (rcn2112@columbia.edu)

Economics - Statistics Major Advising:

Economics: Susan Elmes, 1006 IAB; 212-854-9124; se5@columbia.edu

Statistics: Ronald Neath, 612 Watson;

212-853-1398; rcn2112@columbia.edu

Statistics: Gabriel Young, 610 Watson;

212-853-1395; gjy2107@columbia.edu (rcn2112@columbia.edu)

Mathematics - Statistics Major Advising:

Mathematics: Julien Dubedat, 601 Mathematics;

212-854-8806; jd2653@columbia.edu

Statistics: Ronald Neath, 612 Watson;

212-853-1398; rcn2112@columbia.edu

Statistics: Gabriel Young, 610 Watson;

212-853-1395; gjy2107@columbia.edu (rcn2112@columbia.edu)

Political Science - Statistic Major Advising:

Political Science: Naoki Egami, 734 IAB; 212-854-3623;

naoki.egami@columbia.edu (ryks3@columbia.edu)

Statistics: Ronald Neath, 612 Watson;

212-853-1398; rcn2112@columbia.edu

Statistics: Gabriel Young, 610 Watson;

212-853-1395; gjy2107@columbia.edu (rcn2112@columbia.edu)

Department Administrator:

Dood Kalicharan, 1003 School of Social Work;

212-851-2130; dk@stat.columbia.edu

The Department offers several introductory courses. Students

interested in statistical concepts, who plan on consuming, but not

creating statistics, should take STAT UN1001 INTRO TO STATISTICAL

REASONING. The course is designed for students who have taken

a pre-calculus course, and the focus is on general principles. It is

suitable for students seeking to satisfy the Barnard quantitative

reasoning requirements. Students seeking an introduction to applied

statistics should take STAT UN1101 INTRODUCTION TO STATISTICS.

The course is designed for students who have some mathematical

maturity, but who may not have taken a course in calculus, and the focus

is on the elements of data analysis. It is recommended for pre-med

students, and students contemplating the concentration in statistics.

Students seeking a foundation for further study of probability theory

and statistical theory and methods should take STAT UN1201 CALC-

BASED INTRO TO STATISTICS. The course is designed for students

who have taken a semester of college calculus or the equivalent, and

the focus is on preparation for a mathematical study of probability

and statistics. It is recommended for students seeking to complete

the prerequisite for econometrics, and for students contemplating the

major in statistics. Students seeking a one-semester calculus-based

survey of probability theory and statistical theory and methods should

take STAT GU4001 INTRODUCTION TO PROBABILITY AND STATISTICS.

This course is designed for students who have taken calculus, and is

meant as a terminal course. It provides a somewhat abridged

version of the more demanding sequence STAT GU4203 PROBABILITY

THEORY and STAT GU4204 STATISTICAL INFERENCE. While some

mathematically mature students take the more demanding sequence as

an introduction to the field, it is generally recommended that students

prepare for the sequence by taking STAT UN1201 CALC-BASED INTRO TO

STATISTICS.

The Department offers the Major in Statistics, the Concentration

in Statistics, and interdisciplinary majors with Computer Science,

Economics, Mathematics, and Political Science. The concentration is

suitable for students preparing for work or study where substantial skills

in data analysis are valued and may be taken without mathematical

prerequisites. The concentration consists of a sequence of six courses

in applied statistics, but students may substitute statistics electives

numbered 4203 or above with permission of the concentration advisors.

The major consists of mathematical and computational prerequisites,

an introductory course, and five core courses in probability theory and

theoretical and applied statistics together with three electives. The

training in the undergraduate major is comparable to a masters degree in

statistics.

