DEPARTMENT OF MANAGEMENT SCIENCE AND STATISTICS

Mission Statement

The mission of the Department of Management Science and Statistics is to offer both undergraduate and graduate educational programs that are of high quality and meet the changing needs of the global community, to provide a supportive learning environment for students, to foster the success of our students in their professional careers, and to create an academic environment that stresses excellence in teaching, intellectual contributions, and service. The Department contributes to the field of knowledge through research and education in the quantitative sciences. Theory and analysis are applied to a variety of interdisciplinary problems to discover new approaches for meeting the challenges of decision making in a global arena of expanding technology and information.

Department Information

The disciplines of Management Science and Statistics are integral to modern decision-making processes. These interdisciplinary fields emphasize the use of quantitative methods and computers for analyzing, understanding, visualizing, and interpreting data. Management Science seeks to provide a rational basis for decision analysis across a broad spectrum of business functions such as production/operations, marketing, finance, human resources, project management, logistics, and supply chain management. Statistical methods provide analytical tools for research in high-technology and biomedical industries, insurance, and government agencies. The Department also offers a Master of Science degree in Statistics and Data Science, a Doctor of Philosophy degree in Applied Statistics, and a Graduate Certificate in Operations and Supply Chain Management.

- M.S. in Statistics and Data Science (p. 1)
- Ph.D. in Applied Statistics (p. 2)

Master of Science Degree in Statistics and Data Science

Today, the skills of statisticians and data scientists are in high demand. More organizations need individuals with knowledge of statistics and methods to collect, analyze, interpret data and communicate the results. These statisticians and data scientists are needed in areas such as biomedical fields and bioinformatics—to address drug development and health-related issues; environmental studies—to address pollution and contamination; as well as internet traffic, fraud detection, cyber security, and national defense—to mine data and to provide accurate predictions. Statisticians and data scientists are commonly employed in the industries such as insurance, health, IT companies, finance, biomedical research, manufacturing, service and others. In response to the growing demand for workers with the ability to design experiments, make predictions/forecasts and analyze large complex datasets, the Master of Science degree in Statistics and Data Science at UTSA includes instruction, in a broad range of applied statistical methods, computational tools, data-step training, and statistical/machine learning methods, to prepare students for careers as government officials, industrial workers, and academic statisticians or for pursuing a doctoral degree in statistics and data science fields.

Program Admission Requirements

All application materials must be submitted using the University's online application system and received by the program-specific Fall deadline. Degree-seeking students are only admitted in the Fall semester of each academic year.

In addition to satisfying the University-wide graduate admission requirements, a B.A. or B.S. in statistics, mathematics, engineering, business, or a closely related field is highly recommended as preparation. In particular, the Admissions Committee requires applicants to complete Calculus I, II, and III, and a course in Matrix Theory/Linear Algebra prior to applying for the program. However, if necessary, the Linear Algebra/Matrix Theory course may be taken during the first semester of the program (in addition to degree requirements). All applicants are required to submit recent scores from the Graduate Record Examination (GRE) aptitude test.

Degree Requirements

Candidates for this degree are required to successfully complete 33 semester credit hours as specified below:

Code	Title	Credit Hours
A. All candidates for the Master of Science in Statistics and Data Science must complete the following 12 semester credit hours of coursework:		**12**
STA 5093	Introduction to Statistical Inference	
STA 5103	Applied Statistics	
STA 5503	Mathematical Statistics I	
STA 5513	Mathematical Statistics II	
B. A candidate for the Master of Science degree in Statistics and Data Science must complete 15 semester credit hours of coursework chosen from one or a combination of the following focus areas:		**15**
Biostatistics:		
STA 6033	SAS Programming and Data Management	
STA 6233	R Programming for Data Science	
STA 6413	Nonparametric Statistics	
STA 6813	Multivariate Analysis	
STA 6833	Design and Analysis of Experiments	
STA 6853	Categorical Data Analysis	
STA 6863	Spatial Statistics	
STA 6903	Survival Analysis	
STA 6923	Introduction to Statistical Learning	
Industrial Statistics:		
MS 5453	Management and Control of Quality	
STA 5313	Theory of Sample Surveys with Applications	
STA 6013	Regression Analysis	
STA 6033	SAS Programming and Data Management	
STA 6113	Applied Bayesian Statistics	
STA 6133	Simulation and Statistical Computing	
STA 6233	R Programming for Data Science	
STA 6833	Design and Analysis of Experiments	
STA 6843	Computer Aided Optimal Design	
Management Science:		
MS 5453	Management and Control of Quality	

MS 5463	Lean Operations and Six Sigma	
STA 6013	Regression Analysis	
STA 6033	SAS Programming and Data Management	
STA 6133	Simulation and Statistical Computing	
STA 6233	R Programming for Data Science	
Financial Modeling:		
ECO 6103	Econometrics I	
FIN 6313	Modeling of Financial Decision Making	
STA 6013	Regression Analysis	
STA 6033	SAS Programming and Data Management	
STA 6113	Applied Bayesian Statistics	
STA 6133	Simulation and Statistical Computing	
STA 6233	R Programming for Data Science	
STA 6253	Time Series Analysis and Applications	
Big Data and Analytics		
IS 6713	Data Foundations	
STA 6013	Regression Analysis	
STA 6033	SAS Programming and Data Management	
STA 6233	R Programming for Data Science	
STA 6253	Time Series Analysis and Applications	
STA 6813	Multivariate Analysis	
STA 6923	Introduction to Statistical Learning	
STA 6933	Advanced Topics in Statistical Learning	
General Applied Statistics		
Any 15 hours of 5000/6000-level courses in Statistics or other disciplines as approved by the Graduate Advisor of Record.		
C. A candidate for the Master of Science degree in Statistics and Data Science must complete 6 semester credit hours of graduate-level courses in Statistics, Engineering, Biology or other disciplines as approved by the Graduate Advisor of Record.		**6**
D. Comprehensive Examination: Each candidate for the degree is required to pass a comprehensive examination in Statistics that will cover material in the following courses: STA 5093, STA 5103, STA 5503 and STA 5513. The comprehensive examination will be offered once a year during each summer.		
Total Credit Hours		**33**

