

# STATISTICS

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## ACADEMIC PROGRAMS

Program name	Program type
Cross Disciplinary Studies Minor in Data Science	Minor
Statistics	BS, Minor

The Statistics Department offers a variety of introductory courses to students majoring in diverse disciplines across the University, in addition to providing a vibrant undergraduate degree program in Statistics for students who want to pursue careers in industry or graduate study in the discipline. The department also offers a minor in Statistics and contributes to a minor program in Actuarial Preparation and a cross-disciplinary studies minor program in Data Science.

Data abound in everyday life, in most academic disciplines, and in many industries. Professionals in many fields need to design studies, collect data, analyze results, and draw sound conclusions. In addition, professional statisticians must apply mathematical underpinnings of the discipline to new problems, use computing skills to organize and manipulate data, and communicate effectively with clients as well as with peers.

Employment prospects for professionals with skills in statistics and data science are very bright. Recent graduates of Cal Poly's program in statistics are working for companies in fields as varied as banking, social media, retail, entertainment, insurance, education, and pharmaceutical development.

## Undergraduate Programs

### BS Statistics

The statistics degree program requires students to develop a strong foundation in mathematics and computer science, as well as experience with a field of application. Coursework in the statistics program can be classified into four areas. Some courses provide mathematical background in probability and theoretical statistics. Others focus on computational thinking and coding skills with software packages. Most courses teach particular statistical methods for various types of data analysis such as regression, experimental design, categorical data analysis, time series techniques, multivariate methods, and survival analysis. Finally, some course specifically develop students' skills with oral and written communication and consulting with clients.

Throughout the program students encounter the entire process of conducting statistical investigations, from asking questions and designing studies through drawing conclusions and communicating results, throughout their studies. Statistics students repeatedly analyze real data from genuine studies and also acquire extensive experience using statistical software and writing technical reports of their analyses and findings.

## Actuarial Preparation Minor

For information regarding the Actuarial Preparation Minor, please see College of Science and Mathematics (<http://catalog.calpoly.edu/collegesandprograms/collegeofsciencemathematics>) section.

## Cross Disciplinary Studies Minor in Data Science

Through an inter-college collaboration, the Computer Science and Statistics departments offer a cross-disciplinary minor in Data Science – a rapidly evolving discipline that uses elements of statistics and computer science to gather, organize, summarize, and communicate information from a variety of data sources and data types. Job opportunities for data scientists are growing as the availability of data becomes ever abundant via the internet, consumer transactions, sensor arrays, medical records, embedded biometrics, bionformatics, etc.

The CDSM provides an opportunity for both statistics and computer science students to complement their major training with foundational skills for data science. Statistics majors will acquire essential programming, database, distributed computing, and data mining skills from the Computer Science Department while computer science majors will acquire essential probability, regression modelling, statistical programming, and multivariate analysis skills from the Statistics Department.

## Statistics Minor

The Statistics minor program allows students from across the University to acquire substantial statistical skills that can be applied in their own disciplines.

### DATA Courses

#### DATA 301. Introduction to Data Science. 4 units

Term Typically Offered: W

Prerequisite: CPE/CSC 202; and STAT 302 or STAT 312.

Introduction to the field of data science and the workflow of a data scientist. Types of data (tabular, textual, sparse, structured, temporal, geospatial), basic data management and manipulation, simple summaries, and visualization. 3 lectures, 1 laboratory.

#### DATA 401. Data Science. 4 units

Term Typically Offered: F

Prerequisites: CSC 365, CSC 466, DATA 301, STAT 331 and STAT 419.

Principles of data science and big data analytics. Volume, velocity, and variety of data. Acquisition, processing, and cleaning of large data-sets. Analytics for big data. 3 lectures, 1 laboratory.

#### DATA 451. Data Science Capstone I. 2 units

Term Typically Offered: W

Prerequisite: DATA 401.

Working with clients to develop data-driven solutions for systems to be constructed in DATA 452. Specification and design requirements, elicitation techniques, research and data gathering methods; project planning, time and budget estimating; project team organization. Ethics and professionalism. 2 laboratories.

**DATA 452. Data Science Capstone II. 2 units**

Term Typically Offered: SP

Prerequisite: DATA 451.

Team-based design, implementation, deployment and delivery of a system or analytical methodology that involves working with and analyzing large quantities of data. Technical management of research and development teams. Technical documentation, quality assurance, integration and systems testing. Design and conduct of empirical studies. Visualization and presentation of results orally and in writing. 2 laboratories.

