Statistics is the science of modeling, summarizing, and analyzing data, and of using mathematics and computing tools to make predictions and decisions in the face of uncertainty. Statistical ideas are applicable in any area involving quantitative measurement and in almost every area of scholarly pursuit. The major, administered by the Department of Statistics, is designed to provide students with an understanding of the concepts of statistical inference and a familiarity with the methods of applied statistical analysis. A major in statistics will prepare students for a career in business, industry, or government, and for further graduate study in statistics or in a related area.

The Department of Statistics offers the following majors:

- Statistics (http://catalog.illinois.edu/undergraduate/las/academic-units/stats/statistics-major)- The major, administered by the Department of Statistics, is designed to provide students with an understanding of the concepts of statistical inference and a familiarity with the methods of applied statistical analysis. A major in statistics will prepare students for a career in business, industry, or government, and for further graduate study in statistics or in a related area.
- Statistics and Computer Science (http://catalog.illinois.edu/undergraduate/las/academic-units/stats/statistics-computer-science-major)- This major is sponsored jointly by the Departments of Statistics and Computer Science. The Statistics and Computer Science major is designed for students who would like a strong foundation in computer science, coupled with significant advanced coursework in statistics. The major prepares students for professional or graduate work in statistics and computer science, and for applications of computing in which knowledge of statistics is particularly important, such as data mining and machine learning.

### Minor in Statistics

The minor, administered by the Department of Statistics, is designed to provide students with an understanding of the concepts of statistical inference and a familiarity with the methods of applied statistical analysis. A minor in statistics will assist students with their major field of study to better prepare them for a career in their chosen field. It will also prepare students for graduate studies in statistics or in one of many areas where data analysis plays an important role. Interested students should contact the Statistics undergraduate advisor for admission into the minor. Students should have completed the calculus sequence through MATH 241 before entering the minor. Students must choose from either the Applied or Mathematical Statistics Track.

### Applied Statistics Track

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Select one of the following:</td>
<td></td>
</tr>
<tr>
<td>MATH 125</td>
<td>Elementary Linear Algebra</td>
<td>2-3</td>
</tr>
<tr>
<td>MATH 225</td>
<td>Introductory Matrix Theory</td>
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</tr>
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</table>

### Mathematical Statistics Track Minor

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 415</td>
<td>Applied Linear Algebra</td>
<td>3-4</td>
</tr>
<tr>
<td>STAT 200</td>
<td>Statistical Analysis</td>
<td>3</td>
</tr>
<tr>
<td>or STAT 212</td>
<td>Biostatistics</td>
<td></td>
</tr>
<tr>
<td>STAT 400</td>
<td>Statistics and Probability I ⁴</td>
<td>4</td>
</tr>
<tr>
<td>STAT 410</td>
<td>Statistics and Probability II</td>
<td>3</td>
</tr>
<tr>
<td>or ECE 313</td>
<td>Probability with Engrg Applic</td>
<td></td>
</tr>
<tr>
<td>Choose one 300- or 400-level course from the list maintained by the department. Please see the Statistics advisor for a current list.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total Hours: 18-21

**Actuarial Science Risk Mgmt Courses**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASRM 199</td>
<td>Undergraduate Open Seminar</td>
<td>1-5</td>
</tr>
<tr>
<td>or ASRM 210</td>
<td>Theory of Interest</td>
<td>3</td>
</tr>
</tbody>
</table>

Covers special topics. Approved for Letter and S/U grading. May be repeated in the same term up to 12 hours or separate terms up to 12 hours.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASRM 392</td>
<td>Actuarial Problem Solving</td>
<td>1</td>
</tr>
</tbody>
</table>

Methods and techniques of solving problems in actuarial mathematics for advanced students intending to enter the actuarial profession. Approved for S/U grading only. May be repeated in the same or separate terms to a maximum of 4 hours. Prerequisite: Consent of instructor.

Information listed in this catalog is current as of 06/2018
ASRM 398 Actuarial Internship credit: 0 Hours. (https://courses.illinois.edu/schedule/terms/ASRM/398)
Full-time or part-time practice of actuarial science in an off-campus government, industrial, or research laboratory environment. Summary report required. Approved for S/U grading only. May be repeated in separate terms. Prerequisite: After obtaining an internship, Actuarial Science students must request entry from the Director of the Actuarial Science Program.

ASRM 401 Actuarial Statistics I credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/ASRM/401)
Same as STAT 408. See STAT 408.

ASRM 402 Actuarial Statistics II credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/ASRM/402)
Same as STAT 409. See STAT 409.

