Statistics

Program of Study

The modern science of statistics involves the invention, study, and development of principles and methods for modeling uncertainty through mathematical probability; for designing experiments, surveys, and observational programs; and for analyzing and interpreting empirical data. Mathematics plays a major role in all statistical activity, whether of an abstract nature or dealing with specific techniques for analyzing data. Statistics is an excellent field for students with strong mathematical skills and an interest in applying these skills to problems in the natural and social sciences. A program leading to the bachelor’s degree in Statistics offers coverage of the principles and methods of statistics in combination with solid training in mathematics and some exposure to computing, which is essential to nearly all modern data analysis. In addition, there is considerable elective freedom enabling interested students to examine those areas of knowledge in the biological, physical, and social sciences that are often subjected to detailed statistical analysis. The major also provides a base for graduate study in statistics or in other subjects with strong quantitative components. Students considering graduate study in statistics or related fields are encouraged to discuss their programs with the Departmental Adviser for Majors at an early stage, whether or not they plan to receive an undergraduate degree in Statistics.

Students who are majoring in other fields of study may also complete a minor in Statistics and are encouraged to discuss their course choices with the Departmental Adviser for Minors. Information on the minor (p. 11) follows the description of the major.

General Course Information

Statistics Courses for Students in Other Majors

Courses at the 20000 level are designed to provide instruction in statistics, probability, and statistical computation for students from all parts of the University. These courses differ in emphasis on theory or methods, in the mathematical level, and in the direction of applications.

Explanations and comparisons of the various courses, both entry level and more advanced, are provided in the following sections. Students will also find the course descriptions (http://collegecatalog.uchicago.edu/thecollege/statistics/#courseinventory) to be helpful in choosing appropriate courses.

Introductory Courses and Sequences

To begin their studies in statistics, students can choose from several courses. Most of the introductory courses make intensive use of computers to exemplify and explore statistical concepts and methods. The nature and extent of computer work varies according to the course and instructor. The mathematics prerequisites are a useful guide to the level of mathematical maturity assumed by a statistics course.
Students and College advisers are encouraged to contact the Departmental Adviser for Introductory Courses for advice on choosing an appropriate first course.

For students who do not intend to continue to more advanced statistics courses, STAT 20000 Elementary Statistics is an alternative with no calculus prerequisite that places less emphasis on statistical techniques. STAT 20000 Elementary Statistics may not be taken by students who have already taken STAT 22000 Statistical Methods and Applications or STAT 23400 Statistical Models and Methods or by students who have received AP credit for STAT 22000 Statistical Methods and Applications.

Students with exposure to calculus might choose either STAT 22000 Statistical Methods and Applications or STAT 23400 Statistical Models and Methods. Students may count either STAT 22000 Statistical Methods and Applications or STAT 23400 Statistical Models and Methods, but not both, toward the forty-two credits required for graduation.

STAT 22000 Statistical Methods and Applications is a general introduction to statistical concepts, techniques, and applications to data analysis and to problems in the design, analysis, and interpretation of experiments and observational programs. Computers are used throughout the course. A score of 4 or 5 on the AP Statistics exam yields credit for STAT 22000 Statistical Methods and Applications, although this credit will not count toward the requirements for a major or minor in Statistics.

STAT 23400 Statistical Models and Methods covers much of the same material as STAT 22000 Statistical Methods and Applications, but at a somewhat higher mathematical level. The course is a one-quarter introduction to statistics that is appropriate for any student with a good command of univariate calculus.

STAT 24400-24500 Statistical Theory and Methods I-II is recommended for students who wish to have a thorough introduction to statistical theory and methodology. STAT 24400-24500 Statistical Theory and Methods I-II is more mathematically demanding than either STAT 22000 Statistical Methods and Applications or STAT 23400 Statistical Models and Methods and assumes some familiarity with multivariate calculus and with linear algebra.

As an alternative to STAT 24400-24500 Statistical Theory and Methods I-II, students can elect the three-quarter sequence consisting of STAT 25100 Introduction to Mathematical Probability followed by STAT 24410 Statistical Theory and Methods Ia and STAT 24500 Statistical Theory and Methods II. This alternative sequence (STAT 25100 Introduction to Mathematical Probability; STAT 24410 Statistical Theory and Methods Ia; STAT 24500 Statistical Theory and Methods II) is recommended for students majoring in Statistics and others who are interested in more extensive coverage of probability and statistics. STAT 24410 Statistical Theory and Methods Ia is an alternative version of STAT 24400 Statistical Theory and Methods I that requires STAT 25100 Introduction to Mathematical Probability as a prerequisite and that replaces some probability topics with additional statistical topics not normally covered in STAT 24400-24500 Statistical Theory and Methods I-II. Students may count either STAT 24400 Statistical Theory and Methods I or STAT 24410 Statistical Theory and Methods Ia, but not both, toward the forty-two credits required for graduation.
Students considering a major in Statistics are encouraged to begin with either STAT 24400-24500 Statistical Theory and Methods I-II or, preferably, with the alternative sequence (STAT 25100 Introduction to Mathematical Probability; STAT 24410 Statistical Theory and Methods I; STAT 24500 Statistical Theory and Methods II), rather than with STAT 23400 Statistical Models and Methods. Although students with a strong mathematical background can and do take either STAT 24400-24500 Statistical Theory and Methods I-II or the alternative sequence (STAT 25100 Introduction to Mathematical Probability; STAT 24410 Statistical Theory and Methods I; STAT 24500 Statistical Theory and Methods II) without prior course work in statistics or probability, some students find it helpful to take either STAT 22000 Statistical Methods and Applications or STAT 23400 Statistical Models and Methods as preparation.

Students considering a minor or major in Statistics and completing either STAT 22000 Statistical Methods and Applications or STAT 23400 Statistical Models and Methods prior to taking either STAT 24400-24500 Statistical Theory and Methods I-II or the alternative sequence (STAT 25100 Introduction to Mathematical Probability; STAT 24410 Statistical Theory and Methods I; STAT 24500 Statistical Theory and Methods II) are encouraged to contact the Departmental Adviser for Introductory Courses for advice on integrating these courses into a coherent degree program.

The core of the Statistics major consists of three courses: STAT 25100 Introduction to Mathematical Probability, either STAT 24400 Statistical Theory and Methods I or STAT 24410 Statistical Theory and Methods Ia, and STAT 24500 Statistical Theory and Methods II. This is recommended as a three-quarter cognate sequence for students in the quantitative sciences and mathematics. Note that STAT 25100 Introduction to Mathematical Probability may be taken before, after, or concurrently with STAT 24400-24500 Statistical Theory and Methods I-II, though it is a prerequisite for STAT 24410 Statistical Theory and Methods Ia.