Students may wish to consult the following guidelines when undertaking

course planning. It is advisable to take STAT UN1101 INTRODUCTION

TO STATISTICS and STAT UN2102 Applied Statistical Computing before

taking any of the more advanced concentration courses, STAT UN2103

APPLIED LINEAR REG ANALYSIS, STAT UN2104 APPL CATEGORICAL

DATA ANALYSIS, STAT UN3105 APPLIED STATISTICAL METHODS, and

STAT UN3106 APPLIED MACHINE LEARNING. It is advisable to take

STAT UN1201 CALC-BASED INTRO TO STATISTICS, STAT GU4203

PROBABILITY THEORY, STAT GU4204 STATISTICAL INFERENCE, and STAT

GU4205 LINEAR REGRESSION MODELS in sequence. Courses in stochastic

analysis should be preceded by STAT GU4203 PROBABILITY THEORY, and for many students, it is advisable to take

STAT GU4207 ELEMENTARY STOCHASTIC PROCESS before embarking

on STAT GU4262 Stochastic Processes for Finance, STAT GU4264

STOCHASTIC PROCESSES-APPLICTNS I, or STAT GU4265 STOCHASTIC

METHODS IN FINANCE. Most of the statistics courses numbered from

4221 to 4234 are best preceded by STAT GU4205 LINEAR REGRESSION

MODELS. The data science courses STAT GU4206 STAT COMP # INTRO

DATA SCIENCE, STAT GU4241 STATISTICAL MACHINE LEARNING, and

STAT GU4242 Advanced Machine Learning should be taken in sequence.

Advanced Placement

The Department offers three points of advanced credit for a score of

5 on the AP statistics exam. Students who are required to take an

introductory statistics course for their major should check with their

major advisor to determine whether this credit provides exemption from

their requirement.

Departmental Honors

Students are considered for department honors on the basis of GPA

and the comprehensiveness and difficulty of their course work in the

Department. The Department is generally permitted to nominate one

tenth of graduating students for departmental honors.
Undergraduate Research in Statistics and the Summer Internship

Matriculated students who will be undergraduates at Columbia College, Barnard College, the School of General Studies, or the School of Engineering and Applied Sciences may apply to the Department’s summer internship program. The internship provides summer housing and a stipend. Students work with Statistics Department faculty mentors. Applicants should send a brief statement of interest and a copy of their transcript to Ms. Dood Kalicharan in the Statistics Department office by the end of March to be considered. If summer project descriptions are posted on the Department’s website, please indicate in the statement of interest which project is of interest. Students seeking research opportunities with Statistics Department faculty during the academic year are advised to be entrepreneurial and proactive: identify congenial faculty whose research is appealing, request an opportunity to meet, and provide some indication of previous course work when asking for a project.

Professors
David Blei (with Computer Science)
John Cunningham
Richard R. Davis
Victor H. de la Peña
Andrew Gelman (with Political Science)
Ioannis Karatzas (with Mathematics)
Jingchen Liu
Shaw-Hwa Lo
Marcel Nutz (with Mathematics)
Liam Paninski
Philip Protter
Daniel Rabinowitz
Bodhisattva Sen
Michael Sobel
Simon Tavaré (with Biological Sciences)
Zhiliang Ying
Ming Yuan
Tian Zheng (Chair)

Associate Professors
Samory Kpotufe
Arian Maleki
Sumit Mukherjee

Assistant Professors
Marco Avella
Yuqi Gu
Cynthia Rush
Anne van Delft

Term Assistant Professors
Carsten Chong
Gokce Dayanikli
Yongchen Kwon
Johannes Wiesel

Adjunct Faculty
Demissie Alemayehu
Mark Brown
Guy Cohen
Regina Dolgoarshinnykh
Hammou El Barmi
Tat Seng Fung
Xiaofu He
Ying Liu
Ka-Yi Ng
Ha Nguyen
Cristian Pasarica
Kamrarr Rahnama Rad
Ori Shental
Haiyuan Wang
Rongning Wu

Lecturers in Discipline
Banu Baydil
Anthony Donoghue
Wayne Lee
Dobrin Marchev
Ronald Neath
Alex Pijyan
David Rios
Joyce Robbins
Gabriel Young

Major in Statistics
The requirements for this program were modified in March 2016. Students who declared this program before this date should contact the director of undergraduate studies for the department in order to confirm their options for major requirements.