ASRM 406 Linear Algebra with Financial Applications credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/ASRM/406)
Emphasizes techniques of linear algebra and introductory and advanced applications to actuarial science, finance, and economics. Topics include linear equations, matrix theory, vector spaces, linear transformations, eigenvalues and eigenvectors, and inner product spaces. In addition, current research topics such as modeling, data mining, and generalized linear models are explored. 3 or 4 undergraduate hours. 3 or 4 graduate hours. Credit is not given for both ASRM 406 (formerly MATH 410) and any of MATH 125, MATH 225, MATH 415 or MATH 416. 4 hours of credit requires approval of the instructor and department with completion of additional work of substance. Prerequisite: MATH 241; ASRM 210 (formerly MATH 210) or FIN 221, or consent of instructor.

ASRM 409 Stochastic Processes for Finance and Insurance credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/ASRM/409)
An introduction to stochastic processes and their applications to finance and insurance. Topics include conditional probability, conditional expectation, Markov chains, Poisson processes, reliability theory, Brownian motion and elementary introductions to insurance risk theory and option pricing theory. 3 or 4 undergraduate hours. 3 or 4 graduate hours. Prerequisite: ASRM 401 (formerly MATH 408) or MATH 461.

ASRM 410 Investments and Financial Markets credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/ASRM/410)
Theoretical foundation in financial models and their applications to insurance and other financial risks. Topics include derivative markets, no arbitrage pricing of financial derivatives, interest rate models, dynamic hedging and other risk management techniques. 3 undergraduate hours. No graduate credit. Credit is not given for ASRM 410 (formerly MATH 476) and MATH 567. Prerequisite: Credit or concurrent registration in STAT 409 or STAT 410.

ASRM 450 Methods of Applied Statistics credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/ASRM/450)
Same as STAT 420. See STAT 420.

ASRM 451 Basics of Statistical Learning credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/ASRM/451)
Same as STAT 432. See STAT 432.

ASRM 453 Applied Bayesian Analysis credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/ASRM/453)
Same as STAT 431. See STAT 431.

ASRM 461 Loss Models credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/ASRM/461)
Foundation in the actuarial modeling process; construction, selection and validation of empirical models and parametric models. Also covers survival, severity, frequency and aggregate loss models; statistical methods to estimate model parameters. 3 undergraduate hours. No graduate credit. Credit is not given for ASRM 461 (formerly MATH 478) and ASRM 561 (formerly MATH 568). Prerequisite: ASRM 401 (formerly MATH 408), MATH 461 or MATH 463; credit or concurrent registration in ASRM 402 (formerly MATH 409) or MATH 464.

ASRM 469 Casualty Actuarial Mathematics credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/ASRM/469)
An introduction to property/casualty actuarial science, exploring its mathematical, financial, and risk-theoretical foundations. Specific topics include risk theory, loss reserving, ratemaking, risk classification, credibility theory, reinsurance, financial pricing of insurance, and other special issues and applications. 3 or 4 undergraduate hours. No graduate credit. Credit is not given for ASRM 469 (formerly MATH 479) and ASRM 569 (formerly MATH 569). Prerequisite: ASRM 210 (formerly MATH 210); credit or concurrent registration in ASRM 402 (formerly MATH 409); or consent of instructor.

ASRM 471 Life Contingencies I credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/ASRM/471)
Distribution of the time-to-death random variable for a single life, and its implications for evaluations of insurance and annuity functions, net premiums, and reserves. 3 undergraduate hours. 4 graduate hours. Prerequisite: ASRM 401 (formerly MATH 408) and ASRM 210 (formerly MATH 210).

ASRM 472 Life Contingencies II credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/ASRM/472)
Continuation of ASRM 471. Introduction to tabular or parametric survival models with single or multiple-life states; life insurance and annuity premium calculations; reserving and profit measures; introductions to universal life insurances, participating insurances, pension plans and retirement benefits. 3 undergraduate hours. No graduate credit. Credit is not given for ASRM 472 (formerly MATH 472) and ASRM 575 (formerly MATH 575). Prerequisite: ASRM 471 (formerly MATH 471).

ASRM 499 Topics in Actuarial Science credit: 1 to 4 Hours. (https://courses.illinois.edu/schedule/terms/ASRM/499)
Covers special topics in actuarial science. 1 to 4 undergraduate hours. 1 to 4 graduate hours. Approved for Letter and S/U grading. May be repeated. Prerequisite: Consent of instructor.

