

Business Analytics, M.S.

FOX SCHOOL OF BUSINESS AND MANAGEMENT

Learn more about the Master of Science in Business Analytics.

About the Program

The M.S. in Business Analytics is designed to enable graduates to be effective translators by using data and models to recognize opportunities and improve organizational decision making. Data-driven decision making has been shown to have large positive effects on outcomes of interest to organizations of all types.

The M.S. in Business Analytics leverages the ever-increasing importance of data as a strategic asset to organizations. Students enhance their analytic toolkit with a holistic view of how to improve decision making through analytics. The degree program is designed to allow students to acquire advanced skills and techniques that can be applied to discipline-specific and more general business problems. Graduates are prepared to meet the growing demand for talent in the areas of managing, analyzing, predicting, and discovering insights from the complex data available to modern corporations. They know how to translate data into decisions and decisions into profits.

Time Limit for Degree Completion: 6 years

Campus Location: Main, Center City

Full-Time/Part-Time Status: The degree program can be completed on a full- or part-time basis.

Affiliation(s): Research is supported by Fox School of Business and Management's Center for Data Analytics, Center for Data Science, Center for Statistical Analysis, and numerous grants from government and industry.

Accreditation: All Fox School of Business and Management graduate programs are accredited by the Association to Advance Collegiate Schools of Business (AACSB International).

Job Prospects: The Fox School Center for Student Professional Development provides students with career coaching and professional development resources that support the job search. Graduates are hired into such positions as:

- Big Data Analytics Specialist
- Data Analyst
- Data Scientist
- Management Analyst/Consultant
- Manager of Services or Manufacturing Operations
- Market Research Analyst
- Project Manager
- Research Analyst
- Supply Chain Manager

Non-Matriculated Student Policy: Students with an undergraduate GPA of 3.25 or higher may be allowed to take classes under non-matriculated status. Non-matriculated students may take a maximum of 9 credits. Any additional courses require the student to be matriculated in a program, to pursue the certificate, or to enroll in the 4+1 program.

Financing Opportunities: Citizens and permanent residents of the United States are considered domestic students and are typically eligible for federal student loans as well as alternative loans through private lenders. The Fox School grants 5% tuition scholarships to alumni who are admitted to the program. Scholarship funds are limited and available based on merit.

Admission Requirements and Deadlines

Application Deadline:

Fall:

- December 15 – Early Decision Deadline
- March 1 – Scholarship Deadline and International Deadline
- June 30 – Final Deadline

Applications are reviewed as they are received and can sometimes be considered after the deadline.

APPLY ONLINE to this Fox graduate program at <https://fox.secure.force.com/SiteLogin/>.

Letters of Reference:

Number Required: 2

From Whom: Professional references from an immediate supervisor, current or past, are preferred. Academic references are acceptable.

Bachelor's Degree in Discipline/Related Discipline: A baccalaureate degree is required.

Statement of Goals: In 500 words or less, describe your goals and motivations for pursuing the master's degree in Business Analytics.

Standardized Test Scores:

GRE/GMAT: Required. Scores for the GRE typically fall within the following percentile ranges: 50 to 99 Verbal; 80 to 99 Quantitative.

Applicants who earned their baccalaureate degree from an institution where the language of instruction was other than English, with the exception of those who subsequently earned a master's degree in a country where the language of instruction is English, must report scores for a standardized test of English that meet these minimums:

- TOEFL iBT: 100
- IELTS Academic: 7.0
- Duolingo: 110
- PTE Academic: 68

Resume: Current resume or CV is required.

Transfer Credit: Upper-level graduate credits from an AACSB-accredited graduate business program, but not previously applied to a conferred degree, may be transferred into the M.S. program. The credits must be part of the required degree program at Temple University. To be transferred, the grade must be a "B" or better. The Admissions Committee makes recommendations for transferring credits to the department chair. The maximum number of credits a student may transfer is 6.