Additional Courses in Statistical Theory, Methods, and Applications

For students interested in exploring statistical methods and their applications, STAT 22200 Linear Models and Experimental Design, STAT 22400 Applied Regression Analysis, STAT 22600 Analysis of Categorical Data, and STAT 22700 Biostatistical Methods are recommended. These courses each emphasize a class of methods for the analysis of data. Note that because there is some overlap between STAT 22600 Analysis of Categorical Data and STAT 22700 Biostatistical Methods, only one of these two courses, not both, may be counted toward a major or minor in Statistics. The courses STAT 22200 Linear Models and Experimental Design, STAT 22400 Applied Regression Analysis, and STAT 22600 Analysis of Categorical Data may be taken in any order. Each presumes a previous course in statistics (STAT 22000 Statistical Methods and Applications or higher) and experience using computers in data analysis (as in STAT 22000 Statistical Methods and Applications). STAT 22700 Biostatistical Methods has STAT 22400 Applied Regression Analysis as a prerequisite.

For students who have completed STAT 24500 Statistical Theory and Methods II and are interested in more advanced statistical methodology courses, STAT 24610 Pattern Recognition, STAT 26100 Time Dependent Data, STAT 27400...
Nonparametric Inference, and STAT 34300 Applied Linear Statistical Methods are recommended. In addition to STAT 34300 Applied Linear Statistical Methods, many other graduate courses in Statistics offer opportunities for further study of statistical theory, methods, and applications. For details, consult the instructor or the Departmental Adviser for Majors, or visit the graduate course announcements (collegecatalog.uchicago.edu/graduate/departmentofstatistics/#courseinventory).

Courses in Probability

Students interested in probability can begin with STAT 25100 Introduction to Mathematical Probability, which can be taken separately from any statistics courses and can be supplemented with more advanced probability courses, such as STAT 25300 Introduction to Probability Models or MATH 23500 Markov Chains, Martingales, and Brownian Motion. Students with a strong mathematical background can take STAT 31200 Introduction to Stochastic Processes I, STAT 31300 Introduction to Stochastic Processes II, STAT 38100 Measure-Theoretic Probability I, and STAT 38300 Measure-Theoretic Probability III.

Courses in Machine Learning

A student with a strong computer science background and some knowledge of elementary statistics could take STAT 27725 Machine Learning. Other courses in the category of machine learning include the advanced statistical methodology courses STAT 24610 Pattern Recognition and STAT 27400 Nonparametric Inference. Graduate course offerings in machine learning include STAT 37601 Machine Learning and Large-Scale Data Analysis and STAT 37710 Machine Learning.

Courses in Optimization

A student with a strong mathematical background could take STAT 28000 Optimization. Graduate course offerings in optimization include STAT 31015 Mathematical Computation IIA: Convex Optimization.

GRADING

Students who are majoring or minoring in Statistics must receive a quality grade of at least C- in all of the courses required for their major or minor program in Statistics. Subject to College and divisional regulations, and with the consent of the instructor, students may register for either quality grades or for P/F grading in any 20000-level Statistics course that is not counted toward a major or minor in Statistics. A grade of P is given only for work of C- quality or higher.

The following policy applies to students who wish to receive a mark of I for a Statistics course. In addition to submitting the official Incomplete Form required by the College, students must have completed at least half of the total required course work with a grade of C- or better, and they must be unable to complete the remaining course work by the end of the quarter due to an emergency. Students requesting a mark of I for STAT 20000 Elementary Statistics, STAT 22000 Statistical Methods and Applications, or STAT 23400 Statistical Models and Methods must obtain approval from both the current instructor and the Departmental Adviser for Introductory Courses.
Program Requirements for Majors

Every candidate must obtain approval of his or her course program from the Departmental Adviser for Majors. Students majoring in Statistics should meet the general education requirement in mathematical sciences with courses in calculus. The major program includes four additional prescribed mathematics courses and four prescribed statistics courses. Students should complete the four mathematics courses by the end of their third year. Additional requirements include three approved elective courses in Statistics, as well as one prescribed course in Computer Science for the BA or two prescribed courses in Computer Science for the BS. The BS also requires an approved two-quarter sequence at the 20000 level in a field to which statistics can be applied. Students who are majoring in Statistics must receive a quality grade of at least C- in all of the courses required for their degree. A grade of P is not acceptable for any of these courses.

Prescribed Mathematics Courses

The four prescribed mathematics courses include a Calculus III requirement (MATH 13300 Elementary Functions and Calculus III or MATH 15300 Calculus III or MATH 16300 Honors Calculus III) and a Linear Algebra requirement (STAT 24300 Numerical Linear Algebra or MATH 25500 Basic Algebra II or MATH 25800 Honors Basic Algebra II). Note that MATH 19620 Linear Algebra may not be used to meet the Linear Algebra requirement.

For the BA, one of the following sequences is required: MATH 20000-20100 Mathematical Methods for Physical Sciences I-II or MATH 20400-20500 Analysis in R^n II-III or MATH 20800-20900 Honors Analysis in R^n II-III. For the BS, students must take one of the following three courses: MATH 20000 Mathematical Methods for Physical Sciences I or MATH 20500 Analysis in R^n III or MATH 20900 Honors Analysis in R^n III, and, in addition, one of the following two courses: MATH 20100 Mathematical Methods for Physical Sciences II or MATH 27300 Basic Theory of Ordinary Differential Equations.

Students who are completing majors in both Statistics and Economics should follow the same mathematics requirements as Statistics majors. Students who have already taken MATH 19520 Mathematical Methods for Social Sciences and MATH 19620 Linear Algebra should discuss with the Departmental Adviser for Majors how best to meet the mathematics requirements for the Statistics major. For example, such students can petition to meet the requirements by taking both MATH 20100 Mathematical Methods for Physical Sciences II and STAT 24300 Numerical Linear Algebra.

Prescribed Statistics Courses

The four prescribed Statistics courses are STAT 25100 Introduction to Mathematical Probability, either STAT 24400 Statistical Theory and Methods I or STAT 24410 Statistical Theory and Methods Ia (but not both), STAT 24500 Statistical Theory and Methods II, and either STAT 22400 Applied Regression Analysis or STAT 34300 Applied Linear Statistical Methods. It is recommended that majors take either STAT 25100 Introduction to Mathematical Probability or STAT 24400 Statistical Theory and Methods I as their first course in probability and statistics.
However, if a more elementary introduction is desired, a student may take either STAT 22000 Statistical Methods and Applications or STAT 23400 Statistical Models and Methods (but not both) as additional preparation for either STAT 24400-24500 Statistical Theory and Methods I-II or STAT 24410 Statistical Theory and Methods Ia.