Doctor of Philosophy Degree in Applied Statistics

In this age of advanced technology and big data, there is an increasing demand for individuals with expertise in designing experiments and analyzing large complex data sets via the latest advances in statistical methods and computing technology. In particular, there is a high demand for professionals with a Ph.D. in Applied Statistics to solve real-world problems faced by various areas of scientific study. For example, in the biomedical field, they are needed to develop methods for evaluating the efficacy and safety of new medications/drugs, surgeries, and other treatments. In the bioinformatics area, they address topics such as gene therapy, genomic research, and disease mapping. In environmental studies, statisticians are needed to detect the exposure of the human population to particulate matter based on air quality, to identify polluted areas based on soil samples, and to model areal data. Statisticians are also needed to model and analyze big data, especially in areas of fraud detection, cyber security, and defense-related issues. Statisticians are being recruited in academic institutions and a variety of industries, including insurance and finance institutions, manufacturing and service businesses. The Ph.D. in Applied Statistics combines advanced statistical analysis and theory with practical applications to prepare students with these essential skills to pursue careers in academia, research organizations, government, and private industry.

Program Admission Requirements

In addition to satisfying the University-wide graduate admission requirements, a B.A., B.S., M.A. or M.S. in mathematics, statistics, or a closely related field is required. Students who have not taken mathematical statistics courses at the undergraduate level may be required to complete the equivalent courses in the appropriate background areas before taking graduate courses. The admission requirements consist of:

- A cumulative grade point average of 3.3 or higher in the last 60 hours of coursework
- A Graduate Record Examination (GRE) score from a recent (no more than five years prior to the application date) administration of the exam
- Official transcripts of all undergraduate and graduate coursework completed
- Three letters of recommendation from academic or professional sources familiar with the applicant's background
- A curriculum vita and a statement of experiences, interests, and goals
- International students from non-English speaking countries must also submit a score of at least 79 on the Test of English as a Foreign Language (TOEFL) iBT. TOEFL scores may not be more than two years old.
- Submit evaluated copies of transcripts from foreign countries
- Applicants may be asked to appear before the admissions committee for a personal interview.

Degree Requirements

Candidates with MS in Statistics or a related field are required to successfully complete a minimum of 57 credit hours of course work at levels of 6000/7000 starting from item C below. However, those who do not have the foundation courses listed in item A, are required to complete these courses in addition to the 57 credit hours required for the degree. Candidates with a bachelor's degree are required to successfully complete a minimum of 87 semester credit hours of graduate coursework as specified below:

Code	Title	Credit Hours
A. Foundation Courses		12
All candidates entering the program with only a bachelor's degree or with a non-quantitative master's degree must complete the following 12 semester credit hours of coursework:		
STA 5093	Introduction to Statistical Inference	
STA 5103	Applied Statistics	
STA 5503	Mathematical Statistics I	
STA 5513	Mathematical Statistics II	
B. All candidates entering the program with a bachelor's degree must complete 18 semester credit hours of 6000/7000-level Statistics courses approved by the Graduate Advisor.		18
C. All candidates must complete the following 12 semester credit hours of advanced coursework:		12
STA 6133	Simulation and Statistical Computing	

STA 6713	Linear Models	
STA 7503	Advanced Inference I	
STA 7513	Advanced Inference II	
D. 9 semester credit hours of graduate courses 6000 level or higher within the Department of Management Science and Statistics; as approved by the Graduate Advisor of Record.		9
E. A minimum of 6 semester credit hours of graduate elective courses approved by the Graduate Advisor of Record		6
F. A minimum of 15 semester credit hours of Doctoral Research.		15
G. A minimum of 15 semester credit hours of Doctoral Dissertation.		15
Total Credit Hours		**87**

All students in the program will be required to complete a degree plan specifying the courses they will complete. This degree plan must be approved by the Ph.D. Program Committee before the end of the second semester of enrollment.

Advancement to Candidacy

Advancement to candidacy requires a student to complete University and Applied Statistics program requirements. After completing the required coursework, all candidates for the Ph.D. degree must pass written qualifying examinations and oral defense of dissertation proposal before being admitted to candidacy for the degree. Unless otherwise approved by the Ph.D. Program Committee, all students should take both parts of the written qualifying examination by the end of the Summer term of their first or second year in the program. If a student does not pass one part of the exam, they would have to retake the same part of the exam in the immediate next Summer term. The written examinations are administered by the graduate committee members and are scheduled once a year during the Summer term. Those who do not pass the qualifying examination may not continue in the Doctoral Program but may qualify for the M.S. degree. The oral proposal defense is administered at the discretion of the student's Dissertation Committee. It serves as a hearing for the student's dissertation proposal. Students will be provided no more than two attempts to pass the written qualifying examination and two attempts to pass the oral proposal defense examination. The majority approval of the dissertation examination committee is required to pass the oral proposal defense. Results of the written and oral qualifying examinations must be reported to the Dean of the Graduate School.