**STAT Courses****STAT 130. Statistical Reasoning. 4 units**

GE Area B1

Term Typically Offered: F, W, SP

Prerequisite: Passing score on the ELM examination, or an ELM exemption, or credit in MATH 96 (formerly MATH 104).

Survey of statistical ideas and philosophy. Emphasis on concepts rather than in-depth coverage of statistical methods. Topics include sampling, experimentation, data exploration, chance phenomena, and methods of statistical inference. Not open to students with credit in any statistics course. 4 lectures. Fulfills GE B1; for students admitted Fall 2016 or later, a grade of C- or better in one GE B1 course is required to fulfill GE Area B.

**STAT 150. Introduction to the Discipline of Statistics. 2 units**

Term Typically Offered: F

Prerequisite: freshman and statistics major.

Orientation to the statistics program, introduction to the discipline of statistics, including the development of the discipline, professional ethics, data visualization and the role of statistics in the scientific enterprise. 2 lectures.

**STAT 200. Special Problems for Undergraduates. 1-2 units**

Term Typically Offered: F, W, SP

Prerequisite: Consent of department chair.

Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter.

**STAT 217. Introduction to Statistical Concepts and Methods. 4 units**

GE Area B1

Term Typically Offered: F,W,SP,SU

Prerequisite: Passing score on the ELM examination, or an ELM exemption, or credit in MATH 96 (formerly MATH 104).

Sampling and experimentation, descriptive statistics, confidence intervals, two-sample hypothesis tests for means and proportions, Chi-square tests, linear and multiple regression, analysis of variance. Substantial use of statistical software. Not open to students with credit in STAT 218 or STAT 251. Course may be offered in classroom-based or online format. 4 lectures. Fulfills GE B1; for students admitted Fall 2016 or later, a grade of C- or better in one GE B1 course is required to fulfill GE Area B.

**STAT 218. Applied Statistics for the Life Sciences. 4 units**

GE Area B1

Term Typically Offered: F,W,SP,SU

Prerequisite: Passing score on the ELM examination, or an ELM exemption, or credit in MATH 96 (formerly MATH 104).

Data collection and experimental design, descriptive statistics, confidence intervals, parametric and non parametric one and two-sample hypothesis tests, analysis of variance, correlation, simple linear regression, chi-square tests. Applications of statistics to the life sciences. Substantial use of statistical software. Not open to students with credit in STAT 217 or STAT 251. 4 lectures. Fulfills GE B1; for students admitted Fall 2016 or later, a grade of C- or better in one GE B1 course is required to fulfill GE Area B.

**STAT 251. Statistical Inference for Management I. 4 units**

GE Area B1

Term Typically Offered: F, W, SP

Prerequisite: Completion of the ELM requirement and a passing score on appropriate Mathematics Placement Examination for MATH 221 eligibility, or MATH 118 or equivalent.

Descriptive statistics. Probability and counting rules. Random variables and probability distributions. Sampling distributions and point estimation. Confidence intervals and tests of hypotheses for a single mean and proportion. 4 lectures. Fulfills GE B1; for students admitted Fall 2016 or later, a grade of C- or better in one GE B1 course is required to fulfill GE Area B.

**STAT 252. Statistical Inference for Management II. 5 units**

GE Area B1

Term Typically Offered: F, W, SP

Prerequisite: STAT 251 with a minimum grade of C- or consent of instructor.

Confidence intervals and tests of hypotheses for two means and two proportions. Introduction to ANOVA, regression, correlation, multiple regression, time series, and forecasting. Statistical quality control. Enumerative data analysis. Substantial use of statistical software. 5 lectures. Fulfills GE B1; for students admitted Fall 2016 or later, a grade of C- or better in one GE B1 course is required to fulfill GE Area B.

**STAT 270. Selected Topics. 1-4 units**

Term Typically Offered: TBD

Prerequisite: Open to undergraduate students and consent of instructor.

Directed group study of selected topics. The Schedule of Classes will list title selected. Total credit limited to 8 units. 1 to 4 lectures.

**STAT 301. Statistics I. 4 units**

Term Typically Offered: F, W

Prerequisite: MATH 141.

Introduction to statistics for mathematically inclined students, focused on process of statistical investigations. Observational studies, controlled experiments, randomization, confounding, randomization tests, hypergeometric distribution, descriptive statistics, sampling, bias, binomial distribution, significance tests, confidence intervals, normal model, t-procedures, two-sample procedures. Substantial use of statistical software. 4 lectures.