The major should be planned with the director of undergraduate studies. Courses taken for a grade of Pass/D/Fail, or in which the grade of D has been received, do not count toward the major. The requirements for the major are as follows:

Mathematics and Computer Science Prerequisites
- MATH UN1101 CALCULUS I
- MATH UN1102 CALCULUS II
- MATH UN1201 CALCULUS III
- MATH UN2010 LINEAR ALGEBRA

One of the following five courses
- COMS W1007 Honors Introduction to Computer Science
- ENGI E1006 INTRO TO COMP FOR ENG/APP SCI
- COMS W1005 Introduction to Computer Science and Programming in MATLAB
- STAT UN2102 Applied Statistical Computing
- COMS W1004 Introduction to Computer Science and Programming in Java

Core courses in probability and statistics
- STAT UN1201 CALC-BASED INTRO TO STATISTICS

Chenyang Zhong
Minor in Statistics
Courses taken for a grade of Pass/D/Fail, or in which the grade of D, has been received do not count towards the minor. The requirements for the minor are as follows.

STAT UN1101 INTRODUCTION TO STATISTICS
STAT UN2102 Applied Statistical Computing
STAT UN2103 APPLIED LINEAR REG ANALYSIS
STAT UN2104 APPL CATEGORICAL DATA ANALYSIS
STAT UN3105 APPLIED STATISTICAL METHODS
STAT UN3106 APPLIED MACHINE LEARNING

- Students may replace courses required for the minor by approved Statistics Department courses.

Major in Mathematics-Statistics
The program is designed to prepare the student for: (1) a career in industries such as finance and insurance that require a high level of mathematical sophistication and a substantial knowledge of probability and statistics; and (2) graduate study in quantitative disciplines. Students choose electives in finance, actuarial science, operations research, or other quantitative fields to complement requirements in mathematics, statistics, and computer science.

Courses taken for a grade of Pass/D/Fail, or in which the grade of D has been received, do not count toward the major. The requirements for the major are as follows:

Mathematics
Select one of the following sequences:
MATH UN1101 CALCULUS I
MATH UN1102 CALCULUS II
MATH UN1201 CALCULUS III
MATH UN2010 LINEAR ALGEBRA
MATH UN2500 ANALYSIS AND OPTIMIZATION
OR
MATH UN1101 CALCULUS I
MATH UN1102 CALCULUS II
MATH UN1205 ACCELERATED MULTIVARIABLE CALC
MATH UN2010 LINEAR ALGEBRA

Three approved electives in statistics or, with permission, a cognate field.

- Students preparing for a career in actuarial science are encouraged to replace MATH GU4205 LINEAR REGRESSION MODELS with STAT GU4282 Linear Regression and Time Series Methods, and should take as one of their electives STAT GU4281 Theory of Interest.
- Students preparing for graduate study in statistics are encouraged to replace two electives with MATH GU4061 INTRO MODERN ANALYSIS I and MATH GU4062 INTRO MODERN ANALYSIS II.

Statistics

- Students interested in modeling applications are recommended to take MATH UN3027 Ordinary Differential Equations and MATH UN3028 PARTIAL DIFFERENTIAL EQUATIONS.
- Students interested in finance are recommended to include among their electives MATH GR5010 INTRO TO THE MATH OF FINANCE, STAT GU4261 STATISTICAL METHODS IN FINANCE, and STAT GU4221 TIME SERIES ANALYSIS.
- Students interested in graduate study in mathematics or in statistics are recommended to take MATH GU4061 INTRO MODERN ANALYSIS I and MATH GU4062 INTRO MODERN ANALYSIS II.
- Students preparing for a career in actuarial science are encouraged to replace MATH GU4205 LINEAR REGRESSION MODELS with STAT GU4282 Linear Regression and Time Series Methods, and to take among their electives STAT GU4281 Theory of Interest.

Introductory Courses
Students interested in statistical concepts, but who do not anticipate undertaking statistical analyses, should take STAT UN1101 Introduction to Statistical Reasoning. Students seeking an introduction to applied statistics or preparing for the concentration should take STAT UN1101 Introduction to Statistics (without calculus). Students seeking a foundation for further study of probability theory and statistical theory and methods should take STAT UN1201 Calculus-based Introduction to Statistics. Students seeking a one-semester calculus-based survey should take STAT GU4001 Introduction to Probability and Statistics.
undergraduate seminar STAT UN1202 features faculty lectures prepared with undergraduates in mind; students may attend without registering.

**STAT UN1001 INTRO TO STATISTICAL REASONING. 3.00 points.**
A friendly introduction to statistical concepts and reasoning with emphasis on developing statistical intuition rather than on mathematical rigor. Topics include design of experiments, descriptive statistics, correlation and regression, probability, chance variability, sampling, chance models, and tests of significance.

