

# STAT - Statistics

**STAT 201Q. Statistics in the World. 3 Credits.** (3 Lec) S On Demand.  
PREREQUISITES: M 096, M097 or Math Placement Test within the past 12 months. Discusses statistical reasoning and methods as related to today's society. Emphasizes ideas rather than specific techniques. Focuses on real examples of the use (and misuse) of statistics. Includes sampling, experimentation, descriptive statistics, elementary probability and statistical inference.

**STAT 216Q. Introduction to Statistics. 3 Credits.** (3 Lec) F,S,Su  
PREREQUISITE: Level 3 Math Placement Test within the past 12 months, B or better in M 096/097 or a C- or better in any 100 level or above M course. Traditional and resistant estimators of location and spread, fundamentals of inference using randomization and classical methods, confidence intervals, and tests of hypotheses. This course is taught in the TEAL format. COMMON EXAMS.

**STAT 217Q. Intermediate Statistical Concepts. 3 Credits.** (3 Lec) F,S,Su  
PREREQUISITE: C- or better in STAT 216Q. One- and two-sample tests and associated confidence intervals for means and proportions; analysis of variance; F-tests, correlation, regression, contingency tables. Statistical analysis using the computer. COMMON FINAL ONLY.

**STAT 226Q. Honors Introduction to Statistics. 3 Credits.** (3 Lec) S On Demand.  
PREREQUISITE: Enrollment in the MSU Honors Program or consent of instructor. Honors section of STAT 216Q. Topic coverage parallels STAT 216Q but with greater emphasis on applications, data analysis and interpretation, statistical computing, and statistics in the media.

**STAT 290R. Undergraduate Research. 1-8 Credits.** (1-8 Ind; 8 cr max) F,S,Su  
PREREQUISITE: Consent of department head. Directed undergraduate research. Course will address responsible conduct of research.

**STAT 291. Special Topics. 1-4 Credits.** (1-4 Lec; 12 cr max) On Demand  
PREREQUISITE: None required but some may be determined necessary. Courses not required in any curriculum for which there is a particular one-time need, or given on a trial basis to determine acceptability and demand before requesting a regular course number.

**STAT 332. Statistics for Scientists and Engineers. 3 Credits.** (3 Lec) F,S  
PREREQUISITE: M 172Q. Methods of estimation, data collection, analysis and display of quantitative information, continuous and discrete random variables, families of probability distributions, hypothesis testing, regression, ANOVA.

**STAT 401. Applied Methods in Statistics. 3 Credits.** (2 Lec, 1 Lab) F,S  
PREREQUISITE: Graduate standing and STAT 216Q. This course is intended for graduate students not majoring in mathematical sciences and not ready for STAT 511. Graphical techniques, data collection plans, populations, samples, sampling distributions, analysis of variance for one-way classifications, multiple comparisons, simple linear regression.

**STAT 408. Statistical Computing and Graphical Analysis. 1-3 Credits.** (1-3 Lec; 3 cr max) F  
PREREQUISITE: One of the following: STAT 217Q, STAT 332, or STAT 401. Introduction to statistical packages R or SAS, including data importation, cleaning, graphing, and basic programming. Emphasis on use of graphical displays to explore, understand, and present data, and on organization of code.

**STAT 411. Methods for Data Analysis I. 3 Credits.** (2 Lec, 1 Lab) F,S  
PREREQUISITE: STAT 217Q or STAT 332, or equivalent and consent of instructor. Introduction to statistical inference and design, t-tools, non-parametric alternatives, one-way ANOVA, simple linear regression, multiple linear regression, with an emphasis on statistical thinking, appropriate inference, interpretation of results, and writing. Co-convended with STAT 511.

**STAT 412. Methods for Data Analysis II. 3 Credits.** (2 Lec, 1 Lab) S  
PREREQUISITE: STAT 411. Continuation of STAT 411/STAT 511 to cover principles of experimental design, multi-factor ANOVA, repeated measures, logistic regression, Poisson log-linear regression, and introductions to multivariate and time series analyses, with an emphasis on statistical thinking, appropriate inference and interpretation, and writing. Co-convended with STAT 512.

**STAT 421. Probability Theory. 3 Credits.** (3 Lec) F  
PREREQUISITE: M 273Q and M 242 Strongly recommended. Fundamentals of probability; discrete and continuous random variables; expected value; variance; joint, marginal, and conditional distributions; conditional expectations; applications; simulation; central limit theorem; order statistics.

**STAT 422. Mathematical Statistics. 3 Credits.** (3 Lec) S  
PREREQUISITE: STAT 421. Senior capstone course. Introduction to the theory of point estimation, interval estimation, and hypothesis testing.