**STAT 302. Statistics II. 4 units**

Term Typically Offered: W, SP

Prerequisite: STAT 301.

Continued study of the process, concepts, and methods of statistical investigations. Association, chi-square procedures, one-way ANOVA, multiple comparisons, two-way ANOVA with interaction, simple linear regression, correlation, prediction, multiple regression. Substantial use of statistical software. 4 lectures.

**STAT 305. Introduction to Probability and Simulation. 4 units**

Term Typically Offered: F, W

Prerequisite: one of the following: CPE/CSC 101, CSC 232, CPE/CSC 235, or STAT 331; and MATH 142.

Basic probability rules, counting methods, conditional probability. Discrete and continuous random variables, expected values, variance and covariance. Properties of linear combinations of random variables with applications to statistical estimators. Simulation analysis of random phenomena using a modern computer language. Not open to students with credit in STAT 321. 4 lectures.

**STAT 312. Statistical Methods for Engineers. 4 units**

GE Area B6

Term Typically Offered: F,W,SP,SU

Prerequisite: MATH 142.

Descriptive and graphical methods. Discrete and continuous probability distributions. One and two sample confidence intervals and hypothesis testing. Single factor analysis of variance. Quality control. Introduction to regression and to experimental design. Substantial use of statistical software. 4 lectures. Fulfills GE B6.

**STAT 313. Applied Experimental Design and Regression Models. 4 units**

GE Area B1

Term Typically Offered: F, W, SP

Prerequisite: STAT 217 or STAT 218 or STAT 312 or STAT 542; and MATH 118 or equivalent, or completion of the ELM requirement and a passing score on the appropriate Mathematics Placement Examination for MATH 221 eligibility.

Analysis of variance and regression analysis for students not majoring in statistics or mathematics. Includes one-way classification, randomized blocks, Latin squares, factorial designs, multiple regression, diagnostics, and model comparison. 4 lectures. Fulfills GE B1; for students admitted Fall 2016 or later, a grade of C- or better in one GE B1 course is required to fulfill GE Area B.

**STAT 321. Probability and Statistics for Engineers and Scientists. 4 units**

GE Area B6

Term Typically Offered: F, W, SP

Prerequisite: MATH 142.

Tabular and graphical methods for data summary, numerical summary measures, probability concepts and properties, discrete and continuous probability distributions, expected values, statistics and their sampling distributions, point estimation, confidence intervals for a mean and proportion. Use of statistical software. 4 lectures. Fulfills GE B6.

**STAT 323. Design and Analysis of Experiments I. 4 units**

Term Typically Offered: W, SP

Prerequisite: IME 326 or STAT 252 or STAT 302 or STAT 312 or STAT 313.

Principles, construction and analysis of experimental designs. Completely randomized, randomized complete block, Latin squares, Graeco Latin squares, factorial, and nested designs. Fixed and random effects, expected mean squares, multiple comparisons, and analysis of covariance. 4 lectures.

**STAT 324. Applied Regression Analysis. 4 units**

Term Typically Offered: F, W, SP

Prerequisite: IME 326 or STAT 252 or STAT 302 or STAT 312 or STAT 313.

Linear regression including indicator variables, influence diagnostics, assumption analysis, selection of 'best subset', nonstandard regression models, logistic regression, nonlinear regression models. Not open to students with credit in STAT 334. 4 lectures.

**STAT 330. Statistical Computing with SAS. 4 units**

Term Typically Offered: F, W

Prerequisite: IME 326 or STAT 252 or STAT 302 or STAT 312 or STAT 313.

Data acquisition, cleaning, and management using SAS; reading data into SAS from various sources, recoding variables, subsetting and merging data, exporting results in other formats. Graphical procedures, basic descriptive and inferential statistics. Introduction to SAS macros. 4 lectures.

**STAT 331. Statistical Computing with R. 4 units**

Term Typically Offered: F, SP

Prerequisite: one of the following: IME 326, STAT 252, STAT 302, STAT 312, or STAT 313; and one of the following: BUS 290, CPE/CSC 101, CPE/CSC 235, ECON 395, or STAT 330.

Data acquisition, cleaning, and management in R; use of regular expressions; functional and object-oriented programming; graphical, descriptive, and inferential statistical methods; random number generation; Monte Carlo methods including resampling, randomization, and simulation. 4 lectures.