Electives

Candidates for the BA are required to take three electives, at least two of which must be on List B below. The third elective may be chosen from Lists B, C, or D. If an elective from List D is chosen, it must have been taken before STAT 24400 Statistical Theory and Methods I (or STAT 24410 Statistical Theory and Methods Ia). Students may count either STAT 22600 Analysis of Categorical Data or STAT 22700 Biostatistical Methods, but not both, toward the BA.

Candidates for the BS are required to take three electives. A candidate for the BS who has not taken STAT 34300 Applied Linear Statistical Methods as one of the four prescribed statistics courses must take at least one elective from List A below, a second elective from List B, and a third elective from either List B or C. A candidate for the BS who has taken STAT 34300 Applied Linear Statistical Methods as one of the four prescribed statistics courses must take at least two electives from List B and a third elective from either List B or C. Courses from List D cannot count toward the BS in Statistics. Students may count either STAT 22600 Analysis of Categorical Data or STAT 22700 Biostatistical Methods, but not both, toward the BS.

Note: The following lists may change from time to time as courses change and new courses are added. Please consult the Departmental Adviser for Majors for approval of your electives.

**LIST A: Advanced Statistical Methodology**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAT 24610</td>
<td>Pattern Recognition</td>
</tr>
<tr>
<td>STAT 26100</td>
<td>Time Dependent Data</td>
</tr>
<tr>
<td>STAT 27400</td>
<td>Nonparametric Inference</td>
</tr>
</tbody>
</table>

Some additional graduate courses in Statistics (must be approved by Departmental Adviser for Majors)

**LIST B: Statistical Methodology**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAT 22200</td>
<td>Linear Models and Experimental Design</td>
</tr>
<tr>
<td>STAT 22600</td>
<td>Analysis of Categorical Data *</td>
</tr>
<tr>
<td>STAT 22700</td>
<td>Biostatistical Methods *</td>
</tr>
<tr>
<td>STAT 24610</td>
<td>Pattern Recognition</td>
</tr>
<tr>
<td>STAT 26100</td>
<td>Time Dependent Data</td>
</tr>
<tr>
<td>STAT 26700</td>
<td>History of Statistics</td>
</tr>
<tr>
<td>STAT 27400</td>
<td>Nonparametric Inference</td>
</tr>
<tr>
<td>STAT 37601</td>
<td>Machine Learning and Large-Scale Data Analysis</td>
</tr>
</tbody>
</table>

Some additional graduate courses in Statistics (must be approved by Departmental Adviser for Majors)
Students may count either STAT 22600 Analysis of Categorical Data or STAT 22700 Biostatistical Methods, but not both, toward the major.

LIST C: Other Upper Level/Graduate Courses

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>MATH 23500</td>
<td>Markov Chains, Martingales, and Brownian Motion</td>
</tr>
<tr>
<td>STAT 25300</td>
<td>Introduction to Probability Models</td>
</tr>
<tr>
<td>STAT 27725</td>
<td>Machine Learning</td>
</tr>
<tr>
<td>STAT 28000</td>
<td>Optimization</td>
</tr>
<tr>
<td>STAT 30900</td>
<td>Mathematical Computation I: Matrix Computation Course</td>
</tr>
<tr>
<td>STAT 31015</td>
<td>Mathematical Computation IIA: Convex Optimization</td>
</tr>
<tr>
<td>STAT 31020</td>
<td>Mathematical Computation IIB: Nonlinear Optimization</td>
</tr>
<tr>
<td>STAT 31060</td>
<td>Further Mathematical Computation: Matrix Computation &amp; Optimization</td>
</tr>
<tr>
<td>STAT 31200</td>
<td>Introduction to Stochastic Processes I</td>
</tr>
<tr>
<td>STAT 35000</td>
<td>Principles of Epidemiology</td>
</tr>
<tr>
<td>STAT 37710</td>
<td>Machine Learning</td>
</tr>
</tbody>
</table>

Some additional graduate courses in Statistics (must be approved by Departmental Adviser for Majors)

LIST D: Introductory Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAT 22000</td>
<td>Statistical Methods and Applications</td>
</tr>
<tr>
<td>STAT 23400</td>
<td>Statistical Models and Methods</td>
</tr>
</tbody>
</table>

Computer Science Requirement

Candidates for the BA are required to take one of the following computer science courses: CMSC 10500 Fundamentals of Computer Programming I or CMSC 10600 Fundamentals of Computer Programming II or CMSC 12100 Computer Science with Applications I or CMSC 15100 Introduction to Computer Science I or CMSC 16100 Honors Introduction to Computer Science I. For the BA, CMSC 10600 Fundamentals of Computer Programming II or higher is preferred. Candidates for the BS are required to take one of the following sequences: CMSC 12100-12200 Computer Science with Applications I-II or CMSC 15100-15200 Introduction to Computer Science I-II or CMSC 16100-16200 Honors Introduction to Computer Science I-II.

BS Requirement of Two-Quarter Sequence in a Field to Which Statistics Can Be Applied

Candidates for the BS (but not the BA) are required to take an approved, two-quarter sequence at the 20000 level in a field to which statistics can be applied. Generally this sequence should be in the natural or social sciences, but a sequence in another discipline may be acceptable. Courses in MATH or CMSC may not be used for this requirement. Sequences in which the first course is a prerequisite for the second are preferred. Example sequences include BIOS 20197 Evolution and Ecology-BIOS 20198 Biodiversity, CHEM 22000-22100 Organic Chemistry I-II, CHEM 26100-26200 Quantum Mechanics; Thermodynamics, ECON 20000-20100 The Elements of Economic Analysis I-II, GEOS 21000 Introduction to Mineralogy-GEOS 21100 Introduction to Petrology, PHYS 22500-22700 Intermediate Electricity and
Magnetism I-II, and PHYS 23400-23500 Quantum Mechanics I-II. All sequences must be approved by the Departmental Adviser for Majors.

