STATISTICS (STAT)

STAT 330 - Fundamentals of Modern Statistics I 3 Credits
Prerequisite(s): MATH 221 with a grade of C- or higher. Displaying, describing and modeling data; arrangements for producing data; probability; methods for drawing conclusions from data: significance testing, confidence interval estimation, linear regression, analysis of variance. Examples from many disciplines including the social and natural sciences. Statistical software is used. 3 hours lecture.

STAT 401 - Applied Statistics for the Sciences 3 Credits
Prerequisite(s): MATH 111 or MATH 112. Organizing, displaying, and describing data; designing experiments; methods for drawing conclusions from data; significance testing, confidence intervals, linear regression, analysis of variance, chi-square tests of independence. Examples from disciplines in the natural and physical sciences. Statistical software is used. Not for Mathematics and Computer Science majors. 3 hours lecture.

STAT 441 - Statistical Computing 3 Credits
Prerequisite(s): STAT 330 or STAT 401 with a grade of C- or higher. This course is designed: (1) to acquaint students with the use of the computer in solving statistical problems, and (2) to develop intermediate level statistical methodology. Several statistical computing packages and the student's own programs will be utilized. 3 hours lecture.

STAT 442 - Fundamentals of Modern Statistics II 3 Credits
Prerequisite(s): STAT 330 with a grade of C- or higher. Continuation of STAT 440. Principles of statistical inference, categorical data analysis, one and two-way anova, multiple linear regression, nonparametric methods, bootstrap methods. Examples from a wide variety of disciplines. Statistical software is used. 3 hours lecture.

STAT 443 - Introduction to Mathematical Statistics 3 Credits
Prerequisite(s): MATH 340 with a grade of C- or higher; and STAT 330 or STAT 401 with a grade of C- or higher. Develops statistical methods from probability theory. Topics discrete and continuous probability distributions, estimation, inference and hypothesis testing. 3 hours lecture.

STAT 481 - Introduction to Statistical Data Mining 3 Credits
Prerequisite(s): STAT 442 with a grade of C- or higher. Introduction to the concepts and applications of a variety of data-mining methods. Data mining is the process of selecting, exploring, and modeling large amounts of data to uncover previously unknown patterns in the data. Statistical techniques covered include classification and regression trees, predictive modeling, and unsupervised learning. Hands-on applications to data sets from diverse fields. Statistical software is used. 3 hours lecture.

STAT 487 - Statistical Genomics 3 Credits
Prerequisite(s): BIOL 380; and STAT 330 or STAT 401, or equivalent. Analysis of discrete data illustrated with genetic data on morphological characters, allozymes, restriction fragment length polymorphisms and DNA sequences. Maximum likelihood and Bayesian estimation including iterative procedures. Numerical resampling and bootstrapping. Development of statistical techniques for characterizing genetic disequilibrium and diversity. Locating genes with markers. Cross listed with BIOL 487. 3 hours lecture.

STAT 495 - Topics in Statistical Science 1-3 Credits
Prerequisite(s): STAT 330 with a grade of C- or higher or STAT 401 with a grade of C- or higher. Guided study of selected topics in statistical science such as exploratory data analysis, applied multivariate methods, statistical quality control, design of experiment. May be repeated once for a maximum of 6.0 credits.

STAT 497 - Undergraduate Research in Statistical Science 1-3 Credits
Prerequisite(s): STAT 442 with a grade of C- or higher and departmental approval. Individual research in an area of statistical science agreed upon by the student and instructor. The results of the research will be the basis of a seminar or colloquium to be given by the student. May be repeated five times for a total of six credits. Students must not accumulate more than six credits total in courses MATH 497, MATH 498, STAT 495, STAT 497.

STAT 500 - Biostatistical Methods for Research Workers I 3 Credits
Prerequisite(s): Permission of graduate program coordinator. Planning effective observational and experimental research, data collection and summarization, significance testing and p-values, t-test, chi-square, regression and correlation, use of statistical software, reading statistical results in the literature. Required course for the MPH degree. 3 hours lecture.

STAT 532 - Fundamentals of Statistics 3 Credits
Prerequisite(s): STAT 330 or equivalent with departmental approval. Principles of statistical inference; categorical data analysis; one and two-way anova; multiple linear regression; nonparametric methods; resampling methods. Examples from a variety of disciplines. Statistical software is used. 3 hours lecture. Previous course STAT 541 effective through Spring 2019.