**STAT 334. Applied Linear Models. 4 units**

Term Typically Offered: W, SP

Prerequisite: one of the following: STAT 252, STAT 302, STAT 312, STAT 313, or IME 326; and one of the following: MATH 206, or MATH 244.

Linear models in algebraic and matrix form, diagnostics, transformations, polynomial models, categorical predictors, model selection, correlated errors, logistic regression. Not open to students with credit in STAT 324. 4 lectures.

**STAT 350. Probability and Random Processes for Engineers. 4 units**

GE Area B6

Term Typically Offered: F, W, SP

Prerequisite: MATH 241, EE 228.

Random events, random variables, and random processes, with emphasis on probabilistic treatment of signals and noise. Specific topics include: sample spaces, probability, distributions, independence, moments, covariance, time/ensemble averages, stationarity, common processes, correlation and spectral functions. 4 lectures. Fulfills GE B6.

**STAT 365. Statistical Communication. 2 units**

Term Typically Offered: SP

Prerequisite: Completion of GE Areas A1 and A3; and one of the following: STAT 252, STAT 302, or STAT 313.

Written communication of statistical ideas and content. Analyze data using appropriate methods from previous statistics courses. Writing technical reports with appropriate graphs and tables. Strategies to discern relevant and necessary information to communicate data, ideas, and results to different audiences. 2 lectures.

**STAT 400. Special Problems for Advanced Undergraduates. 1-2 units**

Term Typically Offered: F, W, SP

Prerequisite: Consent of department head.

Individual investigation, research, studies or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter.

**STAT 405. Applied Probability Models. 4 units**

Term Typically Offered: SP

Prerequisites: CPE/CSC 101 or CSC 232 or CPE/CSC 235; MATH 206 or MATH 244; and STAT 305 or STAT 350 or STAT 426.

Advanced probability models, their simulation and application. Poisson processes, Markov chains, random walks, and continuous-time Markov processes. Monte Carlo integration and simulation methods, including Markov chain Monte Carlo and Gibbs sampling. 4 lectures.

**STAT 410. Statistics Education: Pedagogy, Content, Technology, and Assessment. 4 units**

Term Typically Offered: SP

Prerequisite: one of the following: STAT 130, STAT 217, STAT 218, STAT 251, STAT 301, STAT 312, STAT 321, STAT 511, STAT 512 or STAT 542.

Topics related to content, pedagogy, technology, and assessment for teaching statistics in grades 6-16 in accordance with current standards and research for teaching statistics including the Common Core State Standards for Mathematics. 4 lectures.

**STAT 414. Multilevel and Mixed Modeling. 4 units**

Term Typically Offered: F

Prerequisite: STAT 324 or STAT 334 or STAT 524.

Overview of multilevel and mixed models, including hierarchical data, intraclass correlation, fixed vs. random coefficients, variance components, comparisons to traditional analyses. Use of statistical software for implementation of methods. 4 lectures.

**STAT 415. Bayesian Reasoning and Methods. 4 units**

Term Typically Offered: W

Prerequisite: one of the following: IME 326, STAT 252, STAT 302, STAT 312, STAT 313, or STAT 513; and one of the following: STAT 305, STAT 350, or STAT 425. Recommended: STAT 331.

Bayes' theorem, prior and posterior distributions, likelihood functions, Markov Chain Monte Carlo methods, hierarchical modeling. Bayesian data analysis, comparison of Bayesian and classical (frequentist) approaches. 4 lectures.

**STAT 416. Statistical Analysis of Time Series. 4 units**

Term Typically Offered: F

Prerequisite: STAT 324 or STAT 334 or STAT 524.

Time series components, descriptive smoothing methods, regression models for time series data, forecasting via exponential smoothing, evaluation of forecasts, autocorrelation, ARIMA models and Box-Jenkins methods, combining forecasts, frequency domain analysis, filtering. 4 lectures.

**STAT 417. Survival Analysis Methods. 4 units**

Term Typically Offered: W

Prerequisite: IME 326 or STAT 252 or STAT 302 or STAT 312 or STAT 313; and MATH 142.

Parametric and nonparametric methods for analyzing survival data. Topics include Kaplan-Meier and Nelson-Aalen estimates, Cox regression models, accelerated failure time models. Use of statistical software to implement methods throughout course. 4 lectures.

**STAT 418. Categorical Data Analysis. 4 units**

Term Typically Offered: W

Prerequisite: STAT 324 or STAT 334 or STAT 524.

