The Major Program

The statistics program at the university offers a Bachelor of Arts (A.B.) or Bachelor of Science (B.S.) degree in statistics. The major is designed to provide a strong foundation in statistical theory and applications, preparing students for careers in various fields that require statistical expertise.

A.B. Major Requirements:

- Statistics 106, 108, 138, or the equivalent ........................................................................... 12
- Statistics 130A, 130B ........................................................................................................... 8
- Statistics 137 or 141 .............................................................................................................. 4
- Three courses from: Statistics 104, 135, 137, 141, 142, 144, 145 .................................... 12
- Related elective courses .......................................................................................................... 12

Total Units for the Major ..................................................... 52

B.S. Major Requirements:

General Statistics option

Preparatory Subject Matter ......................................................... 9-16

Statistics 16A, 16B, 16C, or 17A, 17B, 17C; or 21A, 21B, 21C .................................................. 9-16
Mathematics 22A ...................................................................................................................... 3
Computer Science Engineering 30 or Computer Science Engineering 40 (or the equivalent) ................................................................. 4
Statistics 32 ................................................................................................................................... 4

Depth Subject Matter .................................................. 45-48

Statistics 106, 108, 138 or the equivalent ........................................................................... 12
Statistics 130A, 130B .............................................................................................................. 8
Statistics 137 or 141 ................................................................................................................. 4
Three courses from: Statistics 104, 135, 137, 141, 142, 144, 145 .................................... 12
Related elective courses ............................................................................................................. 12
Three upper division courses approved by major adviser; they should follow a coherent sequence in a single discipline in the social sciences where statistical methods and models are applied and should cover the quantitative aspects of the discipline.

Total Units for the Major ..................................................... 82-83

Computational Statistics option

Preparatory Subject Matter ......................................................... 30-32

Mathematics 21A, 21B, 21C, 21D ................................................................. 16
Mathematics 22A, or 67 ............................................................................................................ 3-4
Mathematics 25 ......................................................................................................................... 4
Computer Science Engineering 30 or Computer Science Engineering 40 (or the equivalent) ................................................................. 4
Any one introductory statistics course except Statistics 10 .................................................. 3-4

Depth Subject Matter .................................................. 51-52

Statistics 131A, 131B, 131C ...................................................................................................... 12
Three courses from: Statistics 104, 135, 137, 141, 142, 144, 145 .................................... 12
Mathematics 125A, 108 or 125B, and 167 ........................................................................... 12
Related elective courses ............................................................................................................. 12
One upper division course approved by major adviser; it should be in mathematics, computer science, or in quantitative aspects of a substantive discipline.

Total Units for the Major ..................................................... 81-84

A. Aue

Students are encouraged to meet with an advisor to plan a program as early as possible. Sometimes before or during the first quarter of the junior year, students planning to major in Statistics should consult with a faculty advisor to plan the remainder of their undergraduate programs.

Minor Program Requirements:

The Department offers a minor program in Statistics that consists of five upper division level courses focusing on the fundamentals of mathematical statistics and of the most widely used applied statistical methods.

Minor in Statistics

Statistics 106, 108, and 130A-130B or 131A-131B .................................................. 16
One course from: Statistics 104, 135, 137, 138, 141, 142, 144, 145 .......................... 4
Preparation: Statistics 13 or 22 or 100 ................................................................. 100

Graduate Study

The Graduate Program in Statistics offers study and research leading to the M.S. and Ph.D. degrees in Statistics, including a Ph.D. in Statistics with an emphasis in Bioinformatics. Detailed information concerning these degree programs, as well as information on admissions and on financial support, is available from the Department of Statistics.

Graduate Adviser: D. Paul

Statistical Consulting

The Department provides a consulting service for researchers on campus. For more information, call the Statistical laboratory office 530-752-6096.

Integrated B.S./M.S. Degree Program

The Department offers undergraduate majors a path into the Statistics M.S. program through the Integrated Degree Program (I.D.P.). This program is intended for students who seek to be employed as statisticians in government or industry. The minimum units for the integrated program are 150-160.
major GPA requirement is 3.200 at the end of the junior year, although students with demonstrated excellence in their academic work (with a major GPA of 3.500 or above) are most likely to be admitted. Students with a major GPA of 3.500 or above may waive the GRE requirement in the M.S. application. Before moving into the graduate phase, I.D.P. students must satisfy all requirements of the B.S. degree.

