

# Statistics

IN THE COLLEGE OF SCIENCES

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## Faculty

**Emeritus:** Burdick, Macky, Noble, Romano

**Chair:** O'Sullivan

**Associate Chair for Statistics:** Lin

**Professors:** Fan, Levine

**Associate Professors:** Bailey, Chen, Lin

**Assistant Professors:** Román, Scharf

**Lecturer:** Duncan

## Offered by the Department of Mathematics and Statistics

Master of Science degree in statistics.

Concentration in biostatistics.

Major in statistics with the B.S. degree

in applied arts and sciences.

Emphasis in actuarial science.

Emphasis in data science.

Minor in statistics.

## The Major

Statistics is the science which studies data – its collection, description, analysis, and interpretation. Almost all modern professions, from economists to engineers and from social scientists to medical scientists, rely on statistics. Statistical methods are used for studying relationships, predicting results, testing hypothesis, and a variety of other purposes.

The Bachelor of Science degree in statistics is designed to provide students with a fundamental understanding of probability and mathematical statistics, a complementary knowledge of basic methods for data collection and inference, and practical computing skills to carry out statistical analyses of problems in many different areas of application.

One option within the major allows students with a strong interest in statistical or biostatistical aspects of a particular science to apply courses in that science to their major. This option should provide the interested student with a good background for employment or graduate work in statistics, biostatistics, or in that science. Emphases in actuarial science and data science enable students to pursue further specializations aligned with professional opportunities in these areas.

Statistics is the discipline at the heart of the scientific method of discovery. Statistical principles are used in designing experiments and surveys to collect information, and statistical procedures are applied to summarize information, draw conclusions, and make decisions.

Because of the broad applicability of their training in statistical reasoning and data analysis, undergraduate majors are prepared for careers in diverse fields – such as biotechnology, environmental science, insurance, industrial manufacturing, and market research – in which the need for professionally trained statisticians is great.

Graduates who seek to acquire additional skills in applied or theoretical statistics may also consider programs of advanced study at the master's or doctoral level. Statisticians with advanced degrees are sought for senior positions in industry and government, as well as teaching positions in secondary schools, community colleges, and universities.

## Impacted Program

The statistics major and emphases are impacted programs. To be admitted to the statistics major or an emphasis, students must meet the following criteria:

- Complete preparation for the major;
- Complete Mathematics 150 and 151 with a minimum grade of C (2.0) or better. These courses cannot be taken for credit/no credit (Cr/NC);
- Complete a minimum of 60 transferable semester units;
- Have a minimum cumulative GPA of 2.0.

To complete the major, students must fulfill the degree requirements for the major described in the catalog in effect at the time they are accepted into the premajor at SDSU (assuming continuous enrollment).

## Major Academic Plans (MAPs)

Visit <http://www.sdsu.edu/mymap> for the recommended courses needed to fulfill your major requirements. The MAPs website was created to help students navigate the course requirements for their majors and to identify which General Education course will also fulfill a major preparation course requirement.

## Statistics Major

With the B.S. Degree in Applied Arts and Sciences

**(Major Code: 17021) (SIMS Code: 776371)**

All candidates for a degree in applied arts and sciences must complete the graduation requirements listed in the section of this catalog on "Graduation Requirements."

A minor is not required with this major.

Upon entry to the program, the student will be assigned to an undergraduate adviser in statistics. Thereafter, the student will meet with the adviser each semester and discuss his or her academic program. A program of study must be approved by the undergraduate adviser in statistics.

In addition to meeting the requirements for undergraduate standing and the basic requirements for the bachelor of science degree as described in this catalog, the student must complete a Graduation Writing Assessment Requirement and must complete a minimum of 60 units of coursework as described below.

**Preparation for the Major.** Statistics 119 or 250; Mathematics 150, 151, 245, 254. Mathematics 150 and 151 must be completed with a minimum grade of C (2.0) and cannot be taken for credit/no credit (Cr/NC). (17 units)

**Graduation Writing Assessment Requirement.** Passing the Writing Placement Assessment with a score of 10 or completing one of the approved upper division writing courses (W) with a grade of C (2.0) or better. See "Graduation Requirements" section for a complete listing of requirements.