STAT Class Schedule (https://courses.illinois.edu/schedule/DEFAULT/DEFAULT/STAT)

Statistics Courses

STAT 100 Statistics credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/STAT/100)
First course in probability and statistics at a precalculus level; emphasizes basic concepts, including descriptive statistics, elementary probability, estimation, and hypothesis testing in both nonparametric and normal models. Credit is not given for both STAT 100 and any one of the following: ECON 202, PSYC 235, or SOC 485. Prerequisite: MATH 112.

This course satisfies the General Education Criteria for: Quantitative Reasoning I
STAT 200  Statistical Analysis  credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/STAT/200)
Survey of statistical concepts, data analysis, designed and observational studies and statistical models. Statistical computing using a statistical package such as R or a spreadsheet. Topics to be covered include data summary and visualization, study design, elementary probability, categorical data, comparative experiments, multiple linear regression, analysis of variance, statistical inference and model diagnostics. May be taken as a first statistics course for quantitatively oriented students, or as a second course to follow a basic concepts course. Credit is not given for both STAT 200 and STAT 212.
This course satisfies the General Education Criteria for: Quantitative Reasoning I

STAT 212  Biostatistics  credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/STAT/212)
Application of statistical reasoning and statistical methodology to biology. Topics include descriptive statistics, graphical methods, experimental design, probability, statistical inference and regression. In addition, techniques of statistical computing are covered. Credit is not given for both STAT 212 and STAT 200.
This course satisfies the General Education Criteria for: Quantitative Reasoning I

STAT 361  Probability & Statistics for Computer Science  credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/STAT/361)
Same as CS 361. See CS 361.

STAT 385  Statistics Programming Methods  credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/STAT/385)
Statisticians must be savvy in programming methods useful to the wide variety of analysis that they will be expected to perform. This course provides the foundation for writing and packaging statistical algorithms through the creation of functions and object oriented programming. Fundamental programming techniques and considerations will be emphasized. Students will also create dynamic reports that encapsulate their implemented algorithms. Students must have access to a computer on which they can install software. Prerequisite: STAT 200 or STAT 212.

STAT 390  Individual Study  credit: 1 or 2 Hours. (https://courses.illinois.edu/schedule/terms/STAT/390)
May be repeated to a maximum of 8 hours. Prerequisite: Consent of instructor.

STAT 391  Honors Individual Study  credit: 1 or 2 Hours. (https://courses.illinois.edu/schedule/terms/STAT/391)
May be repeated to a maximum of 8 hours. Prerequisite: Consent of instructor.

STAT 400  Statistics and Probability I  credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/400)
Introduction to mathematical statistics that develops probability as needed; includes the calculus of probability, random variables, expectation, distribution functions, central limit theorem, point estimation, confidence intervals, and hypothesis testing. Offers a basic one-term introduction to statistics and also prepares students for STAT 410. Same as MATH 463. 4 undergraduate hours. 4 graduate hours. Prerequisite: MATH 241 or equivalent.

STAT 408  Actuarial Statistics I  credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/408)
Examines elementary theory of probability, including independence, conditional probability, and Bayes' theorem; combinations and permutations; random variables, expectations, and probability distributions; joint and conditional distributions; functions of random variables; sampling; central limit theorem. Same as ASRM 401. 4 undergraduate hours. 4 graduate hours. Credit is not given for both STAT 408 and either MATH 461 or STAT 400. Prerequisite: MATH 241 or equivalent.

STAT 409  Actuarial Statistics II  credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/409)
Continuation of STAT 408. Examines parametric point and interval estimation, including maximum likelihood estimation, sufficiency, completeness, and Bayesian estimation; hypothesis testing; linear models; regression and correlation. Same as ASRM 402. 4 undergraduate hours. 4 graduate hours. Credit is not given for both STAT 409 and STAT 410. Prerequisite: STAT 408.

STAT 410  Statistics and Probability II  credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/410)
Continuation of STAT 400. Includes moment-generating functions, transformations of random variables, normal sampling theory, sufficiency, best estimators, maximum likelihood estimators, confidence intervals, most powerful tests, unbiased tests, and chi-square tests. Same as MATH 464. 3 undergraduate hours. 4 graduate hours. Credit is not given for both STAT 410 and STAT 409. Prerequisite: STAT 400; or STAT 100 and MATH 461.