STAT 534 - Statistical Computing 3 Credits
Prerequisite(s): STAT 330 or equivalent with departmental approval. This course is designed to acquaint students with the computational aspects associated with statistical problems, with particular emphasis on data analytics using the comprehensive statistical software packages SAS and R. The programming environments will be covered in detail: data import and data manipulation techniques, working with multiple datasets, statistical summary procedures, using public domain add-on packages, statistical graphics, and debugging. 3 hours lecture. Previous course STAT 544 effective through Spring 2019.

STAT 536 - Statistical Theory 3 Credits
Prerequisite(s): STAT 532. Discrete and continuous probability distributions, multivariate distributions, sampling theory, transformations, Chi-squared, "F" and "t" distributions. Point estimation, properties of estimators, sufficiency, exponential families, interval estimation, hypothesis testing, power, Neyman-Pearson lemma, likelihood ratio tests. The impact of the above theory on areas such as regression analysis, analysis of variance and analysis of discrete data. 3 hours lecture. Previous course STAT 542 effective through Spring 2019.

STAT 537 - Design and Analysis of Experiments 3 Credits
Prerequisite(s): STAT 532 and STAT 534. Fundamental principles of design. Fixed, random, and mixed effects models. Restricted randomization and block designs. Split-plot designs, confounding and fractional factorial designs. Experimental and sampling errors. 3 hours lecture. Previous course STAT 547 effective through Spring 2019.
STAT 538 - Regression Methods 3 Credits

STAT 543 - Topics in Statistical Theory 3 Credits
Prerequisite(s): STAT 536 and permission of graduate program coordinator. Discrete and continuous probability distributions, multivariate distributions, sampling theory, transformations, Chi-squared, F and T distributions. Point estimation, properties of estimators, sufficiency, exponential families, interval estimation, hypothesis testing, power, Neyman-Pearson Lemma, likelihood ratio tests. The impact of the above theory on areas such as regression analysis, analysis of variance and analysis of discrete data. 3 hours lecture.

STAT 545 - Practicum in Statistics I 3 Credits
Prerequisite(s): STAT 532 and STAT 534; and STAT 537 or STAT 538; and permission of graduate program coordinator. An applied experience in which students work with practitioners in industry, government or research organizations utilizing statistical techniques in a research setting. Students will work with statisticians on projects involving experimental design and data collection as well as the analysis and interpretation of the data. May be repeated once. 3 hours lecture.

STAT 546 - Non-Parametric Statistics 3 Credits
Prerequisite(s): STAT 330 and permission of graduate program coordinator. Selected distribution-free tests and estimation techniques including sign, Kolmogorov-Smirnov, Wilcoxon signed rank, Mann-Whitney, Chi-square, rank correlation, Kendall’s Tau, Kruskal-Wallace, Friedman, McNemar, and others. 3 hours lecture.

STAT 549 - Sampling Techniques 3 Credits
Prerequisite(s): STAT 330 or STAT 443, and permission of graduate program coordinator. Sampling and survey methodology; basic sampling theory; simple, stratified, random, cluster, systematic and area sampling. Sampling errors and estimation procedures. 3 hours lecture.

STAT 552 - Intermediate Statistics Methods 3 Credits
Prerequisite(s): STAT 330, permission of graduate program coordinator. Follow up to introductory statistical methods course. Principles of statistical inference; categorical data analysis; one and two-way anova; multiple linear regression; nonparametric methods; bootstrap methods. Examples from a wide variety of disciplines. Statistical software is used. 3 hours lecture.

STAT 561 - Statistical Data Mining I 3 Credits
Prerequisite(s): STAT 532 or STAT 538 or equivalent, permission of graduate program coordinator. Introduction to the concepts and applications of a variety of data mining methods. Data mining is the process of selecting, exploring, and modeling large amounts of data to uncover previously unknown patterns in the data. Statistical methods covered include classification and regression trees, predictive modeling, and unsupervised learning. Hands-on applications to data sets from diverse fields. Statistical software is used. 3 hours lecture.

STAT 562 - Statistical Data Mining II 3 Credits
Prerequisite(s): STAT 548 and STAT 561, permission of graduate program coordinator. Continuation of STAT 561. An in-depth approach to the topics of STAT 561 including logistic regression, decision trees, classifier theory, predictive modeling and unsupervised learning methods. Mathematical details of these techniques as well as the computational methods for their implementation. Hands-on applications to data sets from diverse fields. Statistical software is used. 3 hours lecture.