**STAT UN1101 INTRODUCTION TO STATISTICS. 3.00 points.**
Prerequisites: intermediate high school algebra. Designed for students in fields that emphasize quantitative methods. Graphical and numerical summaries, probability, theory of sampling distributions, linear regression, analysis of variance, confidence intervals and hypothesis testing. Quantitative reasoning and data analysis. Practical experience with statistical software. Illustrations are taken from a variety of fields. Data-collection/analysis project with emphasis on study designs is part of the coursework requirement.

**STAT UN1201 CALC-BASED INTRO TO STATISTICS. 3.00 points.**
Prerequisites: one semester of calculus. Designed for students who desire a strong grounding in statistical concepts with a greater degree of mathematical rigor than in STAT W1111. Random variables, probability distributions, pdf, cdf, mean, variance, correlation, conditional distribution, conditional mean and conditional variance, law of iterated expectations, distributions, pdf, cdf, mean, variance, correlation, conditional distribution, confidence intervals and hypothesis testing. Maximum likelihood estimation. Serves as the pre-requisite for ECON W3412.
STAT UN1202 UNDERGRADUATE SEM/STATISTICS. 1.00 point.
Prerequisites: Previous or concurrent enrollment in a course in statistics would make the talk more accessible. Prepared with undergrduates majoring in quantitative disciplines in mind, the presentations in this colloquium focus on the interface between data analysis, computation, and theory in interdisciplinary research. Meetings are open to all undergraduates, whether registered or not. Presenters are drawn from the faculty of department in Arts and Sciences, Engineering, Public Health and Medicine.

Fall 2023: STAT UN1202

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<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
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<th>Enrollment</th>
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<td>STAT 1202</td>
<td>001/13337</td>
<td>F 10:10am - 12:00pm</td>
<td>Ronald Neath</td>
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<td>8/25</td>
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</table>

STAT GU4001 INTRODUCTION TO PROBABILITY AND STATISTICS. 3.00 points.
Prerequisites: Calculus through multiple integration and infinite sums. A calculus-based tour of the fundamentals of probability theory and statistical inference. Probability models, random variables, useful distributions, conditioning, expectations, law of large numbers, central limit theorem, point and confidence interval estimation, hypothesis tests, linear regression. This course replaces SIEO 4150.

Spring 2023: STAT GU4001

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<th>Course Number</th>
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<td>Isabella</td>
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<td>STAT 4001</td>
<td>002/14243</td>
<td>T Th 6:10pm - 7:25pm</td>
<td>Carsten Chong</td>
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Fall 2023: STAT GU4001

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<tr>
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<td>001/13343</td>
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<td>Isabella</td>
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Applied Statistics Concentration Courses
The applied statistics sequence, together with an introductory course, forms the concentration in applied statistics. STAT UN2102 Applied statistical computing may be used to satisfy the computing requirement for the major, and the other concentration courses may be used to satisfy the elective requirements for the major. (Students who sat STAT GU4205 Linear Regression for the major would find that they have covered essentially all of the material in STAT UN2103 Applied Linear Regression Analysis.

STAT UN2102 Applied Statistical Computing. 3.00 points.
Corequisites: An introductory course in statistic (STAT UN1101 is recommended).
Corequisites: An introductory course in statistic (STAT UN1101 is recommended). This course is an introduction to R programming. After learning basic programming component, such as defining variables and vectors, and learning different data structures in R, students will, via project-based assignments, study more advanced topics, such as conditionals, modular programming, and data visualization. Students will also learn the fundamental concepts in computational complexity, and will practice writing reports based on their data analyses.

Spring 2023: STAT UN2102

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<th>Course Number</th>
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<td>T Th 4:10pm - 5:25pm</td>
<td>Alex Pijyan</td>
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Fall 2023: STAT UN2102

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<th>Course Number</th>
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<td>Alex Pijyan</td>
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STAT UN2103 APPLIED LINEAR REG ANALYSIS. 3.00 points.
Prerequisites: An introductory course in statistics (STAT UN1101 is recommended). Students without programming experience in R might find STAT UN2102 very helpful. Develops critical thinking and data analysis skills for regression analysis in science and policy settings. Simple and multiple linear regression, non-linear and logistic models, random-effects models. Implementation in a statistical package. Emphasis on real-world examples and on planning, proposing, implementing, and reporting.