Dissertation

Candidates must demonstrate the ability to conduct independent research by completing and defending an original dissertation. The research topic is determined by the student in consultation with his or her supervising professor. A Dissertation Committee selected by the student and supervising professor, guides and critiques the candidate's research. The completed dissertation must be formally presented to and approved by the Dissertation Committee.

Following an open presentation of the dissertation findings, the Dissertation Committee conducts a closed meeting to determine the adequacy of the research and any further requirements for completion of the dissertation. Results of the meeting must be reported to the Dean of the College and to the Dean of the Graduate School.

Awarding of the degree is based on the approval of the Dissertation Committee and the approval of the Dean of the College. The UTSA Dean of the Graduate School certifies the completion of all University-wide requirements.

Graduate Certificate in Operations and Supply Chain Management

The Graduate Certificate in Operations and Supply Chain Management is a 12-semester-credit-hour program offered by the Department of Management Science and Statistics. The Graduate Certificate in Operations and Supply Chain Management (OSCM) is designed to provide specialized training to help expand students' area of expertise, learn about new developments in their fields, augment their professional skills and provide credentials that help advance their careers. It certifies to employers that students awarded the certificate have completed coursework that help them understand a myriad of issues, challenges, problems, and decision tools that relate to the internal and external flow of materials and requisite knowledge. Production/operations management, logistics management, and procurement topics are included to resolve the myriad of complex problems. Moreover, this certificate program will help students discover cutting edge techniques and best practices to leverage their operations and supply chain complexities to achieve competitive advantage.

The operations and supply chain management certificate program provides specialized skills in supply chain management for:

- Students who seek foundational knowledge of supply chain complexities as well as a strong understanding of how companies leverage their supply chains to achieve competitive advantage
- Experienced professionals who wish to update their knowledge of current thinking and best practices through interaction with faculty
- Working professionals who want to supplement their undergraduate or graduate degree with graduate courses in supply chain management

Supply chain management is a broad career field where professionals are involved in every function of global commerce, including marketing, procurement, production and service operations, logistics, and inventory management. The certificate program provides students with a thorough understanding of integrated supply chain and operations activities while emphasizing skills in problem solving, communication, and teamwork.

To earn a Graduate Certificate in Operations and Supply Chain Management, students must complete 12 semester credit hours from the following courses, one of which is required:

Code	Title	Credit Hours
A. Required course:		3
MS 5413	Integrated Global Supply Chain Management	
B. Select three courses from the following:		9
MS 5343	Logistics Systems Management	
MS 5363	Pricing and Revenue Management	
MS 5383	Supply Chain Analytics	
MS 5393	Advanced Production and Operations Management	
MS 5423	Service Management and Operations	
MS 5433	Effective Project Management	
MS 5453	Management and Control of Quality	
MS 5463	Lean Operations and Six Sigma	
Total Credit Hours		**12**

Applicants for the Operations and Supply Chain Management certificate program who are currently enrolled in a graduate degree program at UTSA have already met University requirements for admission. Thus, no formal application process is necessary. The applicant should contact the Certificate Program Advisor and complete a form requesting permission to enter and complete the certificate program. If the request is approved, the form will be signed by the Certificate Program Advisor and the Dean of the College of Business.

Applicants who are not currently enrolled in a graduate degree program at UTSA will be required to apply for admission to UTSA as a special graduate (non-degree seeking) student and to indicate their intent to seek admission into a certificate program. Applicants will be required to meet University admission requirements for special graduate students. If admitted as a special graduate student, the applicant should contact the Certificate Program Advisor and complete a form requesting permission to enter and complete the certificate program. The form will be signed by the Certificate Program Advisor and the Dean of the College of Business. A copy of this form will be sent to the Graduate School.

If it is determined by the Certificate Program Advisor that an applicant requires prerequisite background courses to adequately prepare for the courses included in the certificate program, this will be noted in the applicant's file. The applicant will be notified that the prerequisite courses must be taken before enrolling in certificate program coursework.

Any applicant who is admitted into a certificate program without being currently enrolled in a graduate degree program is considered to be a special graduate student. If the applicant wishes to be admitted into a degree program, they will be required to apply to that program as a degree-seeking student. Admittance into or completion of a certificate program is not considered to be qualification for entry into a graduate degree program. Applicants who are admitted into a certificate program while also pursuing a graduate degree will be classified as degree-seeking students.

Management Science (MS) Courses

MS 5003. Quantitative Methods for Business Analysis. (3-0) 3 Credit Hours.
Prerequisite: MAT 1133, it's equivalent, or consent of instructor. Introduction to managerial decision analysis using quantitative and statistical tools. Course includes a general framework for structuring and analyzing decision problems. Some of the topics include decision theory, statistical techniques (such as analysis of variance, regression, nonparametric tests), introduction to linear programming, and introduction to time series. Uses applicable decision support software. Differential Tuition: $387.

MS 5023. Decision Analysis and Production Management. (3-0) 3 Credit Hours.
Prerequisite: MS 5003 or an equivalent. Study of applications of quantitative approaches (such as mathematical programming, networks, stochastic processes, multicriteria analysis, and simulation) to business decision analysis. Emphasis is given to production management applications (such as resource allocation, scheduling, inventory control, capital budgeting) and the use of computerized decision support systems. (Same as MBA 5413. Credit cannot be earned for both MBA 5413 and MS 5023.) Differential Tuition: $387.