To apply for the I.D.P., undergraduate students must submit the Statistics I.D.P. form along with supporting documentation during the last quarter of their junior year, to enter the I.D.P. in the first quarter of their senior year. In addition, applicants must submit an application to the M.S. program during the senior year, prior to the deadline of May 31st. Before applying to the I.D.P., students are strongly advised to consult with both the undergraduate and graduate advisers. Once a student enters the graduate phase of the I.D.P., they follow the course requirements for the Master’s degree (36 units, 18 of which are graduate level). A maximum of 12 units taken in the undergraduate phase can be transferred to the M.S. program, provided they have not already been used to satisfy any requirements of the B.S. degree.

Courses in Statistics (STA)

Lower Division

10. Statistical Thinking (4)
Lecture—3 hours; discussion—1 hour. Prerequisite: two years of high school algebra. Statistics and probability in daily life. Examines principles of collecting, presenting and interpreting data in order to critically assess results reported in the media. Understanding polls, unemployment rates, health studies; understanding probability, risk and odds. GE credit: SciEng or SocSci.

12. Introduction to Discrete Probability (4)
Lecture—3 hours; laboratory—1 hour. Prerequisite: two years of high school algebra. Random experiments; countable sample spaces; elementary probability axioms; counting formulas; conditional probability; Bayes’ theorem; expectation; gambling problems; binomial, hypergeometric, Poisson, geometric, negative binomial and multinomial models; limiting distributions; Markov chains. Available to students who have completed course 13V or higher. GE credit: SciEng or QL.

13. Elementary Statistics (4)
Lecture—3 hours; discussion—1 hour. Prerequisite: two years of high school algebra or the equivalent in college. Descriptive statistics; basic probability concepts; binomial, normal, Student’s t, and chi-square distributions. Hypothesis testing and confidence intervals for one and two means and proportions. Regression. Not open for credit to students who have completed course 13V or higher. GE credit: SciEng or QL.

32. Basic Statistical Analysis Through Computers (3)
Lecture—3 hours. Prerequisite: Mathematics 168 or 178 or 218; ability to program in a high-level computer language like Pascal. Overview of probability modeling and statistical inference. Solution through mathematical analysis and computer simulation. Recommended as alternative to course 13 for students with some knowledge of calculus and computer programming. Only two units of credit allowed to students who have taken course 13, or 102; not open for credit to students who have taken course 100. GE credit: SciEng or SE.

90X. Seminar (1-2)
Seminar—1 to 2 hours. Prerequisite: high school algebra and consent of instructor. Examination of a special topic in a small group setting.

98. Directed Group Study (1-5)
Prerequisite: consent of instructor. (P/NP grading only)

99. Special Study for Undergraduates (1-5)
Prerequisite: consent of instructor. (P/NP grading only)

Upper Division

100. Applied Statistics for Biological Sciences (4)
Lecture—3 hours; laboratory—1 hour. Prerequisite: Mathematics 168 or the equivalent. Descriptive statistics, probability, sampling distributions, estimation, hypothesis testing, contingency tables, ANOVA, regression; implementation of statistical methods using computer package. Only two units credit allowed to students who have taken course 13, 32 or 103. Not open for credit to students who have taken course 102. GE credit: SciEng or QL.

102. Introduction to Probability Modeling and Statistical Inference (4)
Lecture—3 hours; discussion—1 hour. Prerequisite: two years of high school algebra; upper division standing. Introduction to probability and statistics at a rigorous yet precalculus level. Rigorous precalculus introduction to probability and parametric/nonparametric statistical inference with computing; binomial, Poisson, geometric, sampling distributions; exploratory data analysis; regression analysis; ANOVA. Not open for credit to students who have taken course 100. GE credit: SciEng or QL.