Program Requirements

General Program Requirements:

Number of Credits Required Beyond the Baccalaureate: 30

Required Courses:

Code	Title	Credit Hours
Core Courses		
BA 5687	MS Advanced Professional Development Strategies ¹	0
STAT 5001	Quantitative Methods for Business	3
STAT 5602	Visualization: The Art of Numbers and the Psychology of Persuasion	3
STAT 5603	Statistical Learning and Data Mining	3
STAT 5604	Experiments: Knowledge by Design	3
STAT 5605	Decision Models: From Data to Decisions	3
STAT 5606	Data: Care, Feeding, and Cleaning	3
STAT 5607	Advanced Business Analytics	3
Electives ²		6
Select two from the following:		
BA 5685	Internship or Externship in Business	
MKTG 5103	Marketing Research: Techniques and Application	
MKTG 5111	Customer Data Analytics	
MSOM 5107	Lean, Six Sigma, and the Science of Improvement	
MSOM 5108	Project Management	
STAT 8109	Applied Statistics and Data Science	
STAT 8111	Survey Techniques for Business Applications	
STAT 8116	Categorical Data Analysis	
STAT 8122	Advanced SAS Programming	
Capstone Course		3

BA 5651 or BA 5685	Business Analytics Capstone Internship or Externship in Business
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Total Credit Hours

30

- ¹ BA 5687 may be waived based on prior academic or professional preparation. Students should consult with the Program Director.
- ² Students may select as an elective any graduate-level course that does not substantially duplicate the core courses listed above. Permission from the Program Director is required.

Culminating Events:*Capstone Course:*

All students in the Business Analytics M.S. program participate in a capstone experience that is designed to integrate “real world” problems into the curriculum. In general, a sponsoring corporation provides a problem and real data, and students divide into teams to work on the problem. At the end of the term, the top several groups as judged by professors present to the program's advisory board and other corporate judges.

Contacts**Program Web Address:**

<https://www.temple.edu/academics/degree-programs/business-analytics-ms-bu-busa-ms>

Department Information:

Fox School of Business and Management
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701 Alter Hall (006-22)
Philadelphia, PA 19122
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215-204-7678
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Submission Address for Application Materials:

<https://fox.secure.force.com/SiteLogin/>

Department Contacts:*Academic Director:*

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Specialized Master's Programs Coordinator:

Rachel Carr
Associate Director for Specialized Master's Programs
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Courses**STAT 5001. Quantitative Methods for Business. 1 to 3 Credit Hour.**

This course is designed to introduce you to contemporary elementary applied statistics and to provide you with an appreciation for the uses of statistics in business, economics, everyday life, as well as hands-on capabilities needed in your later coursework and professional employment.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

College Restrictions: Must be enrolled in one of the following Colleges: Business & Mngmnt, Fox School.

Repeatability: This course may not be repeated for additional credits.

STAT 5002. Introduction to Biostatistics. 3 Credit Hours.

Topics cover statistical methods and concepts with special emphasis on applications in health and biological sciences.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

STAT 5170. Special Topics. 1 to 6 Credit Hour.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

STAT 5182. Independent Study. 1 to 6 Credit Hour.

Special study in a particular aspect of statistics under the direct supervision of an appropriate graduate faculty member. No more than six semester hours of independent study may be counted toward degree requirements.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

STAT 5190. Special Topics - Stat. 1 to 6 Credit Hour.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

STAT 5282. Independent Study. 1 to 3 Credit Hour.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

Pre-requisites:

STAT 5001|Minimum Grade of B-|May not be taken concurrently.

STAT 5602. Visualization: The Art of Numbers and the Psychology of Persuasion. 3 Credit Hours.

Organizations are collecting an unprecedented volume of data, and analysts are producing information from data using analytics and models. None of the information that is extracted from the data is usable unless it can be effectively communicated. In this course, we will begin with the fundamental questions of communication: Who is the audience? What is the information? What is the goal? Using these questions to focus our thoughts, we will explore the techniques that allow you to select appropriate information and to craft a narrative that clearly and effectively communicates this information using visual elements. Producing good visual displays is a combination of art and science and compromise between function and form. We will discuss how humans process and encode visual and textual information in relation to selecting an appropriate visual display, and we will cover topics including: exploratory data analyses, charts, tables, graphics, static and dynamic displays, effective presentations, multimedia content, animation, and dashboard design. Examples and cases will be used from a variety of industries.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

College Restrictions: Must be enrolled in one of the following Colleges: Business & Mngmnt, Fox School.

Repeatability: This course may not be repeated for additional credits.