MS 5323. Statistical Methods for Business Analytics. (3-0) 3 Credit Hours.
Prerequisite: MS 5003 or an equivalent. Introduction to multivariate statistical analysis. Typical topics include multiple regression, multiple analysis of variance, logistic regression, discriminant analysis, conjoint analysis, cluster analysis, and factor analysis. Emphasizes the use of computer statistical packages. Differential Tuition: $387.

MS 5333. Introduction to Business Analytics. (3-0) 3 Credit Hours.
This course introduces the basic concepts of business analytics, principles of data mining, Structured Query Language (SQL), and Big Data. It provides students an opportunity to understand how analytics can help improve decisions throughout an organization's value chain. Presents the most prevalent methods for descriptive (e.g., cluster analysis, association analysis), predictive (e.g., multiple regression, logistic regression, decision tree methods), and prescriptive (e.g., optimization) analytics. Differential Tuition: $387.

MS 5343. Logistics Systems Management. (3-0) 3 Credit Hours.
Study of business logistics: the process of planning, implementing, and controlling the flow and storage of goods or services and related information from point of origin to point of consumption to achieve customer satisfaction. Focuses on the cost and value added to products or services by making them available in the desired condition when and where they are needed. Differential Tuition: $387.

MS 5363. Pricing and Revenue Management. (3-0) 3 Credit Hours.
Revenue Management is about "providing the right product to the right customers at the right time at the right price." The main goal of this course is to apply revenue management practices to appropriate industries successfully. Specifically, the course will provide tools to forecast customer demand successfully, identify pricing and revenue opportunities, understand the impact of constrained capacity, opportunity costs, customer response, demand uncertainty and market segmentation on pricing decisions, and accordingly formulate and solve pricing optimization problems for revenue maximization. The material covered in the course assumes a basic understanding of probability and probability distributions, some knowledge of spreadsheet modeling, and using Excel Solver or similar optimization tools to get a solution. Differential Tuition: $407.10.

MS 5383. Supply Chain Analytics. (3-0) 3 Credit Hours.
The main goal of this course is to integrate data analytics with supply chain management. The course will introduce data-driven models, skills, and tools for learners to manage supply chains efficiently and effectively. Specifically, the course will provide an overview of supply chain intelligence and analytics applied in the global marketplace through real-world examples and case studies, and help develop critical thinking skills in support of competition and collaboration strategies in supply chain management. Students learn to define the right data set, ask the right set of questions to drive supply chain efficiency and business value, and use the appropriate models and tools to develop data-driven decisions. Differential Tuition: $387.

MS 5393. Advanced Production and Operations Management. (3-0) 3 Credit Hours.
Operations management as a basic function that must be performed in all business firms involves managing the activities and resources necessary to make products and/or provide services. It can be an effective competitive weapon to penetrate into markets worldwide. The course is designed to address the key operations issues in manufacturing and service organizations that have strategic as well as tactical implications. We review the methods required for design, operation, and improvements of the systems that create products or services. Topics covered include Product/Service Design, Process Strategy and Analysis, Quality and Performance, Capacity Planning & Constraint Management, Inventory Management, Forecasting, Operations Planning & Scheduling, and Resource Planning, etc. Differential Tuition: $387.

MS 5413. Integrated Global Supply Chain Management. (3-0) 3 Credit Hours.
Focuses on effective supply chain strategies for organizations that operate globally with emphasis on how to plan and integrate supply chain components into a coordinated system. Specifically, the course seeks to integrate different perspectives from the practices of marketing, logistics, and operations management. The course will introduce key tactics such as risk pooling and inventory placement, integrated planning, and information sharing. One of the key objectives is to understand the relationship between a focal firm and its suppliers and customers. Differential Tuition: $387.

MS 5423. Service Management and Operations. (3-0) 3 Credit Hours.
Focuses on understanding the variety of service industries (both profit and nonprofit) and the growing importance of the service industry to the economy. In addition to the traditional topics of quality, customer satisfaction and value creation, topics include service encounters, service design and development, service productivity, and globalization of services. Tools and techniques for management service operations are also emphasized. Differential Tuition: $387.

MS 5433. Effective Project Management. (3-0) 3 Credit Hours.
Approaches project management from the perspective that the material is applicable to all disciplines and project types. It not only emphasizes individual project execution, but also provides a strategic perspective. It integrates the critical PMBoK elements in the context of cases and projects. The course examines the traditional concepts and techniques of project management for long-term development programs and short-term projects as well as introducing the innovative adaptive and extreme concepts. Differential Tuition: $387.

MS 5453. Management and Control of Quality. (3-0) 3 Credit Hours.
Prerequisite: MS 5023. An examination of the fundamental nature of quality assurance, its strategic importance in business and industry, and the economic impact of quality. Theoretical and management issues relating to quality problem solving are emphasized. The contribution of the leaders in modern quality management are discussed. Differential Tuition: $407.10.

MS 5463. Lean Operations and Six Sigma. (3-0) 3 Credit Hours.
Course provides an introduction to Six Sigma methodologies and is designed to present the fundamentals of Six Sigma and instill an understanding of what is required to build a sustainable Six Sigma structure. Lean tools, such as physical maps, time value, and Kanban are included as well as advanced Six Sigma statistical tools. Differential Tuition: $387.

MS 5493. Procurement and Inventory Management. (3-0) 3 Credit Hours.
A portion of this course focuses on the key issues related to the strategic implications of sourcing of products, the purchasing of goods and services, and the role of purchasing in a supply chain context. It provides students with an understanding of purchasing processes, issues, and best practices. Emphasis areas include supplier quality, relationship management, and global sourcing. Inventory control concepts, techniques, and strategies for effective integration with basic finance, marketing, and manufacturing objectives are topics covered in this course. Models for dependent and independent demand inventory systems, material requirements planning systems, distribution requirements, planning techniques, and the classical reorder point inventory model are also included. Differential Tuition: $387.