**SUMMARY OF REQUIREMENTS FOR THE BA IN STATISTICS**

### GENERAL EDUCATION

<table>
<thead>
<tr>
<th>One of the following sequences:</th>
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<tbody>
<tr>
<td>MATH 13100-13200</td>
<td>Elementary Functions and Calculus I-II</td>
</tr>
<tr>
<td>MATH 15100-15200</td>
<td>Calculus I-II</td>
</tr>
<tr>
<td>MATH 16100-16200</td>
<td>Honors Calculus I-II</td>
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Total Units: 200

### MAJOR

<table>
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<tr>
<th>One of the following:</th>
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<tbody>
<tr>
<td>MATH 13300</td>
<td>Elementary Functions and Calculus III</td>
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<tr>
<td>MATH 15300</td>
<td>Calculus III</td>
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<td>MATH 16300</td>
<td>Honors Calculus III</td>
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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>MATH 20000-20100</td>
<td>Mathematical Methods for Physical Sciences I-II</td>
</tr>
<tr>
<td>MATH 20400-20500</td>
<td>Analysis in Rn II-III</td>
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<tr>
<td>MATH 20800-20900</td>
<td>Honors Analysis in Rn II-III</td>
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<table>
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<th>One of the following:</th>
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<tbody>
<tr>
<td>STAT 24300</td>
<td>Numerical Linear Algebra</td>
</tr>
<tr>
<td>MATH 25500</td>
<td>Basic Algebra II</td>
</tr>
<tr>
<td>MATH 25800</td>
<td>Honors Basic Algebra II</td>
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<tbody>
<tr>
<td>STAT 24400</td>
<td>Statistical Theory and Methods I</td>
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<tr>
<td>STAT 24410</td>
<td>Statistical Theory and Methods Ia</td>
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<tbody>
<tr>
<td>STAT 24500</td>
<td>Statistical Theory and Methods II</td>
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<tr>
<td>STAT 25100</td>
<td>Introduction to Mathematical Probability</td>
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<tbody>
<tr>
<td>STAT 22400</td>
<td>Applied Regression Analysis</td>
</tr>
<tr>
<td>STAT 34300</td>
<td>Applied Linear Statistical Methods</td>
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<table>
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<tr>
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<tbody>
<tr>
<td>CMSC 10500</td>
<td>Fundamentals of Computer Programming I</td>
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</tbody>
</table>
CMSC 10600  Fundamentals of Computer Programming II
CMSC 12100  Computer Science with Applications I
CMSC 15100  Introduction to Computer Science I
CMSC 16100  Honors Introduction to Computer Science I

Three approved elective courses in Statistics *** 300

Total Units 1200

* Credit may be granted by examination.
** CMSC 10600 Fundamentals of Computer Programming II or higher preferred
*** At least two of the electives must be on List B. The third elective may be chosen from List B, C, or D. If an elective from List D is chosen, it must have been taken before STAT 24400 Statistical Theory and Methods I (or STAT 24410 Statistical Theory and Methods Ia). Students may count either STAT 22600 Analysis of Categorical Data or STAT 22700 Biostatistical Methods, but not both, toward the BA.

SUMMARY OF REQUIREMENTS FOR THE BS IN STATISTICS

GENERAL EDUCATION

One of the following sequences: 200

<table>
<thead>
<tr>
<th>MATH 13100-13200</th>
<th>Elementary Functions and Calculus I-II</th>
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</thead>
<tbody>
<tr>
<td>MATH 15100-15200</td>
<td>Calculus I-II</td>
</tr>
<tr>
<td>MATH 16100-16200</td>
<td>Honors Calculus I-II</td>
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Total Units 200

MAJOR

One of the following: 100

<table>
<thead>
<tr>
<th>MATH 13300</th>
<th>Elementary Functions and Calculus III</th>
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<tbody>
<tr>
<td>MATH 15300</td>
<td>Calculus III</td>
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<td>MATH 16300</td>
<td>Honors Calculus III</td>
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One of the following: 100

<table>
<thead>
<tr>
<th>MATH 20000</th>
<th>Mathematical Methods for Physical Sciences I</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 20500</td>
<td>Analysis in Rn III</td>
</tr>
<tr>
<td>MATH 20900</td>
<td>Honors Analysis in Rn III</td>
</tr>
</tbody>
</table>

One of the following: 100

<table>
<thead>
<tr>
<th>MATH 20100</th>
<th>Mathematical Methods for Physical Sciences II</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 27300</td>
<td>Basic Theory of Ordinary Differential Equations</td>
</tr>
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</table>

One of the following: 100

<table>
<thead>
<tr>
<th>STAT 24300</th>
<th>Numerical Linear Algebra</th>
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<tbody>
<tr>
<td>MATH 25500</td>
<td>Basic Algebra II</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>MATH 25800</td>
<td>Honors Basic Algebra II</td>
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<tr>
<td>One of the following:</td>
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<tr>
<td>STAT 24400</td>
<td>Statistical Theory and Methods I</td>
</tr>
<tr>
<td>STAT 24410</td>
<td>Statistical Theory and Methods Ia</td>
</tr>
<tr>
<td>Both of the following:</td>
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<tr>
<td>STAT 24500</td>
<td>Statistical Theory and Methods II</td>
</tr>
<tr>
<td>STAT 25100</td>
<td>Introduction to Mathematical Probability</td>
</tr>
<tr>
<td>One of the following:</td>
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</tr>
<tr>
<td>STAT 22400</td>
<td>Applied Regression Analysis</td>
</tr>
<tr>
<td>STAT 34300</td>
<td>Applied Linear Statistical Methods</td>
</tr>
<tr>
<td>One of the following sequences:</td>
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<tr>
<td>CMSC 12100-12200</td>
<td>Computer Science with Applications I-II</td>
</tr>
<tr>
<td>CMSC 15100-15200</td>
<td>Introduction to Computer Science I-II</td>
</tr>
<tr>
<td>CMSC 16100-16200</td>
<td>Honors Introduction to Computer Science I-II</td>
</tr>
<tr>
<td>Three approved elective courses in Statistics **</td>
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</tr>
<tr>
<td>A coherent two-quarter sequence at the 20000 level in a field to which statistics can be applied ***</td>
<td></td>
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</table>

| Total Units | 1500 |

* Credit may be granted by examination.

** A candidate for the BS who has **not** taken STAT 34300 Applied Linear Statistical Methods as one of the four prescribed statistics courses must take at least one elective from List A, a second elective from List B, and a third elective from either List B or C. A candidate for the BS who **has** taken STAT 34300 Applied Linear Statistical Methods as one of the four prescribed statistics courses must take at least two electives from List B and a third elective from either List B or C. Courses from List D cannot count toward the BS in Statistics. Students may count either STAT 22600 Analysis of Categorical Data or STAT 22700 Biostatistical Methods, but not both, toward the BS.

