STATISTICS (STAT)

STAT 330 - Fundamentals of Modern Statistics I **3 Credits**
Prerequisite(s): MATH 221 with a grade of C- or better. 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 403 - Techniques and Applications of Statistics **3 Credits**
Prerequisite(s): MATH 112. Statistical techniques for the social and behavioral sciences including estimation, tests of hypothesis, non-parametric statistics, regression and correlation. May not be taken for credit by mathematic majors. 3 hours lecture.

STAT 441 - Statistical Computing **3 Credits**
Prerequisite(s): STAT 330 or STAT 401 with a grade of C- or better. 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 better or STAT 401 with a grade of C- or better. 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 better; and STAT 330 or STAT 401 with a grade of C- or better. 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 better. 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 Biology and Molecular Biology BIOL 487. 3 hours lecture.

STAT 495 - Topics in Statistical Science **1-3 Credits**
Prerequisite(s): STAT 330 with a grade of C- or better or STAT 401 with a grade of C- or better. 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 better 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 541 - Applied Statistics **3 Credits**
Prerequisite(s): STAT 330 or STAT 443 and permission of graduate program coordinator. Review of estimation and hypothesis testing for one sample and two sample problems; introduction to non-parametric statistics and linear regression; fundamental principles of design, completely randomized design, randomized block design, latin square, and 2 factor design. 3 hours lecture.

STAT 542 - Statistical Theory I **3 Credits**
Prerequisite(s): STAT 541 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 543 - Statistical Theory II **3 Credits**
Prerequisite(s): STAT 542 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 544 - Statistical Computing **3 Credits**
Prerequisite(s): STAT 541 or STAT 548; and CMPT 183; and permission of graduate program coordinator. Computer systems for data analysis and data graphics, and intermediate level statistical methodology are investigated. Several statistical computing packages are utilized and evaluated. 3 hours lecture.

STAT 545 - Practicum in Statistics I **3 Credits**
Prerequisite(s): STAT 541 and STAT 544; and STAT 547 or STAT 548; 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 547 - Design and Analysis of Experiments **3 Credits**
Prerequisite(s): STAT 541 or STAT 548, and permission of graduate program coordinator. Fundamental principles of design; fixed, random and mixed models; factorial designs; designs with restricted randomization; split-plot design; confounding; fractional replication; experimental and sampling errors. 3 hours lecture.

STAT 548 - Applied Regression Analysis **3 Credits**
Prerequisite(s): STAT 330 or STAT 443, and permission of graduate program coordinator. Fitting equations to data; matrices, linear regression; correlation; analysis of residuals; multiple regression; polynomial regression; partial correlation; stepwise regression; regression and model building; regression applied to analysis of variance problems; introduction to nonlinear regression. 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 541 or STAT 548 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 541 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 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 **3 Credits**
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 **3 Credits**
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 **3 Credits**
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 **3 Credits**
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 Scientivic Research **3 Credits**
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 I **3 Credits**
Prerequisite(s): STAT 544, STAT 547, STAT 548, and permission of graduate program coordinator. Fundamental statistical concepts and methods used by statistical scientists in the health, biological, medical and pharmaceutical industries. Categorical data analysis, logistic regression, generalized linear models, nonparametric regression techniques. 3 hours lecture.

STAT 641 - Biostatistics II **3 Credits**
Prerequisite(s): STAT 544, STAT 547, STAT 548, and permission of graduate program coordinator. Fundamental statistical concepts and methods used by statistical scientists in the health, biological, medical and pharmaceutical industries. Survival analysis and designs for clinical trials. 3 hours lecture.

STAT 642 - Introduction to Stochastic Processes **3 Credits**
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 **3 Credits**
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 **3 Credits**
Prerequisite(s): STAT 541, STAT 548 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 **3 Credits**
Prerequisite(s): STAT 542, 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 **3 Credits**
Prerequisite(s): STAT 544, STAT 547, STAT 548, 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 **3 Credits**
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 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.