MS 6943. Management Science Internship. (0-0) 3 Credit Hours.
Prerequisites: Graduate standing, 15 semester credit hours of graduate work, and consent of instructor. Internship must be approved in advance by the Internship Coordinator and the student's Graduate Advisor of Record. Supervised full- or part-time off-campus work experience and training in management science. Individual conferences and written reports required. Differential Tuition: $387.

MS 6953. Independent Study. (0-0) 3 Credit Hours.
Prerequisites: Graduate standing and permission in writing (form available) of the instructor and the student's Graduate Advisor of Record. Independent reading, research, discussion, and/or writing under the direction of a faculty member. For students needing specialized work not normally or not often available as part of the regular course offerings. May be repeated for credit, but not more than 6 hours, regardless of discipline, will apply to the degree. Differential Tuition: $387.

MS 6971. Special Problems. (1-0) 1 Credit Hour.
Prerequisite: Consent of instructor. An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Problems courses may be repeated for credit when topics vary, but not more than 6 hours, regardless of discipline, will apply to the degree. Differential Tuition: $135.70.

MS 6973. Special Problems. (3-0) 3 Credit Hours.
Prerequisite: Consent of instructor. An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Problems courses may be repeated for credit when topics vary, but not more than 6 hours, regardless of discipline, will apply to the degree. Differential Tuition: $387.

MS 6983. Master's Thesis. (0-0) 3 Credit Hours.
Prerequisites: Permission of the Graduate Advisor of Record and thesis director. Thesis research and preparation. May be repeated for credit, but not more than 6 hours will apply to the Master's degree. Credit will be awarded upon completion of the thesis. Enrollment is required each term in which the thesis is in progress. Differential Tuition: $387.

MS 7033. Applications in Causal Structural Modeling. (3-0) 3 Credit Hours.
Prerequisite: Consent of instructor. The purpose of this course is to provide students with an overview of structural equation modeling (SEM) procedures, which includes, but not limited to, issues related to measurement evaluation, model selection and specification, model estimation, and model fit. An additional aim of this course is to provide students with the computer skills needed to analyze and interpret their data, especially as it related to factor analysis, path analysis, and SEM. This course also addresses supplemental topics commonly encouraged in SEM and applied research (sample size and power, missing data, non-normal data, order categorical data, etc.). Differential Tuition: $387.

Statistics (STA) Courses

STA 5093. Introduction to Statistical Inference. (3-0) 3 Credit Hours.
Prerequisite: Admission to the Master's program or consent of instructor. Introduction to experiments and sampling, probability, random variables, distributions, standard discrete and continuous models, sampling distributions, maximum likelihood and moment estimation, confidence intervals and hypothesis tests for one- and two-sample means, proportions and variances, large sample approximations, goodness-of-fit, and nonparametric tests. Statistical software will be used for data analysis. Differential Tuition: $387.

STA 5103. Applied Statistics. (3-0) 3 Credit Hours.
Prerequisite: STA 5093 or equivalent, or consent of instructor. This course covers simple linear regression, correlation, multiple regression, model selection, one-, and two-way analysis of variance, fixed-, random- and mixed-effects models, multiple comparisons, factorial experiments, and logistic regression. Statistical software will be used for data analysis. Differential Tuition: $387.

STA 5313. Theory of Sample Surveys with Applications. (3-0) 3 Credit Hours.
Prerequisite: STA 5093 or STA 6003 or consent of instructor. Basic sampling techniques and their comparisons for finite populations. Topics include simple random sampling, stratified sampling, ratio and regression estimates, systematic sampling, cluster sampling, multistage and double sampling, and bootstrap and other sampling plans. Differential Tuition: $407.10.

STA 5503. Mathematical Statistics I. (3-0) 3 Credit Hours.
Prerequisite: Admission to the Statistics graduate program or consent of instructor. Axioms of probability, counting rules, univariate random variables, multivariate random variables, joint, marginal, and conditional probability distributions, mathematical expectation, variable transformation, moment generating function, commonly used probability distributions, sampling distributions, laws of large numbers and the central limit theorem. Differential Tuition: $387.

STA 5513. Mathematical Statistics II. (3-0) 3 Credit Hours.
Prerequisite: STA 5503 or consent of instructor. Data reduction, sufficient and complete statistics, unbiased estimation, maximum likelihood estimation, method of moments, best unbiased estimator, Fisher information, Cramer-Rao lower bound, hypothesis testing, likelihood ratio test, Neyman-Pearson lemma and uniformly most powerful test, and interval estimation. Differential Tuition: $387.

STA 5893. AI Practicum. (3-0) 3 Credit Hours.
Prerequisite: Graduate standing or consent of instructor. This AI practicum course includes weekly AI seminar which provides insights on the current state of the AI and ML technologies and covers a wide variety of AI topics, such as computer vision, natural language processing (NLP), theoretical ML, AI fairness and ethics, cognitive science, AI hardware, etc. The seminars will include speakers from industry and academia, who discuss the state of the practice with real use cases and methodologies to make AI projects a tangible success. The practicum also offers an experiential training opportunity to apply AI to problems in the real world. Standard AI programming tool suites and design flow concepts will be learned through the mini-project. Students will also be introduced to how AI is impacting society, the ethics of AI solutions, concerns surrounding AI, and deploying AI in complex scenarios. Python programming experience is needed. Differential Tuition: $387.