Discrete multivariate statistics, including analysis of cross-classified data, log-linear models for multidimensional contingency tables, goodness of fit statistics, measures of association, model selection, and hypothesis testing. 4 lectures.

**STAT 419. Applied Multivariate Statistics. 4 units**

Term Typically Offered: SP

Prerequisite: One of the following: IME 326, STAT 252, STAT 302, STAT 312, STAT 313, STAT 513, or STAT 542; and one of the following: MATH 206, MATH 244, or graduate standing.

Continuous multivariate statistics. Multivariate linear model, principal components and factor analysis, discriminant analysis, clustering, classification, and canonical correlation. Use of statistical software throughout the course. 4 lectures.

**STAT 421. Survey Sampling and Methodology. 4 units**

Term Typically Offered: F

Prerequisite: IME 326 or STAT 252 or STAT 302 or STAT 312 or STAT 313 or STAT 511 or STAT 512 or STAT 513.

Survey planning, execution, and analysis. Principles of survey research, including non-sampling and sampling error topics. Survey sample designs, including simple random, systematic, stratified, cluster, and multi-stage. Estimation procedures and sample size calculations. 4 lectures.

**STAT 423. Design and Analysis of Experiments II. 4 units**

Term Typically Offered: SP

Prerequisite: STAT 323 or STAT 523.

Continuation of STAT 323. 2k factorial designs, 3k factorial designs, balanced and partially balanced incomplete block designs, nested designs, split-plot designs, response surface methodology, confounding, repeated measures, and other design approaches. 4 lectures.

**STAT 425. Probability Theory. 4 units**

Term Typically Offered: F

Prerequisite: MATH 241; and MATH 248 or CSC 348. Recommended: STAT 301 and STAT 305.

Basic probability theory, combinatorial methods, independence, conditional and marginal probability, probability models for random phenomena, random variables, probability distributions, distributions of functions of random variables, mathematical expectation, covariance and correlation, conditional expectation. 4 lectures.

**STAT 426. Estimation and Sampling Theory. 4 units**

Term Typically Offered: W

Prerequisite: STAT 425. Recommended: STAT 302.

Continuation of STAT 425. Properties of statistics obtained from samples. Sample mean properties, convergence in probability, law of large numbers, and central limit theorem. Selected probability distributions. Theory of estimation. Sampling distribution of estimators. 4 lectures.

**STAT 427. Mathematical Statistics. 4 units**

Term Typically Offered: SP

Prerequisite: STAT 426.

Continuation of STAT 426. The theory of hypothesis testing and its applications. Power and uniformly most powerful tests. Categorical data and nonparametric methods. Other selected topics. 4 lectures.

**STAT 434. Statistical Learning: Methods and Applications. 4 units**

Term Typically Offered: SP

Prerequisites: one of the following: STAT 324, STAT 334, or STAT 524.

Recommended: STAT 331 or STAT 531.

Modern methods in predictive modeling and classification. Splines, smoothing splines, ridge regression, LASSO, regression and classification trees, generalized additive models, logistic regression, and linear discriminant analysis. Model assessment and selection using cross validation, bootstrapping, AIC, and BIC. 4 lectures.

**STAT 440. SAS Certification Preparation. 2 units**

Term Typically Offered: W

Prerequisite: STAT 330.

Programming, data management, and data analysis in preparation for the Certified Base Programmer Exam offered by the SAS Institute. Topics include accessing data, creating data structures, managing data, generating reports, and handling errors. 2 lectures.

**STAT 441. SAS Advanced Certification Preparation. 2 units**

Term Typically Offered: SP

Prerequisite: STAT 440.

Programming topics in preparation for the Certified Advanced Programmer Exam offered by the SAS Institute. Accessing data using PROC SQL, macro processing, applications for indexes, data look-up techniques including array processing, hash objects, and combining/merging. 2 lectures.

**STAT 461. Senior Project I. 1 unit**

Term Typically Offered: F, W, SP

Selection and completion of a project under faculty supervision. Projects typical of problems which graduates must solve in their fields of employment. Project results are presented in a formal report. Minimum 90 hours total time.

**STAT 462. Senior Project II. 2 units**

Term Typically Offered: F, W, SP

Selection and completion of a project under faculty supervision. Projects typical of problems which graduates must solve in their fields of employment. Project results are presented in a formal report. Minimum 90 hours total time.

**STAT 465. Statistical Consulting. 4 units**

Term Typically Offered: SP

Prerequisite: STAT 365; Statistics major; and senior standing.