STAT 420  Methods of Applied Statistics  credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/420)
Systematic, calculus-based coverage of the more widely used methods of applied statistics, including simple and multiple regression, correlation, analysis of variance and covariance, multiple comparisons, goodness of fit tests, contingency tables, nonparametric procedures, and power of tests; emphasizes when and why various tests are appropriate and how they are used. Same as ASRM 450. 3 undergraduate hours. 4 graduate hours. Prerequisite: STAT 408 or STAT 400; MATH 231 or equivalent; knowledge of basic matrix manipulations; or consent of instructor.

STAT 424  Analysis of Variance  credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/424)
Estimation and hypotheses testing in linear models; one-, two-, and higher-way layouts; incomplete layouts; analysis of covariance; and random effects models and mixed models. 3 undergraduate hours. 4 graduate hours. Prerequisite: STAT 408 or STAT 400; MATH 231 or equivalent; knowledge of basic matrix manipulations; or consent of instructor.

STAT 425  Applied Regression and Design  credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/425)
Explores linear regression, least squares estimates, F-tests, analysis of residuals, regression diagnostics, transformations, model building, factorial designs, randomized complete block designs, Latin squares, split plot designs. Computer work is an integral part of the course. 3 undergraduate hours. 4 graduate hours. Prerequisite: STAT 410.

STAT 426  Sampling and Categorical Data  credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/426)
Sampling: simple random, stratified, systematic, cluster, and multi-stage sampling. Categorical data: multiway contingency tables, maximum likelihood estimation, goodness-of-fit tests, model selection, logistic regression. Computer work is an integral part of the course. 3 undergraduate hours. 4 graduate hours. Prerequisite: STAT 410.
STAT 427  Statistical Consulting  credit: 3 or 4 Hours. ([courses.illinois.edu/schedule/terms/STAT/427](https://courses.illinois.edu/schedule/terms/STAT/427))
Students working in groups under the supervision of the instructor, consult with faculty and graduate students through the Statistical Consulting Service; readings from literature on consulting. 3 undergraduate hours. 4 graduate hours. Prerequisite: STAT 425 or consent of instructor.

STAT 428  Statistical Computing  credit: 3 or 4 Hours. ([courses.illinois.edu/schedule/terms/STAT/428](https://courses.illinois.edu/schedule/terms/STAT/428))
Examines statistical packages, numerical analysis for linear and nonlinear models, graphics, and random number generation and Monte Carlo methods. Same as CSE 428. 3 undergraduate hours. 4 graduate hours. Prerequisite: STAT 410 or equivalent; knowledge of a programming language.

STAT 429  Time Series Analysis  credit: 3 or 4 Hours. ([courses.illinois.edu/schedule/terms/STAT/429](https://courses.illinois.edu/schedule/terms/STAT/429))
Studies theory and data analysis for time series; examines auto-regressive moving average model building and statistical techniques; and discusses spectral model building and statistical analysis using windowed periodograms and Fast Fourier Transformations. 3 undergraduate hours. 4 graduate hours. Prerequisite: STAT 410.

STAT 430  Topics in Applied Statistics  credit: 3 or 4 Hours. ([courses.illinois.edu/schedule/terms/STAT/430](https://courses.illinois.edu/schedule/terms/STAT/430))
Formulation and analysis of mathematical models for random phenomena; extensive involvement with the analysis of real data; and instruction in statistical and computing techniques as needed. 3 undergraduate hours. 4 graduate hours. May be repeated with approval. Prerequisite: STAT 410 or STAT 420; or consent of instructor.

STAT 431  Applied Bayesian Analysis  credit: 3 or 4 Hours. ([courses.illinois.edu/schedule/terms/STAT/431](https://courses.illinois.edu/schedule/terms/STAT/431))
Introduction to the concepts and methodology of Bayesian statistics, for students with fundamental knowledge of mathematical statistics. Topics include Bayes’ rule, prior and posterior distributions, conjugacy, Bayesian point estimates and intervals, Bayesian hypothesis testing, noninformative priors, practical Markov chain Monte Carlo, hierarchical models and model graphs, and more advanced topics as time permits. Implementations in R and specialized simulation software. Same as ASRM 453. 3 undergraduate hours. 4 graduate hours. Prerequisite: STAT 410 and knowledge of R.

STAT 432  Basics of Statistical Learning  credit: 3 or 4 Hours. ([courses.illinois.edu/schedule/terms/STAT/432](https://courses.illinois.edu/schedule/terms/STAT/432))
Topics in supervised and unsupervised learning are covered, including logistic regression, support vector machines, classification trees and nonparametric regression. Model building and feature selection are discussed for these techniques, with a focus on regularization methods, such as lasso and ridge regression, as well as methods for model selection and assessment using cross validation. Cluster analysis and principal components analysis are introduced as examples of unsupervised learning. Same as ASRM 451. 3 undergraduate hours. 4 graduate hours. Prerequisite: STAT 400, and either STAT 420 or STAT 425.