103. Applied Statistics for Business and Economics (4)
Lecture—3 hours; discussion—1 hour. Prerequisite: course 13, 32, or 102, and Mathematics 16A, 16B, course 100, or 103. Descriptive statistics; probability; random variables; expectation; binomial, normal, Poisson, other univariate distributions; joint distributions; sampling distributions, central limit theorem; properties of estimators; linear combinations of random variables; testing and estimation; Minitab computing package. Two units credit given to students who have completed course 100. GE credit: SciEng or QL.

104. Applied Statistical Methods: Nonparametric Statistics (4)
Lecture—3 hours; laboratory—1 hour. Prerequisite: course 13, 32, or 102. Two-way and two-way fixed effects analysis of variance models. Randomized complete and incomplete block designs. Multiple comparison procedures. One-way random effects model. GE credit: SciEng or QL.

106. Applied Statistical Methods: Analysis of Variance (4)
Lecture—4 hours. Prerequisite: course 13, 32, or 102; course 100 may replace courses 13, 32 or 102. Sign and Wilcoxon tests, Walsh averages. Two-sample procedures. Inferences concerning scale. Kruskal-Wallis test. Measures of association. Chi square and Khi-Morgen-Smirnov tests. Offered in alternate years. GE credit: SciEng or QL.

108. Applied Statistical Methods: Regression (4)
Lecture—3 hours; discussion—1 hour. Prerequisite: course 13, 32, or 102. Simple linear regression, polynomial regression, stepwise regression, analysis of covariance, correlation, analysis of influence measures, computer output. GE credit: SciEng or QL.

130A. Mathematical Statistics: Brief Course (4)
Lecture—3 hours; discussion—1 hour. Prerequisite: Mathematics 168. Basic probability, densities and distributions, mean, variance, covariance, Chebychev’s inequality, some special distributions, sampling distributions, central limit theorem and law of large numbers, point estimation, some methods of estimation, interval estimation, confidence intervals for certain quantities, computing sample sizes. Only 2 units of credit allowed to students who have taken course 131A. GE credit: SciEng or QL.

130B. Mathematical Statistics: Brief Course (4)
Lecture—3 hours; discussion—1 hour. Prerequisite: course 130A. Transformed random variables, large sample properties of estimators. Basics of hypothesis testing, likelihood ratio tests, goodness-of-fit tests. General linear model, least squares estimates, General-Matrix Theory. Analysis of variance, F-test. Regression and correlation, multiple regression. Selected topics. GE credit: SciEng or QL.

131A. Introduction to Probability Theory (4)
Lecture—3 hours; discussion—1 hour. Prerequisite: course 131A or consent of the instructor. Sampling, methods of estimation, sampling distributions, confidence intervals, testing hypotheses, linear regression, analysis of variance, elements of large sample theory and nonparametric inference. GE credit: SciEng or QL.

131B. Introduction to Mathematical Statistics (4)
Lecture—3 hours; discussion—1 hour. Prerequisite: course 131B or consent of the instructor. Sampling, methods of estimation, sampling distributions, confidence intervals, testing hypotheses, linear regression, analysis of variance, elements of large sample theory and nonparametric inference. GE credit: SciEng or QL.

133. Mathematical Statistics for Economists (4)
Lecture—3 hours; discussion—1 hour. Prerequisite: course 103 and Mathematics 168, or the equivalent; no credit will be given to students majoring in Statistics. Probability, basic statistical inference, and continuous random variables (binomial, normal, t, chi-square); expectation and variance of a random variable, bivariate random variables (bivariate normal); sampling distributions, central limit theorem, estimation, maximum likelihood principle, basics of hypothesis testing [one sample]. GE credit: SciEng or QL.

135. Multivariate Data Analysis (4)
Lecture—3 hours; discussion—1 hour. Prerequisite: course 130B, and preferably course 131B. Multivariate normal distribution; Mahalanobis distance; sampling distributions of the mean vector and covariance matrix; Hotelling’s T2; simultaneous infer-
145. Bayesian Statistical Inference (4) Lecture—3 hours; term paper. Prerequisite: course 108 or the equivalent. Time series relationships, cyclical behavior, correlation, multivariate normal distribution, empirical Bayes, and variational methods. Offered in alternate years. GE credit: SciEng | QL, SE.—(I.)