**Additional Lower Division Coursework Required.** Mathematics 252, Computer Science 107. (7 units)

**Major.** A minimum of 36 upper division units to include Statistics 350A, 350B, 410, 551A, 551B; nine units selected (with the approval of the undergraduate adviser in statistics) from Statistics 325, 496, 520, 560, 575, 580, 596; 12 upper division units in statistics, mathematics (excluding Mathematics 302, 303, 312, 313, 414), computer science, or a science of application (selected with the approval of the undergraduate adviser in statistics).

**Master Plan.** A master plan of the courses taken to fulfill the major must be approved by the adviser and filed with the major department.

### Emphasis in Actuarial Science

(SIMS Code: 776372)

This emphasis is designed to prepare students for careers in the actuarial profession, applying probability and statistical models to problems of insurance and finance. Actuaries improve financial decision making by evaluating the current financial implications of uncertain future events. Students completing this emphasis would also be well prepared for graduate study in actuarial science or statistics.

**Preparation for the Major.** Statistics 119 or 250; Accountancy 201; Computer Science 107; Economics 101, 102; Mathematics 150, 151, 245, 252, 254. Mathematics 150 and 151 must be completed with a minimum grade of C (2.0) and cannot be taken for credit/no credit (Cr/NC). (33 units) The student must complete these courses before being allowed to register for the upper division finance courses.

**Graduation Writing Assessment Requirement.** Passing the Writing Placement Assessment with a score of 10 or completing one of the approved upper division writing courses (W) with a grade of C (2.0) or better. See "Graduation Requirements" section for a complete listing of requirements.

**Major.** A minimum of 36 upper division units to include Statistics 350A, 350B, 551A, 551B, 575; Business Administration 323; Economics 320, 321; Finance 327; three units selected from Statistics 325, 410, 496, 560, 596; six units selected from Finance 421, 427, or an appropriate course selected with the approval of the undergraduate adviser in Statistics.

**Master Plan.** A master plan of the courses taken to fulfill the major must be approved by the adviser and filed with the major department.

### Emphasis in Data Science

(SIMS Code: 776374)

Modern day statistics applications require heavy computing for manipulating massive data sets, mining immense databases, and implementing computationally intensive data analytic tools to solve complex scientific problems. This emphasis is designed to prepare students for careers in statistics by providing them with the data analytic and computational machinery needed to excel in all avenues of statistical science during an information age where statistical computing plays a crucial role. Students completing this emphasis would also be well prepared for graduate study in statistical computing and statistics.

**Preparation for the Major.** Statistics 250, Mathematics 150, 151, 245, 252, 254, Computer Science 107, 108. Mathematics 150 and 151 must be completed with a minimum grade of C (2.0) and cannot be taken for credit/no credit (Cr/NC). (27 units)

**Graduation Writing Assessment Requirement.** Passing the Writing Placement Assessment with a score of 10 or completing one of the approved upper division writing courses (W) with a grade of C (2.0) or better. See "Graduation Requirements" section for a complete listing of requirements.

**Major.** A minimum of 36 upper division units to include Statistics 325, 350A, 350B, 410, 551A, 551B, 580; Computer Science 310; Computer Science 503 or 514 or Management Information Systems 380; Linguistics 571 or 572 [or Big Data Analytics 572] or 581 [or Computer Science 581]; six upper division units in statistics, computer science, or a science of application with a heavy statistical computing component (selected with the approval of the undergraduate adviser in statistics).

**Master Plan.** A master plan of the courses taken to fulfill the major must be approved by the adviser and filed with the major department.

### Statistics Minor

(SIMS Code: 776369)

The minor in statistics consists of a minimum of 15 units in statistics to include Statistics 250 (or equivalent), 350A, 350B or 410, and six units of upper division electives in statistics. For Statistics 550 and 551A, students must satisfy lower division calculus and linear algebra prerequisites (Mathematics 151, 252, and 254 as appropriate).