STAT 570 - Statistical Consulting 3 Credits
Prerequisite(s): STAT 532 or equivalent, permission of graduate program coordinator. An introduction to the statistical and interpersonal issues that arise in statistical consulting. Topics include communicating with scientists in other disciplines, technical writing and presentation, and statistical tools for consulting. Lectures center around real case studies presented by the instructor and invited speakers. Statistical software is used. Emphasis of the course is on the scientific, statistical, computational, and communication skills that a statistical consultant needs for interacting effectively with researchers from a wide range of disciplines. 3 hours lecture.

STAT 571 - Time Series Analysis 3 Credits
Prerequisite(s): STAT 538. The Box-Jenkins approach to the stochastic modeling of time series data. The concepts of stationarity, model identification and estimation, forecasting and diagnostics, are discussed in the context of the ARIMA class of time domain models. Emphasis of the course is on the application of this methodology to real time series. Spectral analysis, transfer function and statespace models will be introduced. Statistical software is used. 3 hours lecture.

STAT 572 - Missing Data Analysis 3 Credits
Prerequisite(s): STAT 532. Missing data can occur in research studies due to attrition, nonresponse, censoring, or simply incorrect data entries. This can become particularly problematic in surveys since the default in statistical packages is to exclude all “cases” with missing values for any variable. In this course, methods for handling missing data are considered. MCAR and MAR mechanisms are introduced, complete case versus available case methods are compared, and the multiple imputation approach is applied to real datasets using statistical software. 3 hours lecture.

STAT 577 - Applied Longitudinal Data Analysis 3 Credits
Prerequisite(s): STAT 538 and STAT 536. This course introduces students to statistical models and methods for longitudinal and clustered data. Methods include analyzing the mean response profiles, modeling the mean parametric curves, modeling covariance, linear mixed effects models, generalized estimating equation models, generalized linear mixed effects models. 3 hours lecture.

STAT 583 - Fundamentals of Data Analysis 3 Credits
Prerequisite(s): STAT 330 and permission of the Graduate Program Coordinator. Theory and application of statistical methods for data analysis in professional industrial areas such as business, manufacturing, biomedical and marketing. Exploratory data analysis; principles of statistical inference; design and analysis of observational studies and experiments; linear regression. Additional topics based on real examples from other disciplines would include biostatistical methods, multivariate analysis, time series analysis, and data mining. Statistical software is used. 3 hours lecture.
STAT 595 - Topics in Statistics  
Prerequisite(s): Permission of graduate program coordinator. Topics such as exploratory data analysis, statistical graphics, statistical quality control and statistical quality assurance, Bayesian methods and Markov chain Monte Carlo studies. May be repeated twice for a total of 9.0 credits. 3 hours lecture.

STAT 597 - Research Methods in Statistical Science  
Prerequisite(s): STAT 552 or equivalent and departmental approval. Preparation for research in statistical science. Application of mathematics and computing science to the development, modeling, validation and evaluation of statistical research methods. Identification of statistical issues in real world problems and novel applications of statistical methods to these problems. Development of research proposals in statistical science. 3 hours lecture.

STAT 600 - Statistical Methods for Research Workers I  
Prerequisite(s): Doctoral status, permission of graduate program coordinator. Planning effective observational and experimental research, data collection and summarization, significance testing and p-values, t-test, chi-square, regression and correlation, use of statistical software, reading statistical results in the literature. 3 hours lecture.

STAT 601 - Statistical Methods for Research Workers II  
Prerequisite(s): STAT 600 or equivalent, permission of graduate program coordinator. Principles and practices of experimental design. Randomized comparative designs, randomized block designs, factorial designs, dealing with concomitant variables, repeated measurements. Predictive modeling and analysis of designed studies. Topics from multivariate analysis, time series analysis, categorical data analysis. Students analyze data from research projects. 3 hours lecture.

STAT 610 - Statistical Methods For Scientific Research  
Prerequisite(s): Departmental approval. This course aims to provide an introduction to the types of statistical analyses used in scientific research. Topics include EDA analysis, inference procedures, modeling and estimation, generalized linear models, multivariate analysis, time series and design of experiments. The course focuses on applications in areas including ecology, environmental health and environmental sciences and public health. 3 hours lecture.