STAT 5603. Statistical Learning and Data Mining. 3 Credit Hours.

This course is designed to change the way you think about data. Numerous firms have demonstrated that the ability to reliably extract managerially-relevant information from data is a potent and enduring source of competitive advantage, a realization that transforms data into an asset that can be a primary source of competitive advantage. Competition is pushing organizations to "mine" (or extract) these insights faster, with greater reliability, and in ways that maximize the probability of implementation. In this course we will explore how statistical learning and data mining techniques can be used to improve decision-making and profitability. The course will provide an overview of the fundamental principles and techniques of data mining, and we will use real-world examples, cases, and "hands-on" techniques to demonstrate data-mining techniques in context, to develop your analytic thinking, and to develop your model building acumen.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

College Restrictions: Must be enrolled in one of the following Colleges: Business & Mngmnt, Fox School.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

STAT 5001|Minimum Grade of B-|May be taken concurrently
OR (MIS 5301|Minimum Grade of B-|May be taken concurrently
AND STAT 5301|Minimum Grade of B-|May be taken concurrently)
OR (MIS 5401|Minimum Grade of B-|May be taken concurrently
AND STAT 5401|Minimum Grade of B-|May be taken concurrently)

STAT 5604. Experiments: Knowledge by Design. 3 Credit Hours.

How do we know which policies, strategies, and decisions work, which should be continued, and which should be changed? Organizations frequently implement strategies and changes, only to find that they fail to produce their intended effects. Thus, there is a gap between what "sounded good" and what was "right." Ultimately, the gold standard for assessing what is "right" is a controlled experiment, which is the least utilized technique in the corporate arsenal. Experiments provide a structured way to construct a feedback loop that allows us to identify errors in our beliefs and to ascertain the real drivers of outcomes. In this course, we will explore how to use this "test and learn" paradigm to answer questions such as how advertising should be designed and targeted, what types of promotions are most effective, what products should be offered, how employees should be compensated, which sales channels should be emphasized, how webpages should be designed, and more. Experiments are an ideal way to understand how to implement a "test and learn" approach to management and to separate the "signal" from the "noise."

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

College Restrictions: Must be enrolled in one of the following Colleges: Business & Mngmnt, Fox School.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

STAT 5001|Minimum Grade of B-|May be taken concurrently
OR (MIS 5301|Minimum Grade of B-|May be taken concurrently
AND STAT 5301|Minimum Grade of B-|May be taken concurrently)
OR (MIS 5401|Minimum Grade of B-|May be taken concurrently
AND STAT 5401|Minimum Grade of B-|May be taken concurrently)

STAT 5605. Decision Models: From Data to Decisions. 3 Credit Hours.

Good analysts know that predictions are always uncertain. However, merely expressing uncertainty is not sufficient for decision making. In addition, we need to combine the results of uncertain inputs into a more general model, account for the relative severity of negative outcomes, and choose a strategy that best achieves our goals (e.g. highest expected value, most robust, least chance of losing, etc.). We also need to communicate the process and conclusions to constituents and to decision-makers. This course focuses on techniques for combining uncertain inputs into a decision model that can be used to characterize likely and unlikely outcomes, to quantify risk, and to identify inputs to a decision that are "high leverage" (i.e., outcomes are very sensitive to those inputs). In addition, you will learn how to build a decision model, how to make better decisions in the presence of uncertainty, and how to deal with multi-stage decisions.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

College Restrictions: Must be enrolled in one of the following Colleges: Business & Mngmnt, Fox School.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

STAT 5001|Minimum Grade of B-|May be taken concurrently
OR (MIS 5301|Minimum Grade of B-|May be taken concurrently
AND STAT 5301|Minimum Grade of B-|May be taken concurrently)
OR (MIS 5401|Minimum Grade of B-|May be taken concurrently
AND STAT 5401|Minimum Grade of B-|May be taken concurrently)

STAT 5606. Data: Care, Feeding, and Cleaning. 3 Credit Hours.