The minor program includes a combination of courses in applied statistical methods, computer-oriented data analysis, probability, and mathematical statistics, which can be tailored to the student's major, academic, or professional interests. For example, business students interested in actuarial science may wish to consider a minor comprising Statistics 350A, 350B, 551A, and 551B. Students in the social, behavioral, and natural sciences who are particularly interested in applications and data analysis may wish to consider a minor comprising Statistics 350A, 350B, 410, and 520.

Students considering a minor in statistics are encouraged to consult with their major adviser and with the minor adviser in statistics. Courses in the minor may not be counted toward the major, but may be used to satisfy preparation for the major and general education requirements, if applicable. A minimum of six upper division units must be completed at San Diego State University.

### Courses (STAT)

*Refer to Courses and Curricula and University Policies sections of this catalog for explanation of the course numbering system, unit or credit hour, prerequisites, and related information.*

#### LOWER DIVISION COURSES

##### STAT 119. Elementary Statistics for Business (3) [GE]

Measures of central tendency and variability, frequency distributions; probability, Bayes theorem, probability distributions (including binomial, hypergeometric, and normal), sampling distributions, confidence intervals, significance testing, regression and correlation. Statistics 119A is designed to be taken concurrently for students who may need additional review. Not open to students with credit in Statistics 250. Students with credit or concurrent registration in the following lower division statistics courses other than Statistics 250 will be awarded a total of four units for the two (or more) courses: Statistics 119; Administration, Rehabilitation and Postsecondary Education 201; Biology 215; Civil Engineering 160; Economics 201; Linguistics 270; Political Science 201; Psychology 280; Sociology 201.

##### STAT 119A. Recitation for Elementary Business Statistics (1) Cr/NC

Two hours of activity.

Prerequisite: Concurrent registration in Statistics 119.

Additional problem solving, data analyses, statistical concept discussions, and applications.

##### STAT 119X. Elementary Statistics Support (1) Cr/NC

Three hours of activity.

Prerequisite: Concurrent registration in Statistics 119. Required for students who have not satisfied the SDSU Mathematics/Quantitative Reasoning Assessment requirement.

Required support course for Statistics 119. Credit in this course satisfies the SDSU Mathematics/Quantitative Reasoning Assessment requirement.

##### STAT 200. Introduction to Data Science with R (4)

Three lectures and three hours of laboratory.

Basic data analysis with R. Summarizing and visualizing data. Sampling and distribution. Analysis tools to include clustering, confidence intervals, regression, and sampling.

**STAT 250. Statistical Principles and Practices (3) [GE]**

Two lectures and two hours of activity.

Descriptive statistics, data displays, measures of central tendency and variability, random variables, sampling distribution. Estimation and hypothesis tests for means and proportions, linear regression and correlation. Not open to students with credit in Statistics 119. Students with credit or concurrent registration in the following lower division statistics courses other than Statistics 119 will be awarded a total of four units for the two (or more) courses: Statistics 250; Administration, Rehabilitation and Postsecondary Education 201; Biology 215; Civil Engineering 160; Economics 201; Linguistics 270; Political Science 201; Psychology 280; Sociology 201.

**STAT 296. Experimental Topics (1-4)**

Selected topics. May be repeated with new content. See *Class Schedule* for specific content. Limit of nine units of any combination of 296, 496, 596 courses applicable to a bachelor's degree.

**STAT 299. Special Study (1-3)**

Prerequisite: Consent of instructor.  
Individual study. Maximum credit six units.

**UPPER DIVISION COURSES**

(Intended for Undergraduates)

**NOTE: Proof of completion of prerequisites required** for all upper division courses: Copy of transcript.

**STAT 325. SAS Programming and Data Management (3)**

Prerequisite: Statistics 250 or comparable course in statistics.  
Entry, management, and summary of statistical data using SAS programming language. Data structures and manipulation, screen editing, visual displays, macros, related topics.