**STAT 425. Biostatistical Data Analysis. 3 Credits.** (3 Lec) F alternate years starting S 2015 then to be offered F even years. PREREQUISITE: STAT 411 Statistical methodology applicable to vital statistics, life tables and survival curves, clinical trials, epidemiologic investigations, and cause-effect studies. Co-convended with STAT 525.

**STAT 431. Nonparametric Statistics. 3 Credits.** (3 Lec) S  
To be offered alternate odd years PREREQUISITE: One of the following: STAT 217Q, STAT 332, STAT 401 or STAT 411/STAT 511. Goodness-of-fit tests, sign tests, randomization and permutation tests, Wilcoxon and Mann-Whitney tests, Kruskal-Wallis and Friedman's tests, Spearman and Kendall's measures of association, bootstrap techniques, and other alternative nonparametric test procedures. Emphasis on methods and interpretations rather than theory.

**STAT 436. Introduction to Time Series Analysis. 3 Credits.** (3 Lec) F alternate years, to be offered even years.  
PREREQUISITE: STAT 411/STAT 511 or consent of instructor. An introduction to time series analysis considering time series regression, autoregressive, moving average, and ARIMA models, time series model building, estimation, and forecasting, and basic frequency domain methods. Co-convended with STAT 536.

**STAT 437. Introduction to Applied Multivariate Analysis. 3 Credits.** (3 Lec) S alternate years, to be offered odd years.  
PREREQUISITE: STAT 412/STAT 512 or consent of instructor. Classic multivariate methods, including but not limited to principal components analysis, canonical correlation analysis, factor analysis, discrimination and classification methods, cluster analysis, and other topics may depend on instructor.

**STAT 439. Introduction to Categorical Data Analysis. 3 Credits.** (3 Lec) S alternate years, to be offered even years.  
PREREQUISITE: STAT 412/STAT 512. Contingency table analysis, Poisson regression, logistic regression, log-linear models, multicategory logit models.

**STAT 441. Experimental Design. 3 Credits.** (3 Lec) S  
PREREQUISITE: STAT 411/STAT 511 and M 221 or M 333 or M 441 or consent of instructor. An introduction to the design and analysis of experiments: topics include analysis of variance methods, matrix forms, multiple comparisons, fixed and random effects, factorial designs, balanced complete and incomplete blocking designs, designs with nested effects, and split plot designs. Co-convended with STAT 541.

**STAT 446. Sampling. 3 Credits.** (3 Lec) F  
PREREQUISITE: One of the following: STAT 217Q, STAT 332, or STAT 401. Probability sampling, sources of bias and uncertainty, survey design, methods for the natural sciences, simple random sampling, stratified random sampling, systematic sampling, cluster sampling.

**STAT 448. Mixed Effects Models. 3 Credits.** (3 Lec) F alternate years offered in odd years. PREREQUISITE: STAT 411/STAT 511 or consent of instructor. In depth analysis of random, fixed and mixed effects models including use of stat software and interpretation of results. Emphasis on observations correlated in time (repeated measures) and space, and on random coefficients models (growth curves).

**STAT 490R. Undergraduate Research. 1-6 Credits.** (1-6 Ind; 12 cr max) F,S,Su  
PREREQUISITE: Junior standing in statistics and consent of department head. Directed undergraduate research/creative activity which may culminate in a research paper, journal article, or undergraduate thesis. Course will address responsible conduct of research. May be repeated.

**STAT 491. Special Topics. 1-4 Credits.** (1-4 Ind; 12 cr max) On Demand  
PREREQUISITE: Course prerequisites as determined for each offering. Course not required in any curriculum for which there is a particular one-time need, or given on a trial basis to determine acceptability and demand before requesting a regular course number.

**STAT 492. Independent Study. 1-3 Credits.** (1-3 Ind; 6 cr max) F,S,Su  
Max 6 cr. PREREQUISITE: Junior standing, consent of instructor, and approval of department head. Directed research and study on an individual basis.

**STAT 494. Seminar. 1 Credit.** (1 Sem; 4 cr max) On Demand  
PREREQUISITE: Junior standing and as determined for each offering. Topics offered at the upper division level which are not covered in regular courses. Students participate in preparing and presenting material.

**STAT 498. Internship. 2-12 Credits.** (2-12 Ind; 12 cr max) F,S,Su  
PREREQUISITE: Junior standing, consent of instructor, and approval of department head. An individualized assignment arranged with an agency business, or other organization to provide guided experience in the field.

**STAT 501. Intermediate Probability and Statistics. 3 Credits.** (3 Lec) F  
 PREREQUISITE: STAT 422 or consent of instructor. Families of probability distributions, distributions of functions of random variables, limiting distributions, order statistics. Cross-listed with M 501.