*** Generally, this sequence should be in the natural or social sciences, but a sequence in another discipline might be acceptable. Courses in MATH or CMSC may not be used for this requirement. Sequences in which the first course is a prerequisite for the second are preferred. Example sequences include BIOS 20197 Evolution and Ecology-BIOS 20198 Biodiversity, CHEM 22000-22100 Organic Chemistry I-II, CHEM 26100-26200 Quantum Mechanics; Thermodynamics, ECON 20000-20100 The Elements of Economic Analysis I-II, GEOS 21000 Introduction to Mineralogy-GEOS 21100 Introduction to Petrology, PHYS 22500-22700 Intermediate Electricity and Magnetism I-II, and PHYS 23400-23500 Quantum Mechanics I-II. All sequences must be approved by the Departmental Adviser for Majors.
HONORS

The BA or BS with honors is awarded to students with Statistics as their primary major who have a GPA of 3.0 or higher overall and 3.25 or higher in the courses in the major and also complete an approved honors paper (STAT 29900 Bachelor’s Paper). This paper is typically based on a structured research program that the student undertakes with faculty supervision, in the first quarter of his or her fourth year. Eligible students who wish to be considered for honors should consult the Departmental Adviser for Majors before the end of their third year. The research paper or project used to meet this requirement may not be used to meet the bachelor’s paper or project requirement in another major or course. NOTE: Credit for STAT 29900 Bachelor’s Paper will not count towards the courses required for a major in Statistics.

JOINT BA/MS OR BS/MS IN STATISTICS

This program enables unusually well-qualified undergraduate students to complete an MS in Statistics along with a BA or BS during their four years at the College. Although a student may receive a BA or BS in any field, a program of study other than Statistics is recommended.

Only a small number of students will be selected for the program through a competitive admissions process. Participants must apply to the MS program in Statistics by June 1 of their third year for admission to candidacy for an MS in Statistics during their fourth year. To be considered, students should have completed almost all of their undergraduate requirements, including all of their general education and language competence requirements, by the end of their third year. They should also have completed, at a minimum, both STAT 24400 Statistical Theory and Methods I (or STAT 24410 Statistical Theory and Methods Ia) and STAT 24500 Statistical Theory and Methods II with A or A- grades and all the mathematics requirements for the Statistics major with very high grades. While these are the minimum criteria, admission is competitive, and additional qualifications may be needed. Interested students are strongly encouraged to consult both the Departmental Adviser for Majors and their College adviser early in their third year.

Participants in the joint BA/MS or BS/MS program must meet the same requirements as students in the MS program in Statistics. Of the nine courses that are required at the appropriate level, up to three may also meet the requirements of an undergraduate program. For example, STAT 24400-24500 Statistical Theory and Methods I-II and STAT 24610 Pattern Recognition, which are required for the MS in Statistics, could also be used to meet part of the requirements of a BA or BS program in Mathematics for courses outside of Mathematics.

Other requirements include a master’s paper and participation in the Consulting Program of the Department of Statistics. For details, visit http://www.stat.uchicago.edu/admissions.

MINOR PROGRAM IN STATISTICS

The focus in the minor is on statistical methodology, whereas the Statistics major has a substantial theoretical component. The minor in Statistics requires
five courses, some prescribed and some electives. Students begin the minor with an introductory course. If the introductory course is a required component of a student's major, the student must choose an additional elective to complete the five-course Statistics minor. Students with AP credit for the introductory course STAT 22000 Statistical Methods and Applications can choose either an additional elective or an introductory course to complete the five-course Statistics minor. In no case can AP credit for STAT 22000 Statistical Methods and Applications count toward the requirements for a minor in Statistics.

All students considering the Statistics minor are encouraged to plan their program early in consultation with the Departmental Adviser for Minors.

Courses in the minor may not be double-counted toward the student's major(s), other minors, or general education requirements. No student at the University of Chicago may count both STAT 22000 Statistical Methods and Applications or STAT 23400 Statistical Models and Methods toward the forty-two credits required for graduation.

Students planning a Statistics minor who have completed either STAT 22000 Statistical Methods and Applications or STAT 23400 Statistical Models and Methods and later plan to take STAT 24500 Statistical Theory and Methods II should consult the Departmental Adviser for Minors. In no case can more than one introductory course be included in the minor.

Students who are minoring in Statistics must receive a quality grade of at least C- in all of the courses required for the minor. A grade of P is not acceptable for any of these courses. More than half of the requirements for the minor must be met by registering for courses bearing University of Chicago course numbers.

Summary of Requirements for the Minor in Statistics

Students may satisfy the requirements for the Statistics minor using one of two program plans.

PROGRAM PLAN A

<table>
<thead>
<tr>
<th>Section</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>One of the following introductory courses:*</td>
<td>100</td>
</tr>
<tr>
<td>STAT 22000 Statistical Methods and Applications</td>
<td></td>
</tr>
<tr>
<td>STAT 23400 Statistical Models and Methods</td>
<td></td>
</tr>
<tr>
<td>STAT 24500 Statistical Theory and Methods II **</td>
<td></td>
</tr>
<tr>
<td>One required statistical topics course:</td>
<td>100</td>
</tr>
<tr>
<td>STAT 22400 Applied Regression Analysis</td>
<td></td>
</tr>
<tr>
<td>Three electives on statistical topics</td>
<td>300</td>
</tr>
<tr>
<td>Total Units</td>
<td>500</td>
</tr>
</tbody>
</table>

* Students with AP credit for STAT 22000 Statistical Methods and Applications may choose either program Plan A or Plan B. Students completing Plan A with either STAT 22000 Statistical Methods and Applications or STAT 23400 Statistical Models and Methods forgo AP credit for STAT 22000 Statistical Methods and Applications.
** If STAT 24500 Statistical Theory and Methods II is used as the introductory course in the minor, then the prerequisite STAT 24400 Statistical Theory and Methods I or STAT 24410 Statistical Theory and Methods Ia may not be counted toward the minor, but may be counted toward another major.

PROGRAM PLAN B

This plan is appropriate when the introductory Statistics course is a required component of a student’s major. Students with AP credit for STAT 22000 Statistical Methods and Applications are not required to take an introductory Statistics course and may use this plan to satisfy the five-course Statistics minor requirement.

One required statistical topics course:  
STAT 22400 Applied Regression Analysis

Four electives on statistical topics

Total Units 500

Electives

Candidates for the Statistics minor are required to take three or four electives, depending on the choice of program Plan A or Plan B. One elective must be from List A below. The other two electives may be chosen from List A, B, or C.