STA 5973. Directed Research. (0-0) 3 Credit Hours.
Prerequisites: Graduate standing and permission in writing (form available) from the instructor and the student's Graduate Advisor of Record. The directed research course may involve either a laboratory or a theoretical problem. May be repeated for credit, but not more than 6 hours, regardless of discipline, will apply to the Master's degree. Differential Tuition: $407.10.

STA 6003. Statistical Methods in Research and Practice. (3-0) 3 Credit Hours.
Prerequisite: One semester of calculus and one statistics course, or consent of instructor. The course includes concepts and knowledge in basic probability, common distributions, point and interval statistical estimation, test of hypothesis, simple and multiple linear regression, and analysis of variance. Course emphasis will be placed on understanding the underlying assumptions and limitations of the different techniques. Statistical software will be used for data analysis. Differential Tuition: $387.

STA 6013. Regression Analysis. (3-0) 3 Credit Hours.
Prerequisite: STA 5103 or equivalent, or consent of instructor. Multiple regression analysis, including model adequacy checks, transformations, weighted regression, diagnostics, outlier detection, polynomial regression, indicator variables, multicollinearity, remedial measures, variable selection, model validation, autocorrelation, and specialized regressions including robust regression, nonlinear regression, logistic regression, generalized linear models, and penalized regressions. Statistical software will be used for data analysis. Differential Tuition: $387.

STA 6033. SAS Programming and Data Management. (3-0) 3 Credit Hours.
Prerequisite: An introductory course in computer programming or consent of instructor. Essential SAS programming concepts with a focus on data management and the preparation of data for statistical analysis: reading raw data from different sources, creating data files in various formats, creating and modifying SAS datasets, SAS libraries, formats, character and numeric functions, combining datasets, summarizing and displaying data, and arrays. Efficient programming techniques are stressed. Differential Tuition: $387.

STA 6113. Applied Bayesian Statistics. (3-0) 3 Credit Hours.
Prerequisite: STA 5103 or consent of instructor. Probability and uncertainty, conditional probability and Bayes' Rule, single parameter and multiple parameter Bayesian analysis, posterior analysis for commonly used distributions, prior distribution elicitation, Bayesian methods in linear models, Bayesian computation including Markov chain Monte Carlo (MCMC) simulation, and applications. Differential Tuition: $387.

STA 6133. Simulation and Statistical Computing. (3-0) 3 Credit Hours.
Prerequisite: STA 5513 or consent of instructor. Random variable generation, accept-reject methods, simulation from multivariate distributions, Markov chain Monte Carlo simulation, numerical quadrature, Monte Carlo integration, importance sampling, Laplace approximation, methods for variance reduction, bootstrap and jackknife, deterministic methods for function optimization, and EM algorithm. Differential Tuition: $387.

STA 6233. R Programming for Data Science. (3-0) 3 Credit Hours.
This course is designed to introduce students to the statistical program R for data analysis and manipulation. Topics include preprocessing/manipulating/combining datasets, summarizing and visualizing data techniques, writing functions, programming, data simulation and resampling methods, and interfacing R with other programming languages such as SQL and others. Techniques for efficient programming will be stressed. The concept of high-performance computing (multi-core/parallel-processing) is also demonstrated. Differential Tuition: $387.

STA 6253. Time Series Analysis and Applications. (3-0) 3 Credit Hours.
Prerequisite: STA 5513 or consent of instructor. Examples and goals of time series analysis, autocovariance function, stationarity, linear processes, autoregressive and moving average (ARMA) processes, spectral analysis, the periodogram, linear filters, regression models with ARMA errors, forecasting in times series models, estimation by maximum likelihood and least squares, diagnostics, model selection, autoregressive integrated moving average (ARIMA), and other nonstationary processes. Differential Tuition: $387.

STA 6413. Nonparametric Statistics. (3-0) 3 Credit Hours.
Prerequisite: STA 5093 or consent of instructor. This course will cover nonparametric statistical inference methods for one-sample location problems, two-sample location problems, two-sample dispersion problems, and regression problems, nonparametric smoothing regression methods including local regression and penalized regression with the optimal choice of the smoothing parameter, multiple nonparametric regression, density estimation, wavelets, and other adaptive nonparametric regression methods. Differential Tuition: $387.

STA 6443. Statistical Modeling. (3-0) 3 Credit Hours.
Prerequisite: Basic statistics or equivalent. Introduction of basic statistical methods, with specific emphasis on inferential statistics and predictive modeling algorithms . Topics include (i) exploratory data analysis; data visualization, graphical methods, extracting important variables and detecting outliers, (ii) linear models; analysis of variance (ANOVA), linear regression models, and logistic regression models. Students will be provided the opportunity to gain an understanding of when to apply and how to select various predictive modeling algorithms for various types of problems, as well as data assumptions and requirements for algorithm use, proper parameter setting, and interpreting results. Differential Tuition: $387.

STA 6543. Predictive Modeling. (3-0) 3 Credit Hours.
This course presents students with basic understanding of predictive modeling techniques and predictive analytics tools, with specific emphasis on problem-solving with real data using R programming. Topics include data preprocessing, over-fitting and model tuning, supervised learning methods, including linear regression and classification, nonlinear regression and classification models, resampling methods, model regularization, tree and rule-based methods, and support vector machines. Unsupervised learning methods include principal component analysis, clustering methods, and outlier detection. Students will learn how to select various predictive modeling algorithms for a wide variety of applications and how to code the programs in R, as well as assumptions and requirements of predictive modelling, optimal tuning parameter setting, and how to interpret and report the results. Differential Tuition: $387.