Blending of the theoretical and practical aspects of statistical consulting. Development of tools necessary to conduct effective consulting sessions, present oral arguments and written reports, work collaboratively to solve problems, and utilize professional publications in statistics. 4 lectures.

**STAT 470. Selected Advanced Topics. 1-4 units**

Term Typically Offered: TBD

Prerequisite: Consent of instructor.

Directed group study of selected topics for advanced students. Open to undergraduate and graduate students. Class Schedule will list topic selected. Total credit limited to 8 units. 1-4 lectures.

**STAT 485. Cooperative Education Experience. 6 units**

CR/NC

Term Typically Offered: F, W, SP

Prerequisite: Sophomore standing and consent of instructor.

Part-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Major credit limited to 6 units; total credit limited to 12 units. Credit/No Credit grading only.

**STAT 495. Cooperative Education Experience. 12 units**

CR/NC

Term Typically Offered: F, W, SP

Prerequisite: Sophomore standing and consent of instructor.

Full-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Major credit limited to 12 units; total credit limited to 24 units. Credit/No Credit grading only.

**STAT 511. Statistical Methods. 4 units**

Term Typically Offered: F

Prerequisite: Graduate standing and intermediate algebra or equivalent.

Statistical methods in research for graduate students not majoring in mathematical sciences. Probability distributions, confidence intervals, hypothesis testing, contingency tables, linear regression and correlation, multiple regression, analysis of variance. Substantial use of statistical software. 4 lectures. Formerly STAT 512.



**STAT 513. Applied Experimental Design and Regression Models. 4 units**

Term Typically Offered: W, SP

Prerequisite: Graduate standing and one of the following: STAT 217, STAT 218, STAT 252, STAT 312, STAT 511, STAT 512, or STAT 542.

Applications of statistics for graduate students not majoring in mathematics. Analysis of variance including the one-way classification, randomized blocks, Latin squares, and factorial designs. Introduction to multiple regression and to analysis of covariance. Substantial use of statistical software. 4 lectures. Not open to students with credit in STAT 313.

**STAT 523. Design and Analysis of Experiments I. 4 units**

Term Typically Offered: W, SP

Prerequisite: STAT 513 or STAT 542.

Principles, construction and analysis of experimental designs. Completely randomized, randomized complete block, Latin squares, Graeco-Latin squares, factorial, and nested designs. Fixed and random effects, expected mean squares, multiple comparisons, and analysis of covariance. Not open to students with credit in STAT 323. 4 lectures.

**STAT 524. Applied Regression Analysis. 4 units**

Term Typically Offered: F, W, SP

Prerequisite: STAT 513 or STAT 542.

Linear regression including indicator variables, influence diagnostics, assumption analysis, selection of 'best subset', nonstandard regression models, logistic regression, nonlinear regression models. Not open to students with credit in STAT 324 or STAT 334. 4 lectures.

**STAT 530. Statistical Computing with SAS. 4 units**

Term Typically Offered: F, W

Prerequisite: STAT 511 or STAT 512 or STAT 513 or STAT 542.

Techniques available to the statistician for efficient use of computers to perform statistical computations and to analyze large amounts of data. Use of the SAS software system. Includes data preparation, report writing, basic statistical methods, and a research project. Not open to students with credit in STAT 330. 4 lectures.

**STAT 531. Statistical Computing with R. 4 units**

Term Typically Offered: F, SP

Prerequisite: Graduate standing, STAT 513 or STAT 542, and one computer programming course; or consent of instructor.

Obtain, manage, and clean data; use of regular expressions; functional and object-oriented programming; graphical, descriptive, and inferential statistical methods; random number generation; Monte Carlo methods including resampling, randomization, and simulation. Not open to students with credit in STAT 331. 4 lectures.

**STAT 542. Statistical Methods for Engineers. 4 units**

Term Typically Offered: F,W,SP,SU

Prerequisite: MATH 142 and graduate standing.

Descriptive and graphical methods. Discrete and continuous probability distributions. One and two sample confidence intervals and hypothesis testing. Single factor analysis of variance. Quality control. Introduction to regression and to experimental design. Substantial use of statistical software. Not open to students with credit in STAT 312. 4 lectures.

**STAT 570. Selected Advanced Topics. 1-4 units**

Term Typically Offered: TBD

Prerequisite: Graduate standing or consent of instructor.

Directed group study of selected topics for graduate students. Open to undergraduate and graduate students. The Schedule of Classes will list title selected. Total credit limited to 8 units. 1-4 lectures.