141. Statistical Computing (4) Lecture—3 hours; laboratory—1 hour. Prerequisite: one introductory class in Statistics [such as 13, 32, 100, or 102] or the equivalent. Organization of computations to access, transform, explore, analyze data and produce results. Concepts and vocabulary of statistical/scientific computing. GE credit: SciEng | QI, SE.—I. (I.)

142. Reliability (4) Lecture—3 hours; discussion/laboratory—1 hour. Prerequisite: course 130B or 131B or consent of instructor. Stochastic modeling and inference for reliability in the presence of competing risks, random processes, statistical failure models, notions of aging, maintenance policies and their optimization. Offered in alternate years. GE credit: SciEng | QI, SE.—I. (I.)

144. Sampling Theory of Surveys (4) Lecture—3 hours; laboratory—1 hour. Prerequisite: course 130B or 131B. Simple random, stratified random, cluster, and systematic sampling plans; mean, proportion, total, ratio, and regression estimators for these plans; sample survey design, absolute and relative error, sample size selection, strata construction; sampling and nonsampling sources of error. Offered in alternate years. GE credit: SciEng | QI, SE.—I. (I.)

145. Bayesian Statistical Inference (4) Lecture—3 hours; laboratory—1 hour. Prerequisite: courses 130A and 130B, or 131A and 131B, or the equivalent. Subjective probability, Bayes Theorem, conjugative priors, estimation, testing, prediction, empirical Bayes methods, properties of Bayesian procedures, comparisons with classical procedures, approximation techniques, Gibbs sampling, importance sampling, applications, multinations, computer implemented data analysis. Offered in alternate years. GE credit: SciEng | QI, SE.—I. (I.)

190X. Seminar (1-2) Seminar—1-2 hours. Prerequisite: one of courses 13, 32, 100, 102, or 108. In-depth examination of a special topic in a small group setting.

192. Internship in Statistics (1-2) Internship—3-36 hours; term paper. Prerequisite: upper division standing and consent of instructor. Work experience in statistics. (P/NP grading only)

194HA. 194HB. Special Studies for Honors Students (4-4) Independent study—12 hours. Prerequisite: senior qualifying for honors. Directed reading, research and writing, culminating in completion of a senior honors thesis or project under direction of a faculty adviser. (Deferred grading only, pending completion of sequence.) GE credit: SciEng | SE.—I. (I.)

198. Directed Group Study (1-5) Prerequisite: consent of instructor. (P/NP grading only)

199. Special Study for Advanced Undergraduates (1-5) Prerequisite: consent of instructor. (P/NP grading only)

Graduate

201. SAS Programming for Statistical Analysis (3) Lecture—2 hours; discussion/laboratory—1 hour. Prerequisite: introduction to SAS/STAT Statistics course; some knowledge of vectors and matrices; courses 106 or 108 or the equivalent suggested. Introduction to SAS language, data management, statistical applications: basic matrix arithmetic, graphics, summary statistics, data sets, variables and functions, linear models, repetitive code, simple macros, ODS and GAPS, formatting output, correspondence analysis, bootstrap. Prepare SAS base programmer certification exam. —II. (III.)

205. Statistical Methods for Research with SAS (4) Lecture—3 hours; laboratory—1 hour. Prerequisite: An introductory upper division statistics course and some knowledge of vectors and matrices; suggested courses are 100, or 102, or 103, or the equivalent. Focus on linear statistical models widely used in scientific research. Emphasis on concepts, methods, and data analysis using SAS. Topics include simple and multiple linear regression, polynomial regression, diagnostics, model selection, variable transformation, factorial ANOVA/ANOCVA. —III. (III.)

206. Statistical Methods for Research—II (4) Lecture—3 hours; laboratory/discussion—1 hour. Prerequisite: introductory statistics course; some knowledge of vectors and matrices. Focus on linear statistical models. Emphasis on concepts, methods, and data analysis; formal mathematics kept to minimum. Topics include simple and multiple linear regression, polynomial regression, diagnostics, model selection, factorial designs and analysis of covariance. Use of professional level software. —I. (I.)

207. Statistical Methods for Research—II (4) Lecture—3 hours; laboratory/discussion—1 hour. Prerequisite: course 206, knowledge of vectors and matrices. Linear and nonlinear statistical models. Emphasis on concepts, methods/data analysis using professional level software; formal mathematics kept to minimum. Topics include linear mixed models, repeated measures, generalized linear models, model selection, analysis of missing data, and multiple testing procedures. —II. (I.)