Spring 2023: STAT UN2103

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<th>Course Number</th>
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<td>Daniel</td>
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<td>STAT 2103</td>
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<td>Wayne Lee</td>
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Fall 2023: STAT UN2103

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<th>Course Number</th>
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<td>001/14239</td>
<td>M W 8:40am - 9:55am</td>
<td>Ronald Neath</td>
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STAT UN2104 APPL CATEGORICAL DATA ANALYSIS. 3.00 points.
Prerequisites: STAT UN2103 is strongly recommended. Students without programming experience in R might find STAT UN2102 very helpful.
Prerequisites: STAT UN2103 is strongly recommended. Students without programming experience in R might find STAT UN2102 very helpful. This course covers statistical models and methods for analyzing and drawing inferences for problems involving categorical data. The goals are familiarity and understanding of a substantial and integrated body of statistical methods that are used for such problems, experience in analyzing data using these methods, and proficiency in communicating the results of such methods, and the ability to critically evaluate the use of such methods. Topics include binomial proportions, two-way and three-way contingency tables, logistic regression, log-linear models for large multi-way contingency tables, graphical methods. The statistical package R will be used.

Spring 2023: STAT UN2104

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<th>Course Number</th>
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</table>
STAT UN3105 APPLIED STATISTICAL METHODS. 3.00 points.
Prerequisites: At least one, and preferably both, of STAT UN2103 and UN2104 are strongly recommended. Students without programming experience in R might find STAT UN2102 very helpful.
Prerequisites: At least one, and preferably both, of STAT UN2103 and UN2104 are strongly recommended. Students without programming experience in R might find STAT UN2102 very helpful. This course is intended to give students practical experience with statistical methods beyond linear regression and categorical data analysis. The focus will be on understanding the uses and limitations of models, not the mathematical foundations for the methods. Topics that may be covered include random and mixed-effects models, classical non-parametric techniques, the statistical theory causality, sample survey design, multi-level models, generalized linear regression, generalized estimating equations and over-dispersion, survival analysis including the Kaplan-Meier estimator, log-rank statistics, and the Cox proportional hazards regression model. Power calculations and proposal and report writing will be discussed.

Fall 2023: STAT UN3105
Course Number Section/Call Number Times/Location Instructor Points Enrollment
STAT 3105 001/13341 M W 2:40pm - 3:55pm Room TBA Alex Pijyan 3.00 41/86

STAT UN3106 APPLIED MACHINE LEARNING. 3.00 points.
Prerequisites: STAT UN2103. Students without programming experience in R might find STAT UN2102 very helpful.
Prerequisites: STAT UN2103. Students without programming experience in R might find STAT UN2102 very helpful. This course is a machine learning class from an application perspective. We will cover topics including data-based prediction, classification, specific classification methods (such as logistic regression and random forests), and basics of neural networks. Programming in homeworks will require R.

Spring 2023: STAT UN3106
Course Number Section/Call Number Times/Location Instructor Points Enrollment
STAT 3106 001/14240 T Th 2:40pm - 3:55pm 703 Hamilton Hall Gabriel Young 3.00 44/45

Foundation Courses
The calculus-based foundation courses for the core of the statistics major. These courses are GU4203 Probability Theory, GU4204 Statistical Inference, GU4205 Linear Regression, GU4206 Statistical Computing and Introduction to Data Science, and GU4207 Elementary Stochastic processes. Ideally, students would take Probability theory or the equivalent before taking either Statistical Inference or Elementary Stochastic Processes, and would have taken Statistical Inference before, or at least concurrently with taking Linear Regression Analysis, and would have taken Linear Regression analysis before, or at least concurrently, with taking the computing and data science course. A semester of calculus should be taken before Probability, additional semesters of calculus are recommended before Statistical Inference, and a course in linear algebra before Linear Regression is strongly recommended. For the more advanced electives in stochastic processes, Probability Theory is an essential prerequisite, and many students would benefit from taking Elementary Stochastic Processes, too. Linear Regression and the computing and data science course should be taken before the advanced electives in machine learning and data science. Linear Regression is a strongly recommended prerequisite, or at least co-requisite, for the remaining advanced statistical electives.