STA 6713. Linear Models. (3-0) 3 Credit Hours.
Prerequisite: STA 5103 or equivalent, or consent of instructor. This course includes multivariate normal distribution, distribution of quadratic forms, Gauss Markov Theorem, theory for the full rank and less than full rank models, generalized least squares, estimability and testable hypotheses, general linear hypothesis, linear mixed models and variance components, and generalized linear models. Statistical software will be used for data analysis. Differential Tuition: $387.

STA 6813. Multivariate Analysis. (3-0) 3 Credit Hours.
Prerequisite: STA 5103 or equivalent, or consent of instructor. This course includes multivariate normal distribution, estimation of mean vector and covariance matrix, Hotelling's T-squared statistic, principal components, factor analysis, MANOVA, multivariate regression, cluster analysis, discriminant analysis, Wishart distribution, and tests concerning covariance matrices. Statistical software will be used for data analysis. Differential Tuition: $387.

STA 6833. Design and Analysis of Experiments. (3-0) 3 Credit Hours.
Prerequisite: STA 5103 or equivalent, or consent of instructor. Introduction to experimental design and applied data analysis as used in business, technological, and scientific settings. Topics include one-factor and two-factor experiments, randomized block designs, two-level and three-level factorial and fractional factorial designs, nested and split-plot designs, and optimal designs. Statistical software will be used for data analysis. Differential Tuition: $387.

STA 6843. Computer Aided Optimal Design. (3-0) 3 Credit Hours.
Prerequisite: STA 6833 or equivalent, or consent of instructor. Introduction to obtaining experimental designs and statistical methods for fitting response surfaces, and how to computer-generate the designs and use them in applied settings. Topics discussed include generating designs for obtaining process improvements with steepest ascents and for fitting response surfaces of different shapes, and use of the resultant model diagnostics to find optimum operating conditions. Use is made of JMP and SAS for design generation. Differential Tuition: $387.

STA 6853. Categorical Data Analysis. (3-0) 3 Credit Hours.
Prerequisite: STA 5103 or equivalent, or consent of instructor. This course will cover types of categorical data, analysis of multi-dimensional contingency tables, asymptotic inferences on contingency tables including testing of independence, logit models for binary response data, multinomial logit models for multi-categorical response data, log-linear models for contingency tables, specialized methods for ordinal data, generalized linear models, and generalized linear mixed-effects model. Statistical software will be used for data analysis. Differential Tuition: $387.

STA 6863. Spatial Statistics. (3-0) 3 Credit Hours.
Prerequisite: STA 5103 or equivalent, or consent of instructor. This course will cover problems dealing with spatial statistics, random fields, Gaussian random fields, covariograms and variograms, stationarity and isotropy, covariogram/variogram estimation, spatial prediction (kriging), statistical properties of kriging predictors, cross validation, simulation of random fields, and models for lattice/areal data. Differential Tuition: $387.

STA 6903. Survival Analysis. (3-0) 3 Credit Hours.
Prerequisite: STA 5093 or equivalent, or consent of instructor. This course introduces both parametric and nonparametric methods for analyzing time to event data. Topics include survivor and hazard functions, censoring, Kaplan-Meier estimation, log-rank and related tests, inference based on standard lifetime distributions, regression approach to survival analysis including the Cox proportional hazards model, and time dependent covariates. Emphasis will be given on application, interpretation and data analysis using statistical software. Differential Tuition: $387.

STA 6923. Introduction to Statistical Learning. (3-0) 3 Credit Hours.
Prerequisite: STA 5103 or equivalent, or consent of instructor. This course provides an introduction to statistical learning and data mining tools in analyzing the vast amounts of data found in business, informatics, cyber security and other industries. The course mostly covers supervised and unsupervised learnings. The topics include concepts in statistical and machine learnings, variance-bias tradeoff, linear regressions with model assessment and regularization, model averaging, resampling tools, tree regressions and classification, discriminant analysis, nearest-neighbor classification, principal components, and cluster analysis. Statistical software will be used for data analysis. Differential Tuition: $387.

STA 6933. Advanced Topics in Statistical Learning. (3-0) 3 Credit Hours.
Prerequisite: STA 6923 or equivalent, or consent of instructor. This course provides deeper understanding in selected statistical learning concepts and tools with mathematical justifications. The topics include linear and nonlinear methods in regression and classification with regularization, additive models with bagging and boosting, random forest, support vector machines, and neural networks. Statistical software will be used for data analysis. Differential Tuition: $387.

STA 6943. Statistics Internship. (0-0) 3 Credit Hours.
Prerequisites: Graduate standing, 15 semester credit hours of graduate work, and consent of instructor. Internship must be approved in advance by the Internship Coordinator and the student's Graduate Advisor of Record. Supervised full- or part-time off-campus work experience and training in statistics. Individual conferences and written reports required. Differential Tuition: $387.

STA 6953. Independent Study. (0-0) 3 Credit Hours.
Prerequisites: Graduate standing and permission in writing (form available) from the instructor and the student's Graduate Advisor of Record. Independent reading, research, discussion, and/or writing under the direction of a faculty member. For students needing specialized work not normally or not often available as part of the regular course offerings. May be repeated for credit, but not more than 6 hours, regardless of discipline, will apply to the degree. Differential Tuition: $387.