LIST A: Core Statistical Methodology

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAT 22200</td>
<td>Linear Models and Experimental Design</td>
</tr>
<tr>
<td>STAT 22600</td>
<td>Analysis of Categorical Data</td>
</tr>
<tr>
<td>STAT 22700</td>
<td>Biostatistical Methods</td>
</tr>
</tbody>
</table>

* Students may count either STAT 22600 Analysis of Categorical Data or STAT 22700 Biostatistical Methods, but not both, toward the minor. STAT 22600 Analysis of Categorical Data is offered by the Department of Statistics, while STAT 22700 Biostatistical Methods is scheduled and offered by the Department of Public Health Sciences (http://healthbsd.uchicago.edu).

LIST B: Other Statistical Methodology

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAT 26700</td>
<td>History of Statistics</td>
</tr>
<tr>
<td>STAT 31900</td>
<td>Introduction to Causal Inference</td>
</tr>
<tr>
<td>STAT 35000</td>
<td>Principles of Epidemiology</td>
</tr>
<tr>
<td>STAT 35201</td>
<td>Introduction to Clinical Trials</td>
</tr>
<tr>
<td>STAT 35600</td>
<td>Applied Survival Analysis</td>
</tr>
<tr>
<td>STAT 35700</td>
<td>Epidemiologic Methods</td>
</tr>
<tr>
<td>STAT 35800</td>
<td>Statistical Applications</td>
</tr>
<tr>
<td>STAT 36900</td>
<td>Applied Longitudinal Data Analysis</td>
</tr>
<tr>
<td>SOCI 20112</td>
<td>Applications of Hierarchical Linear Models</td>
</tr>
</tbody>
</table>
The 30000-level courses in List B are scheduled and offered by the Department of Public Health Sciences (http://health.bsd.uchicago.edu). Undergraduates may enroll in 30000-level courses by instructor consent.

**LIST C: Advanced Statistical Methodology**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAT 24610</td>
<td>Pattern Recognition</td>
</tr>
<tr>
<td>STAT 26100</td>
<td>Time Dependent Data</td>
</tr>
<tr>
<td>STAT 27400</td>
<td>Nonparametric Inference</td>
</tr>
<tr>
<td>STAT 33100</td>
<td>Sample Surveys</td>
</tr>
<tr>
<td>STAT 37601</td>
<td>Machine Learning and Large-Scale Data Analysis</td>
</tr>
</tbody>
</table>

Courses in List C may have advanced prerequisites in mathematics, statistics, and/or computer science. The 30000-level courses in List C are offered by the Departments of Statistics or Computer Science. Undergraduates may enroll in 30000-level courses by instructor consent.

For any electives, students are advised to confirm the recommended prerequisites listed in the course descriptions (p. 14).

The statistical topics courses on List A, List B, and List C are approved electives for the minor. The lists may change from time to time as courses change and new courses are introduced. Please consult the Departmental Adviser for Minors for approval of electives. Students may petition the Departmental Adviser for Minors for approval of another course. Such courses must have a minimum statistics prerequisite of introductory statistics (STAT 22000 Statistical Methods and Applications, STAT 23400 Statistical Models and Methods, or STAT 24500 Statistical Theory and Methods II).


Students who elect the minor program in Statistics must meet with the Departmental Adviser for Minors before the end of Spring Quarter of their third year to declare their intention to complete the minor. The approval for the minor program, signed by the Departmental Adviser for Minors, should be submitted to a student’s College adviser by the deadline above on the Consent to Complete a Minor Program Form obtained from the student’s College adviser or downloaded from the College Forms and Petitions (https://college.uchicago.edu/advising/forms-and-petitions).

College-level Statistics courses are shown below. Graduate-level courses can be found on the Department of Statistics page of the Graduate Announcements (collegecatalog.uchicago.edu/graduate/departmentofstatistics/#courseinventory).
STATISTICS COURSES

STAT 20000. Elementary Statistics. 100 Units.
This course introduces statistical concepts and methods for the collection, presentation, analysis, and interpretation of data. Elements of sampling, simple techniques for analysis of means, proportions, and linear association are used to illustrate both effective and fallacious uses of statistics.
Terms Offered: Autumn, Winter, Spring
Note(s): Students with credit for STAT 22000 or 23400 not admitted. This course is recommended for students who do not plan to take advanced statistics courses, and it may not be used in the Statistics major or minor. This course meets one of the general education requirements in the mathematical sciences.

STAT 22000. Statistical Methods and Applications. 100 Units.
This course introduces statistical techniques and methods of data analysis, including the use of computers. Examples are drawn from the biological, physical, and social sciences. Students are required to apply the techniques discussed to data drawn from actual research. Topics include data description, graphical techniques, exploratory data analyses, random variation and sampling, one- and two-sample problems, analysis of variance, linear regression, and analysis of discrete data.
Terms Offered: Autumn, Winter, Spring
Prerequisite(s): Two quarters of calculus
Note(s): Students may count either STAT 22000 or 23400, but not both, toward the forty-two credits required for graduation.

STAT 22200. Linear Models and Experimental Design. 100 Units.
This course covers principles and techniques for the analysis of experimental data and the planning of the statistical aspects of experiments. Topics include linear models; analysis of variance; randomization, blocking, and factorial designs; confounding; and incorporation of covariate information.
Terms Offered: Spring
Prerequisite(s): STAT 22000 or 23400 or 24500

STAT 22400. Applied Regression Analysis. 100 Units.
This course introduces the methods and applications of fitting and interpreting multiple regression models. The primary emphasis is on the method of least squares and its many varieties. Topics include the examination of residuals, the transformation of data, strategies and criteria for the selection of a regression equation, the use of dummy variables, tests of fit, nonlinear models, biases due to excluded variables and measurement error, and the use and interpretation of computer package regression programs. The techniques discussed are illustrated by many real examples involving data from both the natural and social sciences. Matrix notation is introduced as needed.
Terms Offered: Autumn, Spring
Prerequisite(s): STAT 22000 or 23400 or 24500 or PBHS 32100
Equivalent Course(s): PBHS 32400
STAT 22600. Analysis of Categorical Data. 100 Units.
This course covers statistical methods for the analysis of structured, counted data. Topics may include Poisson, multinomial, and product-multinomial sampling models; chi-square and likelihood ratio tests; log-linear models for cross-classified counted data, including models for data with ordinal categories and log-multiplicative models; logistic regression and logit linear models; and measures of association. Applications in the social and biological sciences are considered, and the interpretation of models and fits, rather than mathematical details of computational procedures, is emphasized.
Terms Offered: Winter
Prerequisite(s): STAT 22000 or 23400 or 24500
Equivalent Course(s): PBHS 32600