208. Statistical Methods in Machine Learning (4) Lecture—3 hours; laboratory/discussion—1 hour. Prerequisite: course 206, 207 and 135, or their equivalents. Focus on linear and nonlinear statistical models. Emphasizes algorithms, and data analysis, formal mathematics kept to minimum. Topics include resampling methods, regularization techniques in regression and modern classification, cluster analysis, and dimension reduction techniques. Use professional level software. —II. (III.)

222. Biostatistics: Survival Analysis (4) Lecture—3 hours; discussion/laboratory—1 hour. Prerequisite: course 131C. Incomplete data, life tables, nonparametric and parametric methods, accelerated failure time models, proportional hazards models, partial likelihood; advanced topics. (Same course as Biostatistics 222.)—I. (I.)

223. Biostatistics: Generalized Linear Models (4) Lecture—3 hours; discussion/laboratory—1 hour. Prerequisite: course 131C. Likelihood and linear regression; generalized linear model; Binomial regression; case-control studies; dose-response and bioassay; Poisson regression; Gamma regression; quasi-likelihood models; estimating equations; multivariate GLMs. (Same course as Biostatistics 223.)—II. (II.)

224. Analysis of Longitudinal Data (4) Lecture—3 hours; discussion/laboratory—1 hour. Prerequisite: course/Biostatistics 222, 223 and course 232B or consent of instructor. Standard and advanced methodology, theory, algorithms, and applications relevant for analysis of repeated mea-
expectation. Topics selected from martingales, Markov chains, ergodic theory. (Same course as Mathematics 235A-235B-235C.)—I-II-III. (I-II-III.)

kov chains, ergodic theory. (Same course as Mathematics 167 or Mathematics 67 or equivalent. 243. Computational Statistics (4)

gramming languages. Offered in alternate years.—II. systems and platforms; comparison of scientific pro-
motations; algorithms (markov chain monte carlo, expec-
tation and variance; application to data. Offered in alternate years. —II.

240A-240B. Nonparametric Inference (4-4)

Lecture—3 hours; term paper. Prerequisite: course 131B or the equivalent; course 237A is a prerequi-
site for course 237B. Advanced topics in time series analysis. Models for experimental data, measures of dependence, large-sample theory, statistical estimation and inference. Univariate and multivariate spectral analysis, regression, ARIMA models, state-space models, Kalman filtering. Offered in alternate years. —III.

238. Theory of Multivariate Analysis (4)

Lecture—3 hours; term paper. Prerequisite: courses 131B and 135. Multivariate normal and Wishart distributions, Hotelling’s T-Squared, simultaneous inference, likelihood ratio and union intersection tests, Bayesian methods, discriminant analysis, prin-
cipal component and factor analysis, multivariate clustering, multivariate analysis of variance, application to data. Offered in alternate years. —II.

241. Asymptotic Theory of Statistics (4)

Lecture—3 hours; term paper. Prerequisite: course 231C; courses 235A-235B-235C recommended. Topics in asymptotic theory of statistics chosen from weak convergence, contiguity, empirical processes, Edge-
worth expansion, and semiparametric inference. Offered in alternate years. (III.)

242. Introduction to Statistical Programming (4)

Lecture—3 hours; laboratory—1 hour. Prerequisite: courses 130A and 130B or equivalent. Essentials of statistical computing using a general-purpose statistical
language. Topics include algorithms; design; debugging and efficiency; object-oriented concepts; model specification and fitting; statistical visualization;
data and text processing; databases; computer systems and platforms; comparison of scientific pro-
gramming languages. Offered in alternate years. —II.

243. Computational Statistics (4)

Lecture—3 hours; laboratory—1 hour. Prerequisite: courses 130A and 130B or equivalent, and Mathe-
matics 167 or Mathematics 67 or equivalent. Numerical analysis: random number generation; computer experiments and resampling techniques (bootstrap, cross validation); numerical optimization; matrix decompositions and linear algebra computa-
tions; eigenvalues and eigenvectors; principal components; Markov chains; Monte Carlo, expec-
tation-maximization; algorithm design and efficiency; parallel and distributed computing. Offered in alternate years. —II.