**STAT 350A. Statistical Methods (3)**

Prerequisite: Statistics 250 or comparable course in statistics.  
One- and two-sample hypothesis tests, paired difference tests, tests for variances, analysis of variance. Linear regression and correlation. Chi-square tests. Simple nonparametric tests. Power of hypothesis tests.

**STAT 350B. Statistical Methods (3)**

Prerequisite: Statistics 350A.  
Multiple regression, factorial models and nonparametric methods, all with emphasis on applications.

**STAT 410. R Programming and Data Science (3)**

Prerequisite: Statistics 350B.  
Numerical and simulation methods, statistical graphics, and statistical procedures for analyzing data. Logistic regression, multiple linear regression, and one- and two-way ANOVA models. Matrix formulations of regression models.

**STAT 496. Experimental Topics (1-4)**

Selected topics. May be repeated with new content. See *Class Schedule* for specific content. Limit of nine units of any combination of 296, 496, 596 courses applicable to a bachelor's degree.

**STAT 499. Special Study (1-3)**

Prerequisite: Consent of instructor.  
Individual study. Maximum credit six units.

**UPPER DIVISION COURSES**

(Also Acceptable for Advanced Degrees)

**NOTE: Proof of completion of prerequisites required** for all upper division courses: Copy of transcript.

**STAT 520. Applied Multivariate Analysis (3)**

Prerequisite: Statistics 350B or comparable course in statistics.  
Multivariate normal distribution, multivariate analysis of variance, principal components, factor analysis, discriminant function analysis, classification, and clustering. Statistical software packages will be used for data analysis.

**STAT 550. Applied Probability (3)**

Prerequisites: Mathematics 151 and 254.  
Computation of probabilities via enumeration and simulation, discrete and continuous distributions, moments of random variables. Markov chains, counting and queuing processes, and selected topics.

**STAT 551A. Probability and Mathematical Statistics (3)**

Prerequisite: Mathematics 252.

Discrete and continuous random variables, probability mass functions and density functions, conditional probability and Bayes' theorem, moments, properties of expectation and variance, joint and marginal distributions, functions of random variables, moment generating functions. Special distributions and sampling distributions.

**STAT 551B. Probability and Mathematical Statistics (3)**

Prerequisite: Statistics 551A.

Point and interval estimation and hypothesis testing in statistical models with applications to problems in various fields.

**STAT 560. Sample Surveys (3)**

Prerequisite: Statistics 550 or 551A.

Methods for design and analysis of sample surveys with applications to social and biological sciences. Simple random sampling, stratification and clustering, ratio and regression estimators, subsampling, selected topics in survey methodology.

**STAT 570. Stochastic Processes (3)**

Prerequisite: Statistics 551A.

Introduction to stochastic processes with selected applications.

**STAT 575. Actuarial Modeling (3)**

Prerequisite: Statistics 550 or 551A.

Actuarial models and applications of probability and statistics to insurance and other financial risks. Utility theory; risk models, compound processes; survival distributions and life tables; life insurance, annuities and benefits.

**STAT 580. Statistical Computing (3)**

Two lectures and two hours of activity.

Prerequisite: Statistics 551B.

Machine computation in development, application, and evaluation of advanced statistical techniques. Floating arithmetic and algorithm stability; numerical methods for parameter estimation (including maximum likelihood) and multivariate probability integration; simulation and other computer-intensive statistical techniques.

**STAT 596. Advanced Topics in Statistics (1-4)**

Prerequisite: Consent of instructor.

Selected topics in statistics. May be repeated with the approval of the instructor. See *Class Schedule* for specific content. Limit of nine units of any combination of 296, 496, 596 courses applicable to a bachelor's degree. Maximum credit of six units of 596 applicable to a bachelor's degree. Credit for 596 and 696 applicable to a master's degree with approval of the graduate adviser.

**GRADUATE COURSES**

Refer to the *Graduate Bulletin*.