STAT 433  Stochastic Processes  credit: 3 or 4 Hours. ([courses.illinois.edu/schedule/terms/STAT/433](https://courses.illinois.edu/schedule/terms/STAT/433))
A stochastic process is a random process that represents the evolution of some system over time. Topics may include discrete-time and continuous-time Markov chains, birth-and-death chains, branching chains, stationary distributions, random walks, Markov pure jump processes, birth-and-death processes, renewal processes, Poisson process, queues, second order processes, Brownian motion (Wiener process), and Ito’s lemma. 3 undergraduate hours. 4 graduate hours. Prerequisite: STAT 400 required, STAT 410 preferred, and MATH 225 (or equivalent knowledge of Linear Algebra) highly recommended.

STAT 434  Survival Analysis  credit: 3 or 4 Hours. ([courses.illinois.edu/schedule/terms/STAT/434](https://courses.illinois.edu/schedule/terms/STAT/434))
Introduction to the analysis of time-to-event outcomes. Topics center around three main procedures: the Kaplan-Meier estimator, the log-rank test, and Cox regression. Emphasis on big-picture concepts, basic methodological understanding, and practical implementation in R. 3 undergraduate hours. 4 graduate hours. Prerequisite: STAT 410, STAT 420, and knowledge of R at the level of STAT 420.

STAT 440  Statistical Data Management  credit: 3 or 4 Hours. ([courses.illinois.edu/schedule/terms/STAT/440](https://courses.illinois.edu/schedule/terms/STAT/440))
The critical elements of data storage, data cleaning, and data extractions that ultimately lead to data analysis are presented. Includes basic theory and methods of databases, auditing and querying databases, as well as data management and data preparation using standard large-scale statistical software. Students will gain competency in the skills required in storing, cleaning, and managing data, all of which are required prior to data analysis. Same as CSE 440. 3 undergraduate hours. 4 graduate hours. Prerequisite: STAT 400 or STAT 409.

STAT 443  Professional Statistics  credit: 3 or 4 Hours. ([courses.illinois.edu/schedule/terms/STAT/443](https://courses.illinois.edu/schedule/terms/STAT/443))
This project-based course emphasizes written, visual, and oral communication of statistical results and conclusions. An introduction to statistical consulting is also provided. Additional topics include introductions to statistical methodologies in industry and aspects of careers in statistics. 3 undergraduate hours. 4 graduate hours. Prerequisite: STAT 420 or consent of instructor.

STAT 448  Advanced Data Analysis  credit: 4 Hours. ([courses.illinois.edu/schedule/terms/STAT/448](https://courses.illinois.edu/schedule/terms/STAT/448))
Several of the most widely used techniques of data analysis are discussed with an emphasis on statistical computing. Topics include linear regression, analysis of variance, generalized linear models, and analysis of categorical data. In addition, an introduction to data mining is provided considering classification, model building, decision trees, and cluster analysis. Same as CSE 448. 4 undergraduate hours. 4 graduate hours. Prerequisite: STAT 400 or STAT 409, and credit for or concurrent registration in STAT 410.

STAT 458  Math Modeling in Life Sciences  credit: 3 or 4 Hours. ([courses.illinois.edu/schedule/terms/STAT/458](https://courses.illinois.edu/schedule/terms/STAT/458))
Same as ANSC 448 and IB 487. See ANSC 448.

STAT 466  Image and Neuroimaging Analysis  credit: 3 or 4 Hours. ([courses.illinois.edu/schedule/terms/STAT/466](https://courses.illinois.edu/schedule/terms/STAT/466))
Same as PSYC 466. See PSYC 466.
STAT 480  Data Science Foundations  credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/480)
Examines the methods of data management and analysis for “big data”, characterized by high volume, variety, velocity, and veracity. Attention will be focused on advanced statistical analysis and visualization in data science applications employing parallel processing, storage and distribution techniques necessary for analysis of massive data sets. Data mining techniques, machine learning methods, and streaming technologies will be utilized for real-time analysis. Students must have access to a computer on which they can install software. 3 undergraduate hours. 4 graduate hours. Prerequisite: STAT 425 and familiarity with high-level language (e.g. Python, Java, C, F#), and command line programming.

STAT 484  Ethical Practice of Statistics  credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/484)
Same as PSYC 484. See PSYC 484.