STAT 22700. Biostatistical Methods. 100 Units.
This course is designed to provide students with tools for analyzing categorical, count, and time-to-event data frequently encountered in medicine, public health, and related biological and social sciences. This course emphasizes application of the methodology rather than statistical theory (e.g., recognition of the appropriate methods; interpretation and presentation of results). Methods covered include contingency table analysis, Kaplan-Meier survival analysis, Cox proportional-hazards survival analysis, logistic regression, and Poisson regression.
Instructor(s): Fan Yang
Terms Offered: Winter
Prerequisite(s): PBHS 32400, STAT 22400 or STAT 24500 or equivalent or consent of instructor.
Equivalent Course(s): PBHS 32700
STAT 23400. Statistical Models and Methods. 100 Units.
This course is recommended for students throughout the natural and social sciences who want a broad background in statistical methodology and exposure to probability models and the statistical concepts underlying the methodology. Probability is developed for the purpose of modeling outcomes of random phenomena. Random variables and their expectations are studied; including means and variances of linear combinations and an introduction to conditional expectation. Binomial, Poisson, normal and other standard probability distributions are considered. Some probability models are studied mathematically, and others are studied via simulation on a computer. Sampling distributions and related statistical methods are explored mathematically, studied via simulation, and illustrated on data. Methods include, but are not limited to, inference for means and variances for one- and two-sample problems, correlation, and simple linear regression. Graphical description and numerical data description are used for exploration, communication of results, and comparing mathematical consequences of probability models and data. Mathematics employed is to the level of univariate calculus, but it is less demanding than that required by STAT 24400.
Terms Offered: Autumn, Winter, Spring
Prerequisite(s): MATH 13300, 15300, or 16300
Note(s): Students may count either STAT 22000 or 23400, but not both, toward the forty-two credits required for graduation. Recommended sequence for Economics majors: MATH 19620, STAT 23400, ECON 21000 in consecutive quarters.

STAT 24300. Numerical Linear Algebra. 100 Units.
This course is devoted to the basic theory of linear algebra and its significant applications in scientific computing. The main objective is to provide a working knowledge of linear algebra and matrix computation suitable for advanced studies in which numerical methods are in demand, such as in statistics, econometrics, and scientific data organization and computation. Topics covered will include: Gaussian elimination, LU decomposition, vector spaces, linear transformations and their matrix representations, orthogonality and projections, QR factorization, eigenvectors and eigenvalues, diagonalization of real symmetric and complex Hermitian matrices, the spectral theorem, Cholesky decomposition, and Singular Value Decomposition. In addition, students will program in MATLAB or R using basic algorithms for linear systems, eigenvalue problem, matrix factorization, and sensitivity analysis.
Terms Offered: Autumn
Prerequisite(s): Multivariate calculus (MATH 19520 or 20000 or 20500 or equivalent). Previous exposure to linear algebra is helpful.
Equivalent Course(s): STAT 30750
STAT 24400-24500. Statistical Theory and Methods I-II.
This course is a systematic introduction to the principles and techniques of statistics, as well as to practical considerations in the analysis of data, with emphasis on the analysis of experimental data. The first quarter covers tools from probability and the elements of statistical theory. Topics include the definitions of probability and random variables, binomial and other discrete probability distributions, normal and other continuous probability distributions, joint probability distributions and the transformation of random variables, principles of inference (including Bayesian inference), maximum likelihood estimation, hypothesis testing and confidence intervals, likelihood ratio tests, multinomial distributions, and chi-square tests. Examples are drawn from the social, physical, and biological sciences. The coverage of topics in probability is limited and brief, so students who have taken a course in probability find reinforcement rather than redundancy. The second quarter covers statistical methodology, including the analysis of variance, regression, correlation, and some multivariate analysis. Some principles of data analysis are introduced, and an attempt is made to present the analysis of variance and regression in a unified framework. Computers are used in the second quarter. Students who have already taken STAT 25100 are urged to take STAT 24410 instead of STAT 24400. Students taking either STAT 24400 or STAT 24410 will have appropriate preparation for STAT 24500.
STAT 24400. Statistical Theory and Methods I. 100 Units.
This course is a systematic introduction to the principles and techniques of statistics, as well as to practical considerations in the analysis of data, with emphasis on the analysis of experimental data. The first quarter covers tools from probability and the elements of statistical theory. Topics include the definitions of probability and random variables, binomial and other discrete probability distributions, normal and other continuous probability distributions, joint probability distributions and the transformation of random variables, principles of inference (including Bayesian inference), maximum likelihood estimation, hypothesis testing and confidence intervals, likelihood ratio tests, multinomial distributions, and chi-square tests. Examples are drawn from the social, physical, and biological sciences. The coverage of topics in probability is limited and brief, so students who have taken a course in probability find reinforcement rather than redundancy. The second quarter covers statistical methodology, including the analysis of variance, regression, correlation, and some multivariate analysis. Some principles of data analysis are introduced, and an attempt is made to present the analysis of variance and regression in a unified framework. Computers are used in the second quarter. Students who have already taken STAT 25100 are urged to take STAT 24410 instead of STAT 24400. Students taking either STAT 24400 or STAT 24410 will have appropriate preparation for STAT 24500.
Terms Offered: Autumn or Winter or both
Prerequisite(s): Multivariate calculus (MATH 19520 or 20000 or 20500, or equivalent)
Note(s): Some previous experience with statistics and/or probability and linear algebra helpful but not required. Students may count either STAT 24400 or STAT 24410, but not both, toward the forty-two credits required for graduation.

STAT 24500. Statistical Theory and Methods II. 100 Units.
No description available.
Terms Offered: Winter, Spring
Prerequisite(s): Multivariate calculus (MATH 19520 or 20000 or 20500, or equivalent) and linear algebra (MATH 19620 or 25500 or STAT 24300 or equivalent) and STAT 24400 or STAT 24410

STAT 24410. Statistical Theory and Methods Ia. 100 Units.
This course is an alternative version of STAT 24400 that requires STAT 25100 Introduction to Mathematical Probability as a prerequisite and that replaces some probability topics with additional statistics topics not normally covered in STAT 24400-24500 Statistical Theory and Methods I-II.
Terms Offered: Autumn
Prerequisite(s): STAT 25100; Multivariate calculus (MATH 19520 or 20000 or 20500, or equivalent)
Note(s): Some previous experience with statistics and/or linear algebra helpful but not required. Students may count either STAT 24400 or STAT 24410, but not both, toward the forty-two credits required for graduation.
STAT 24500. Statistical Theory and Methods II. 100 Units.
No description available.
Terms Offered: Winter, Spring
Prerequisite(s): Multivariate calculus (MATH 19520 or 20000 or 20500, or equivalent) and linear algebra (MATH 19620 or 25500 or STAT 24300 or equivalent) and STAT 24400 or STAT 24410