STAT GU4203 PROBABILITY THEORY
STAT GU4204 STATISTICAL INFEERENCE

Advanced Statistics Courses
Advanced statistics courses combine theory with methods and practical experience in data analysis. Undergraduates enrolling in advanced statistics courses would be well-advised to have completed STAT GU4203 (Probability Theory), GU4204 (Statistical Inference), and GU4205 (Linear Regression).

STAT GU4221 TIME SERIES ANALYSIS. 3.00 points.
Prerequisites: STAT GU4205 or the equivalent. Least squares smoothing and prediction, linear systems, Fourier analysis, and spectral estimation. Impulse response and transfer function. Fourier series, the fast Fourier transform, autocorrelation function, and spectral density. Univariate Box-Jenkins modeling and forecasting. Emphasis on applications. Examples from the physical sciences, social sciences, and business. Computing is an integral part of the course.

Spring 2023: STAT GU4221
Course Number Section/Call Number Times/Location Instructor Points Enrollment
STAT 4221 001/14253 T Th 6:10pm - 7:25pm 301 Uni Hall Gabriel Young 3.00 14/25

Fall 2023: STAT GU4221
Course Number Section/Call Number Times/Location Instructor Points Enrollment
STAT 4221 001/13356 T Th 6:10pm - 7:25pm Room TBA Rongning Wu 3.00 11/35

STAT GU4222 NONPARAMETRIC STATISTICS. 3.00 points.
CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: STAT GU4204 or the equivalent. Prerequisites: STAT GU4204 or the equivalent. Statistical inference without parametric model assumption. Hypothesis testing using ranks, permutations, and order statistics. Nonparametric analogs of analysis of variance. Non-parametric regression, smoothing and model selection.

Spring 2023: STAT GU4222
Course Number Section/Call Number Times/Location Instructor Points Enrollment
STAT 4222 001/14254 T Th 4:10pm - 5:25pm 614 Schermerhorn Hall Arian Maleki 3.00 4/25

STAT GU4223 MULTIVARIATE STAT INFEERENCE. 3.00 points.
Prerequisites: STAT GU4205 or the equivalent. Prerequisites: STAT GU4205 or the equivalent. Multivariate normal distribution, multivariate regression and classification; canonical correlation; graphical models and Bayesian networks; principal components and other models for factor analysis; SVD; discriminant analysis; cluster analysis.
STAT GU4224 BAYESIAN STATISTICS. 3.00 points.
Prerequisites: STAT GU4204 or the equivalent.
This course introduces the Bayesian paradigm for statistical inference. Topics covered include prior and posterior distributions: conjugate priors, informative and non-informative priors; one- and two-sample problems; models for normal data, models for binary data, Bayesian linear models; Bayesian computation: MCMC algorithms, the Gibbs sampler; hierarchical models; hypothesis testing, Bayes factors, model selection; use of statistical software. Prerequisites: A course in the theory of statistical inference, such as STAT GU4204 or the equivalent.

STAT GU4231 SURVIVAL ANALYSIS. 3.00 points.
Prerequisites: STAT GU4205 or the equivalent.
Prerequisites: STAT GU4205 or the equivalent. Survival distributions, types of censored data, estimation for various survival models, nonparametric estimation of survival distributions, the proportional hazard and accelerated lifetime models for regression analysis with failure-time data. Extensive use of the computer

STAT GU4232 GENERALIZED LINEAR MODELS. 3.00 points.
CC/GS: Partial Fulfillment of Science Requirement
Prerequisites: STAT GU4205 or the equivalent.
Prerequisites: STAT GU4205 or the equivalent. Statistical methods for rates and proportions, ordered and nominal categorical responses, contingency tables, odds-ratios, exact inference, logistic regression, Poisson regression, generalized linear models

STAT GU4233 Multilevel Models. 3 points.
Prerequisites: STAT GU4205 or the equivalent.
Theory and practice, including model-checking, for random and mixed-effects models (also called hierarchical, multi-level models). Extensive use of the computer to analyse data.