**STAT 502. Intermediate Mathematical Statistics. 3 Credits.** (3 Lec) S  
 PREREQUISITE: STAT 501 or M 501. Estimation, likelihood inference, statistical hypothesis tests, sufficient statistics, exponential families, Bayesian statistics. Cross-listed with M 502.

**STAT 505. Linear Models. 3 Credits.** (3 Lec) F  
 PREREQUISITE: STAT 412 or STAT 512. Special matrix theory for statistics, multivariate normal distribution, distributions of quadratic forms, estimation and testing for the general linear model, one-way and two-way classification models, contrasts (main effect, simple effect and interaction), multiple comparison techniques.

**STAT 506. Advanced Regression Analysis. 3 Credits.** (3 Lec) S  
 PREREQUISITE: STAT 505. Applications of linear models using statistical packages; detecting and dealing with violations of assumptions including nonconstant variance, nonnormality, and collinearity; mixed effects models.

**STAT 509. Stochastic Processes. 3 Credits.** (3 Lec) S alternate years, to be offered even years.  
 PREREQUISITE: STAT 421. Conditional probability theory, discrete and continuous time markov chains including birth and death processes and long run behavior; Poisson processes; queuing systems; system reliability. Cross-listed with M 509.

**STAT 510. Statistical Consulting Seminar. 1 Credit.** (1 Sem; 6 cr max) F,S  
 PREREQUISITE: Graduate standing in statistics. Seminar discussions of issues and cases in statistical consulting. Supervised practice in consulting with researchers from various disciplines.

**STAT 511. Methods of Data Analysis I. 3 Credits.** (2 Lec, 1 Lab) F,S  
 PREREQUISITE: Graduate standing, STAT 216Q or STAT 401, and consent of instructor. This course targets non-statistics graduate students. Introduction to statistical inference and design, t-tools, non-parametric alternatives, one-way ANOVA, simple linear regression and multiple linear regression, with an emphasis on statistical thinking, appropriate inference, interpretation of results and writing. Semester project required. Co-convened with STAT 411.

**STAT 512. Methods of Data Analysis II. 3 Credits.** (2 Lec, 1 Lab) S  
 PREREQUISITE: STAT 411/STAT 511 (co-convened). Continuation of STAT 411/STAT 511 to cover principles of experimental design, multi-factor ANOVA, repeated measures, logistic regression, Poisson log-linear regression, and introductions to multivariate and time series analyses, with an emphasis on statistical thinking, appropriate inference and interpretation, and writing. A semester project is required. Co-convened with STAT 412.

**STAT 520. Topics in Applied Statistics. 3 Credits.** (3 Lec) F  
 PREREQUISITE: STAT 422 and consent of instructor. Current topics selected from computational statistics, time series and spatial statistics, decision theory, sampling, linear and mixed models, and multivariate statistics.

**STAT 525. Biostatistics. 3 Credits.** (3 Lec) F alternate years  
 to be offered even years PREREQUISITE: STAT 411 or STAT 511. Statistical methodology applicable to vital statistics, life tables and survival curves, clinical trials, epidemiologic investigations, and cause-effect studies. Co-convened with STAT 425.

**STAT 528. Statistical Quality Control. 3 Credits.** (3 Lec) F alternate years, to be offered odd years.  
 PREREQUISITE: STAT 421 or an equivalent transfer course in probability theory. Modeling process quality, traditional SQC tools, control charts for variable and attribute data, CUSUM and WMA charts, process capability analysis, reliability statistics, accelerated testing.

**STAT 532. Bayesian Data Analysis. 3 Credits.** (3 Lec) F  
 PREREQUISITE: STAT 422 or STAT 502 or M 502 and STAT 506 recommended. Fundamentals of Bayesian inference, methods of Bayesian data analysis, computational methods for posterior simulation, fundamentals of hierarchical modeling.

**STAT 534. Spatial Data Analysis. 3 Credits.** (3 Lec) S alternate years, to be offered odd years.  
 PREREQUISITE: STAT 412, STAT 512, and STAT 422, or equivalent, or consent of the instructor. Statistical methods of spatial data analysis, stationary and nonstationary random fields, covariance structures, geostatistical models and analysis, spatial point process models and analysis, spatial lattice models and analysis.

**STAT 536. Time Series Analysis. 3 Credits.** (3 Lec) F alternate years, to be offered even years.

PREREQUISITE: STAT 411, STAT 511, or consent of the instructor.  
 An introduction to time series analysis considering time series regression, autoregressive, moving average, and ARIMA models, time series model building, estimation, and forecasting, and basic frequency domain methods. Co-convened with STAT 436.