STAT 640 - Biostatistics: Categorical Data Analysis  
Prerequisite(s): STAT 537 and STAT 538. Fundamental statistical concepts and methods used by statistical scientists in the health, biological, medical, and biopharmaceutical industries. Two way table analysis, three way table analysis, logistic regression, generalized linear models, loglinear models, matched pairs. 3 hours lecture.

STAT 641 - Biostatistics: Clinical Trials and Survival Analysis  
Prerequisite(s): STAT 537 and STAT 538. Fundamental statistical concepts and methods used by statistical scientists in the health, biological, medical, and biopharmaceutical industries. Survival analysis, and designs for clinical trials. 3 hours lecture.

STAT 642 - Introduction to Stochastic Processes  
Prerequisite(s): MATH 540 and permission of graduate program coordinator. Generating functions, convolutions, recurrent events, random walk models, gambler’s ruin problems, Markov chains and processes, time dependent stochastic processes, queuing theory and epidemic models. 3 hours lecture.

STAT 645 - Advanced Topics in Statistics  
Prerequisite(s): Permission of graduate program coordinator. Recent developments in statistical science. Topics such as data mining, statistical genomics, computationally intensive data-analytic methods, statistical consulting, dynamic statistical graphics and visualization, applied time series analysis. May be repeated with no limit as long as the topic is different. 3 hours lecture.

STAT 646 - Multivariate Analysis  
Prerequisite(s): STAT 532, STAT 538 and permission of graduate program coordinator. Analysis of multiple response variables simultaneously; covariance and the multivariate normal distribution; manova, discriminant functions; principle components and canonical correlations. 3 hours lecture.

STAT 647 - Practicum in Statistics II  
Prerequisite(s): STAT 536, STAT 545, at least one 600-level course, and permission of graduate program coordinator. An applied experience in which students work with practitioners in industry, government or research organizations utilizing advanced statistical techniques in a research setting. Students will be expected to exhibit the ability to work independently on projects involving advanced techniques in experimental design, analysis and interpretation of data. May be repeated once.

STAT 648 - Advanced Statistical Methods  
Prerequisite(s): STAT 534, STAT 537, STAT 538, and permission of graduate program coordinator. Advanced statistical concepts and methods used by statistical scientists in the analysis of designed experiments and observational studies. Response surface methodology, analysis of covariance, the general linear model, the cell means model and the analysis of variance of unbalanced or messy data. 3 hours lecture.

STAT 649 - Independent Study in Statistics  
Prerequisite(s): Permission of graduate program coordinator and departmental approval. Independent study under the direction of a faculty member, offering the opportunity to pursue topics in statistics which may be outside the scope of regular curricular offerings or may be an extension of an existing course or courses. Approval must be obtained from the graduate coordinator and faculty advisor. May be repeated once for a maximum of 6.0 credits during the graduate program.

STAT 656 - Functional Analysis  
Prerequisite(s): STAT 537 and STAT 538. Advanced statistical concepts and methods used by statistical scientists in the analysis of functional data. Methods include analysis of covariance, functional principal components analysis, smoothing splines, and functional regression models. 3 hours lecture.

STAT 657 - Advanced Design and Analysis of Experiments  
Prerequisite(s): STAT 537 and STAT 538. Principles of design, incomplete block design, fractional factorial design, response surface design, repeated measures design, robust parameter design, cross-over design, analysis of covariance. 3 hours lecture.

STAT 697 - Capstone Experience  
Prerequisite(s): Permission of GPC. Culminating experience undertaken by students during their last semester who do not wish to pursue a formal Master’s thesis. The capstone project focuses on a specific topic of interest to the student that incorporates and applies what they've learned throughout the course of their Statistics graduate program. 3 hours lecture.
STAT 698 - Master's Thesis 3 Credits
Prerequisite(s): Permission of graduate program coordinator.
Independent study under faculty advisement. Students must follow
the MSU Thesis Guidelines, which may be obtained from the Graduate
School. Students should take STAT 699 if they do not complete STAT 698
within the semester.

STAT 699 - Master's Thesis Extension 1 Credit
Prerequisite(s): STAT 698, permission of graduate program coordinator.
Continuation of Master's Thesis project. Thesis extension will be graded
IP (In Progress) until thesis is completed, at which time a grade of Pass
or Fail will be given. Course may be repeated.