STAT 24610. Pattern Recognition. 100 Units.
This course treats statistical models and methods for pattern recognition and machine learning. Topics include a review of the multivariate normal distribution, graphical models, computational methods for inference in graphical models in particular the EM algorithm for mixture models and HMM’s, and the sum-product algorithm. Linear discriminative analysis and other discriminative methods, such as decision trees and SVM’s are covered as well.
Terms Offered: Spring
Prerequisite(s): Linear algebra at the level of STAT 24300. Knowledge of probability and statistical estimation techniques (e.g., maximum likelihood and linear regression) at the level of STAT 24500
Equivalent Course(s): STAT 37500

STAT 25100. Introduction to Mathematical Probability. 100 Units.
This course covers fundamentals and axioms; combinatorial probability; conditional probability and independence; binomial, Poisson, and normal distributions; the law of large numbers and the central limit theorem; and random variables and generating functions.
Terms Offered: Autumn, Spring
Prerequisite(s): MATH 20000 or 20500, or consent of instructor

STAT 25150. Introduction to Mathematical Probability-A. 100 Units.
This course covers fundamentals and axioms; combinatorial probability; conditional probability and independence; binomial, Poisson, and normal distributions; the law of large numbers and the central limit theorem; and random variables and generating functions.
Instructor(s): Robert Fefferman Terms Offered: Spring
Prerequisite(s): MATH 20500 or consent of instructor

STAT 25300. Introduction to Probability Models. 100 Units.
This course introduces stochastic processes as models for a variety of phenomena in the physical and biological sciences. Following a brief review of basic concepts in probability, we introduce stochastic processes that are popular in applications in sciences (e.g., discrete time Markov chain, the Poisson process, continuous time Markov process, renewal process and Brownian motion).
Terms Offered: Winter
Prerequisite(s): STAT 24400 or 25100
Equivalent Course(s): STAT 31700
STAT 26100. Time Dependent Data. 100 Units.
This course considers the modeling and analysis of data that are ordered in time. The main focus is on quantitative observations taken at evenly spaced intervals and includes both time-domain and spectral approaches.
Terms Offered: Winter
Prerequisite(s): STAT 24500 is required; alternatively STAT 22400 and exposure to multivariate calculus. Some previous exposure to Fourier series is helpful but not required.
Equivalent Course(s): STAT 33600

STAT 26700. History of Statistics. 100 Units.
This course covers topics in the history of statistics, from the eleventh century to the middle of the twentieth century. We focus on the period from 1650 to 1950, with an emphasis on the mathematical developments in the theory of probability and how they came to be used in the sciences. Our goals are both to quantify uncertainty in observational data and to develop a conceptual framework for scientific theories. This course includes broad views of the development of the subject and closer looks at specific people and investigations, including reanalyses of historical data.
Instructor(s): S. Stigler Terms Offered: Spring
Prerequisite(s): Prior statistics course
Equivalent Course(s): CHSS 32900, HIPS 25600, STAT 36700

STAT 27400. Nonparametric Inference. 100 Units.
Nonparametric inference is about developing statistical methods and models that make weak assumptions. A typical nonparametric approach estimates a nonlinear function from an infinite dimensional space rather than a linear model from a finite dimensional space. This course gives an introduction to nonparametric inference, with a focus on density estimation, regression, confidence sets, orthogonal functions, random processes, and kernels. The course treats nonparametric methodology and its use, together with theory that explains the statistical properties of the methods.
Terms Offered: Autumn
Prerequisite(s): STAT 24400 is required; alternatively STAT 22400 and exposure to multivariate calculus and linear algebra.
Equivalent Course(s): STAT 37400

STAT 27725. Machine Learning. 100 Units.
This course offers a practical, problem-centered introduction to machine learning. Topics covered include the Perceptron and other online algorithms; boosting; graphical models and message passing; dimensionality reduction and manifold learning; SVMs and other kernel methods; and a short introduction to statistical learning theory. Weekly programming assignments give students the opportunity to try out each learning algorithm on real world datasets.
Instructor(s): R. Kondor Terms Offered: Autumn
Prerequisite(s): CMSC 15400. STAT 22000 or STAT 23400 strongly recommended.
Equivalent Course(s): CMSC 25400
STAT 27850. Multiple Testing, Modern Inference, and Replicability. 100 Units.
This course examines the problems of multiple testing and statistical inference from a modern point of view. High-dimensional data is now common in many applications across the biological, physical, and social sciences. With this increased capacity to generate and analyze data, classical statistical methods may no longer ensure the reliability or replicability of scientific discoveries. We will examine a range of modern methods that provide statistical inference tools in the context of modern large-scale data analysis. The course will have weekly assignments as well as a final project, both of which will include both theoretical and computational components.
Instructor(s): R. Foygel Barber Terms Offered: Winter
Prerequisite(s): Stat 24400 or equivalent. Undergraduates may enroll with permission of the instructor.
Equivalent Course(s): STAT 30850

STAT 28000. Optimization. 100 Units.
This is an introductory course on optimization that will cover the rudiments of unconstrained and constrained optimization of a real-valued multivariate function. The focus is on the settings where this function is, respectively, linear, quadratic, convex, or differentiable. Time permitting, topics such as nonsmooth, integer, vector, and dynamic optimization may be briefly addressed. Materials will include basic duality theory, optimality conditions, and intractability results, as well as algorithms and applications.
Terms Offered: Spring
Prerequisite(s): MATH 20500 or 20800; STAT 24300 or MATH 25500 or MATH 25800

STAT 29700. Undergraduate Research. 100 Units.
This course consists of reading and research in an area of statistics or probability under the guidance of a faculty member. A written report must be submitted at the end of the quarter.
Terms Offered: Autumn, Winter, Spring
Prerequisite(s): Consent of faculty adviser and Departmental Adviser for Majors
Note(s): Students are required to submit the College Reading and Research Course Form. Open to all students, including nonmajors. May be taken either for quality grades or for P/F grading.

STAT 29900. Bachelor’s Paper. 100 Units.
This course consists of reading and research in an area of statistics or probability under the guidance of a faculty member, leading to a bachelor’s paper. The paper must be submitted at the end of the quarter.
Terms Offered: Autumn, Winter, Spring
Prerequisite(s): Consent of faculty adviser and Departmental Adviser for Majors
Note(s): Students are required to submit the College Reading and Research Course Form. Open only to students who are majoring in Statistics. May be taken for P/F grading. Credit for STAT 29900 may not be counted toward the major in Statistics.