STAT GU4234 SAMPLE SURVEYS. 3.00 points.
Prerequisites: STAT GU4204 or the equivalent. Introductory course on the design and analysis of sample surveys. How sample surveys are conducted, why the designs are used, how to analyze survey results, and how to derive from first principles the standard results and their generalizations. Examples from public health, social work, opinion polling, and other topics of interest

STAT GU4241 STATISTICAL MACHINE LEARNING. 3.00 points.
Prerequisites: STAT GU4206.
Prerequisites: STAT GU4206. The course will provide an introduction to Machine Learning and its core models and algorithms. The aim of the course is to provide students of statistics with detailed knowledge of how Machine Learning methods work and how statistical models can be brought to bear in computer systems - not only to analyze large data sets, but to let computers perform tasks that traditional methods of computer science are unable to address. Examples range from speech recognition and text analysis through bioinformatics and medical diagnosis. This course provides a first introduction to the statistical methods and mathematical concepts which make such technologies possible

STAT GU4261 STATISTICAL METHODS IN FINANCE. 3.00 points.
Prerequisites: STAT GU4205 or the equivalent.
A fast-paced introduction to statistical methods used in quantitative finance. Financial applications and statistical methodologies are intertwined in all lectures. Topics include regression analysis and applications to the Capital Asset Pricing Model and multifactor pricing models, principal components and multivariate analysis, smoothing techniques and estimation of yield curves statistical methods for financial time series, value at risk, term structure models and fixed income research, and estimation and modeling of volatilities. Hands-on experience with financial data

STAT GU4263 STAT INF/TIME-SERIES MODELLING. 3.00 points.
Prerequisites: STAT GU4204 or the equivalent. STAT GU4205 is recommended. Modeling and inference for random processes, from natural sciences to finance and economics. ARMA, ARCH, GARCH and nonlinear models, parameter estimation, prediction and filtering. This is a core course in the MS program in mathematical finance. 

### Fall 2023: STAT GU4263

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<th>Times/Location</th>
<th>Instructor</th>
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<td>Sa 10:10am - 12:40pm</td>
<td>Franz Rembart</td>
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### STAT GU4291 ADVANCED DATA ANALYSIS. 3.00 points.
Prerequisites: STAT GU4205 and at least one statistics course numbered between GU4221 and GU4261. This is a course on getting the most out of data. The emphasis will be on hands-on experience, involving case studies with real data and using common statistical packages. The course covers, at a very high level, exploratory data analysis, model formulation, goodness of fit testing, and other standard and non-standard statistical procedures, including linear regression, analysis of variance, nonlinear regression, generalized linear models, survival analysis, time series analysis, and modern regression methods. Students will be expected to propose a data set of their choice for use as case study material. 

### Spring 2023: STAT GU4291

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### Fall 2023: STAT GU4291

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### Actuarial Sciences Courses

Only students preparing for a career in actuarial sciences should consider the courses in this section. Such students may also be interested in courses offered through the School of Professional Studies M.S. Program in Actuarial Science, but must check with the academic advisors in their schools to know whether they are allowed to register for those courses. Students majoring in statistics and preparing for a career in actuarial science may take STAT GU4282 (Regression and Time Series Analysis) in place of the major requirement STAT GU4205 (Linear Regression Analysis).

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<tr>
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<tr>
<td>STAT GU4282</td>
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<td>Linear Regression and Time Series Methods</td>
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### Advanced Stochastic Processes Courses

The stochastic processes electives in this section have STAT GU4203 (Probability Theory) or the equivalent as prerequisites. Most students would also benefit from taking STAT GU4207 (Elementary Stochastic Processes) before embarking on the more advanced stochastic processes electives.

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### Advanced Data Science Courses

In response to the ever growing importance of "big data" in scientific and policy endeavors, the last few years have seen an explosive growth in theory, methods, and applications at the interface between computer science and statistics. The Department offers a sequence that begins with the core course STAT GU4206 (Statistical Computing and Introduction to Data Science) and continues with the advanced electives GU4241 (Statistical Machine Learning) and GU4242 (Advanced Machine Learning), and also the advanced elective STAT GU4243 (Applied Data Science). Undergraduate students without experience in programming would likely benefit from taking the statistical computing and data science course before attempting GU4241, GU4242, or GU4243.