STA 6961. Comprehensive Examination. (0-0) 1 Credit Hour.
Prerequisite: Approval of the appropriate Graduate Program Committee to take the Comprehensive Examination. Independent study course for the purpose of taking the Comprehensive Examination. May be repeated as many times as approved by the Graduate Program Committee. Enrollment is required each term in which the Comprehensive Examination is taken if no other courses are being taken that term. The grade report for the course is either "CR" (satisfactory performance on the Comprehensive Examination) or "NC" (unsatisfactory performance on the Comprehensive Examination). Differential Tuition: $129.

STA 6973. Special Problems. (3-0) 3 Credit Hours.
Prerequisite: Consent of instructor. An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Problems courses may be repeated for credit when topics vary, but not more than 6 hours, regardless of discipline, will apply to the degree. Differential Tuition: $387.

STA 6983. Master's Thesis. (0-0) 3 Credit Hours.
Prerequisites: Permission from the Graduate Advisor of Record and thesis director. Thesis research and preparation. May be repeated for credit, but not more than 6 hours will apply to the Master's degree. Credit will be awarded upon completion of the thesis. Enrollment is required each term in which the thesis is in progress. Differential Tuition: $387.

STA 7023. Applied Linear Statistical Models. (3-0) 3 Credit Hours.
Prerequisite: Consent of instructor. An in-depth study of regression and analysis of variance models. Topics include multiple regression and model building, multiple and partial correlation, analysis of residuals, analysis of variance, multivariate analysis of variance, analysis of variance as regression analysis, generalized linear model, and applications of statistical models to problems in business. Computer software packages such as SAS or SPSS will be used for data analysis. This course is designed for doctoral students in Business and cannot be applied to a Master of Science degree in Applied Statistics without consent of the instructor and prior approval from the Graduate Advisor of Record. Differential Tuition: $387.

STA 7033. Multivariate Statistical Analysis. (3-0) 3 Credit Hours.
Prerequisite: Consent of instructor. An advanced treatment of multivariate statistical techniques. Topics include multivariate normal distribution, multivariate tests of hypotheses, confidence regions, principal component analysis, factor analysis, discrimination and classification analysis, and clustering. Computer software packages such as SAS or SPSS will be used for data analysis. This course is designed for doctoral students in Business and cannot be applied to a Master of Science degree in Applied Statistics without consent of the instructor and prior approval from the Graduate Advisor of Record. Differential Tuition: $407.10.

STA 7211. Doctoral Research. (0-0) 1 Credit Hour.
May be repeated for credit, but not more than 15 hours may be applied toward the Doctoral degree. Differential Tuition: $129.

STA 7212. Doctoral Research. (0-0) 2 Credit Hours.
May be repeated for credit, but not more than 15 hours may be applied toward the Doctoral degree. Differential Tuition: $258.

STA 7213. Doctoral Research. (0-0) 3 Credit Hours.
May be repeated for credit, but not more than 15 hours may be applied toward the Doctoral degree. Differential Tuition: $387.

STA 7214. Doctoral Research. (0-0) 4 Credit Hours.
May be repeated for credit, but not more than 15 hours may be applied toward the Doctoral degree. Differential Tuition: $516.

STA 7216. Doctoral Research. (0-0) 6 Credit Hours.
May be repeated for credit, but not more than 15 hours may be applied toward the Doctoral degree. Differential Tuition: $774.

STA 7311. Doctoral Dissertation. (0-0) 1 Credit Hour.
Prerequisite: Admission to candidacy for Doctoral degree in Applied Statistics. May be repeated for credit, but not more than 15 hours may be applied toward the Doctoral degree. Differential Tuition: $129.

STA 7313. Doctoral Dissertation. (0-0) 3 Credit Hours.
Prerequisite: Admission to candidacy for Doctoral degree in Applied Statistics. May be repeated for credit, but not more than 15 hours may be applied toward the Doctoral degree. Differential Tuition: $387.

STA 7314. Doctoral Dissertation. (0-0) 4 Credit Hours.
Prerequisite: Admission to candidacy for Doctoral degree in Applied Statistics. May be repeated for credit, but not more than 15 hours may be applied toward the Doctoral degree. Differential Tuition: $516.

STA 7316. Doctoral Dissertation. (0-0) 6 Credit Hours.
Prerequisite: Admission to candidacy for Doctoral degree in Applied Statistics. May be repeated for credit, but not more than 15 hours may be applied toward the Doctoral degree. Differential Tuition: $774.

STA 7503. Advanced Inference I. (3-0) 3 Credit Hours.
Prerequisite: STA 5513 or equivalent and Doctoral standing. This course is a brief introduction to measure and Lebesgue integration, location-scale families of distributions, exponential families of distributions, sufficiency, completeness, ancillarity, Fisher information, model identifiability, principles of estimation, best-unbiased estimation, variance lower bounds, maximum likelihood estimation, some other estimation methods, and small sample properties of estimators. Differential Tuition: $387.

STA 7513. Advanced Inference II. (3-0) 3 Credit Hours.
Prerequisite: STA 7503. Different forms of stochastic convergence, laws of large numbers, central limit theorems, multivariate delta method, asymptotic properties of maximum likelihood estimators, tests of hypotheses, Neyman-Pearson theory, uniformly most powerful tests, unbiased tests, monotone likelihood ratio families, likelihood ratio tests, Wald and Rao/Score tests, asymptotic properties of tests, tests of linear hypothesis, Bonferroni and Scheffe multiple tests, confidence regions, duality between confidence regions and tests of hypotheses. Differential Tuition: $387.