**STAT 537. Multivariate Analysis I. 3 Credits.** (3 Lec) S alternate years, to be offered even years.  
 PREREQUISITE: STAT 505. Multivariate regression, principal components analysis, exploratory and confirmatory factor analysis, discriminant and classification analysis, cluster analysis, classification and regression trees, basic structural equation modeling, along with bagging and boosting methods.

**STAT 538. Multivariate Analysis II. 3 Credits.** (3 Lec) F alternate years, to be offered even years.  
 PREREQUISITE: STAT 537. Special topics in multivariate analysis including general latent variable methods, analysis of covariance structures, common principle components, robust and distribution free multivariate analysis.

**STAT 539. Generalized Linear Models. 3 Credits.** (3 Lec) S alternate years, to be offered odd years.  
 PREREQUISITE: STAT 422 and STAT 411/STAT 511. Analysis of categorical data including logistic regression, log-linear models, analysis of deviance, extrabinomial variation, quasi-likelihood.

**STAT 541. Experimental Design. 3 Credits.** (3 Lec) S  
 PREREQUISITE: STAT 411/STAT 511 and M 221 or M 333 or M 441. An introduction to the design and analysis of experiments: topics include analysis of variance methods, matrix forms, multiple comparisons, fixed and random effects, factorial designs, balanced complete and incomplete blocking designs, designs with nested effects, and split plot designs. Co-convened with STAT 441.

**STAT 550. Advanced Mathematical Statistics. 3 Credits.** (3 Lec) S alternate years, to be offered even years.  
 PREREQUISITE: STAT 502 or M 502 and either M 384, M 505, or M 547. Sufficiency, completeness, ancillary statistics, invariance, likelihood-based inference, large sample theory, Edgeworth and saddlepoint approximations.

**STAT 575. Professional Paper and Project. 1-4 Credits.** (1-4 Lec; 6 cr max) F,S,Su  
 PREREQUISITE: Graduate standing. A research or professional paper or project dealing with a topic in the field. The topic must have been mutually agreed upon by the student and his or her major advisor and graduate committee.

**STAT 576. Internship. 2-12 Credits.** (2-12 I; max cr unlimited) F,S,Su  
 PREREQUISITE: Graduate standing, consent of instructor and approval of department head. An individualized assignment arranged with an agency, business or other organization to provide guided experience in the field.

**STAT 578. Response Surface Methodology. 3 Credits.** (3 Lec) S alternate years, to be offered odd years.  
 PREREQUISITE: STAT 541 or STAT 505. Diagnostics; fractional-factorial analysis; method of steepest ascent; canonical analysis; response optimization; ridge analysis; response surface design including central composite designs, orthogonal designs, rotatable designs, and optimal designs; mixture designs.

**STAT 589. Graduate Consultation. 3 Credits.** (3 Ind) F,S,Su  
 PREREQUISITE: Master's standing. This course may be used only by students who have completed all of their coursework (and thesis, if on a thesis plan) but who need additional faculty or staff time.

**STAT 590. Master's Thesis. 1-10 Credits.** (1-10 Ind; max cr unlimited) F,S,Su  
 PREREQUISITE: Master's standing.

**STAT 591. Special Topics. 1-4 Credits.** (1-4 Lec, 12 cr max) On Demand  
 PREREQUISITE: Upper division courses and others as determined for each offering. Courses not required in any curriculum for which there is a particular one time need, or given on a trial basis to determine acceptability and demand before requesting a regular course number.

**STAT 592. Independent Study. 1-3 Credits.** (1-3 Ind; 6 cr max) F,S,Su  
 PREREQUISITE: Graduate standing, consent of instructor, approval of department head and Dean of Graduate Studies. Directed research and study on an individual basis.

**STAT 594. Seminar. 1 Credit.** (1 Sem; 6 cr max) F,S,Su  
 PREREQUISITE: Graduate standing or seniors by petition. Course prerequisites as determined for each offering. Topics offered at the graduate level which are not covered in regular courses. Students participate in preparing and presenting discussion material.

**STAT 689. Doc Reading & Research. 3-5 Credits.** (3-5 Ind; 15 cr max) F,S,Su  
PREREQUISITE: Doctoral standing. This course may be used by doctoral students who are reading research publications in the field in preparation for doctoral thesis research.

**STAT 690. Doctoral Thesis. 1-10 Credits.** (1-10 Ind; max unlimited) F,S,Su  
PREREQUISITE: Doctoral standing.

### **Font Notice**

This document should contain certain fonts with restrictive licenses. For this draft, substitutions were made using less legally restrictive fonts. Specifically:

Times was used instead of Adobe Garamond Pro.

The editor may contact Leepfrog for a draft with the correct fonts in place.