250. Topics in Applied and Computational Statistics (4)

Lecture—3 hours; lecture/discussion—1 hour. Pre-
requisite: course 131A; course 232A recom-
mended, not required. Resampling, nonparametric and semiparametric methods, incomplete data anal-
ysis, diagnostics, multivariate and time series analy-
sis, applied Bayesian methods, sequential analysis and quality control, categorical data analysis, spa-

tal and image analysis, computational biology, func-
tional data analysis, models for correlated data learning theory. May be repeated for credit with consent of graduate advisor. Offered irregularly. —I, II, III.

251. Topics in Statistical Methods and Models (4)

Lecture—2 hours; discussion—1 hour. Prerequisite: course 231B or the equivalent. Topics may include Bayesian analysis, nonparametric and semiparamet-
ric regression, sequential analysis, bootstrap, statisti-
cal methods in high dimensions, reliability, spatial processes, inference for stochastic process, stochas-
tic methods in finance, empirical processes, change-
point problems, asymptotics for parametric, non-
parametric and semiparametric models, nonlinear time series, robustness. May be repeated for credit with consent of instructor. Offered irregularly. —II.

252. Advanced Topics in Biostatistics (4)

Lecture—3 hours; discussion/laboratory—1 hour. Prerequisite: course 222, 223. Biostatistical methods and models selected from the following: genetics, bioinformatics and genomics; longitudinal or func-
tional data; clinical trials and experimental design; and Human Resources in Science and Engineering, nutri-
tion and toxicology; survival analysis; observational studies and epidemiology; computer-intensive or Bayesian methods in biostatistics. May be repeated for credit with consent of adviser when topic differs. (Same course as Biostatistics 252.) Offered in alternate years. —III.

280. Orientation to Statistical Research (2)

Seminar—2 hours. Prerequisite: consent of instructor. Guided orientation to original statistical research papers, and oral presentations in class of such papers by students under the supervision of a faculty member. May be repeated one time for credit. (S/U grading only.)

290. Seminar in Statistics (1-6)

Prerequisite: consent of instructor. Seminar on advanced topics in probability and statistics. (S/U grading only)—I, II, III. (I, II, III.)

292. Graduate Group in Statistics Seminar (1-2)

Seminar—1-2 hours. Prerequisite: graduate standing. Advanced study in various fields of statistics with emphasis in applied topics, presented by mem-
ers of the Graduate Group in Statistics and other guest speakers. (S/U grading only)—I, II, III. (I, II, III.)

298. Directed Group Study (1-5)

Prerequisite: graduate standing, consent of instruc-
tor.

299. Individual Study (1-12)

Prerequisite: consent of instructor. (S/U grading only)

299D. Dissertation Research (1-12)

Prerequisite: advancement to candidacy for Ph.D., consent of instructor. (S/U grading only)

300. Professional

300. Methods of Teaching Statistics (2)

Lecture/discussion—1 hour; laboratory—1 hour. Prerequisite: graduate standing. Practical experience in methods/problems of teaching statistics at univer-
sity undergraduate level. Lecturing techniques, analy-
sis of tests and supporting material, preparation and grading of examinations, and use of statistical soft-
ware. Emphasis on practical training. May be repeated for credit. (S/U grading only)—I, II.

366. Teaching Assistant Training Practicum (1-4)

Prerequisite: consent of instructor; graduate stand-
ing. (S/U grading only)—I, II, III. (I, II, III.)

396. Teaching Assistant Training Practicum (1-4)

Prerequisite: consent of instructor; graduate stand-
ing. (S/U grading only)—I, II, III. (I, II, III.)

401. Methods in Statistical Consulting (3)

Lecture—3 hours; discussion—1 hour. Introduction to consulting, in-class consulting as a group, statistical consulting with clients, and in-class discussion of con-
sulting problems. Client work drawn from a pool of University clients. Students must be enrolled in the graduate program in Statistics or Biostatistics. May be repeated for credit with consent of graduate adviser. Offered irregularly. (S/U grading only)—I, II, III. (I, II, III.)