Data is ubiquitous. Real data is also "dirty." Analysis of unclean data can significantly distort the results of analyses, and it can reduce or eliminate the benefits of an information-driven strategy. Thus, the first step in generating good information from data is to "clean" the data. Substantial research has been done on procedures to automatically or semi-automatically identify--and, when possible, correct--errors in large datasets. Even after data have been "scrubbed" the datasets are frequently not in the correct configuration for analysis. Data combination and manipulation involves techniques for merging and summarizing datasets, extracting subsets of data, and transforming variables within the datasets. In this course we explore tools and techniques for cleaning raw data (fixing errors, identifying outliers, etc.), extracting subsets or samples of data, merging and combining datasets, summarizing disaggregate data, and manipulating and transforming individual variables within the datasets. We will also discuss good procedures for ensuring data quality and reliability in data collection. In addition, we will discuss techniques to identify issues in data collection and how to clean the data.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

College Restrictions: Must be enrolled in one of the following Colleges: Business & Mngmnt, Fox School.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

STAT 5001|Minimum Grade of B-|May be taken concurrently
 OR (MIS 5301|Minimum Grade of B-|May be taken concurrently
 AND STAT 5301|Minimum Grade of B-|May be taken concurrently)
 OR (MIS 5401|Minimum Grade of B-|May be taken concurrently
 AND STAT 5401|Minimum Grade of B-|May be taken concurrently)

STAT 5607. Advanced Business Analytics. 3 Credit Hours.

This course builds upon the foundation in Business Analytics. In previous courses, we saw that data by itself is useless, and that it must be transformed into information in order to have value to decision makers. This course will extend your understanding of the art and science of extracting information from data into increasingly complex and "real world" data. Specifically, we will cover extensions to regression, logistic regression, hierarchical modeling, model selection, and other topics spanning the process of building and evaluating models. In addition, we will practice drawing intuition and insight from models and effectively communicating that insight in a format that can help decision-makers to make better decisions.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

College Restrictions: Must be enrolled in one of the following Colleges: Business & Mngmnt, Fox School.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

STAT 5001|Minimum Grade of B-|May be taken concurrently
 OR (MIS 5301|Minimum Grade of B-|May be taken concurrently
 AND STAT 5301|Minimum Grade of B-|May be taken concurrently)
 OR (MIS 5401|Minimum Grade of B-|May be taken concurrently
 AND STAT 5401|Minimum Grade of B-|May be taken concurrently)

STAT 5611. Business Analytics II. 1.5 Credit Hour.

Organizations are drowning in a sea of data. However, data by itself is useless. To have value, it must be transformed into information that can be used to make decisions. It has been shown by myriad companies that one path to success in the business arena is through superior use of information - information about customers, markets, and operations. This course extends the material presented in Business Analytics I, continuing the development of the art and science of extracting information from data. The emphasis is on using extracted information to improve business decisions. It also delves into the presentation of quantitative data using state of the art tools and techniques.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

College Restrictions: Must be enrolled in one of the following Colleges: Business & Mngmnt, Fox School.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

(MIS 5301|Minimum Grade of B-|May not be taken concurrently
 AND STAT 5301|Minimum Grade of B-|May not be taken concurrently)
 OR (MIS 5401|Minimum Grade of B-|May not be taken concurrently
 AND STAT 5401|Minimum Grade of B-|May not be taken concurrently)
 OR STAT 5001|Minimum Grade of B-|May not be taken concurrently.

STAT 5651. Capstone in Analytics. 3 Credit Hours.

The capstone in analytics is the culmination of analytics-focused coursework. You will work with real data from "live" clients. Some of you will work on projects at companies for which you are interning. Others will work with MBA teams as part of our Fox Management Consulting program, providing analytics support for a live client. Others will work on primarily analytics focused projects.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

STAT 5801. Statistical Analysis for Management. 3 Credit Hours.

In this course, you'll learn how to use statistics to help solve business problems throughout an enterprise. You'll examine case examples of statistical analysis in areas such as marketing, finance and management. You'll learn descriptive and inferential techniques such as regression analysis and how to analyze data and reach decisions, using statistical computer software and Excel.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

STAT 5802. Quantitative Techniques for Management. 3 Credit Hours.

In this course you'll apply advanced quantitative techniques for managerial decision-making such as forecasting, linear programming, simulation, decision analysis, Markov chains and game theory. You'll use customized software and Excel to analyze these models extensively and apply them to decisions regarding resource allocation and other managerial problems.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

STAT 5890. Special Topics. 1 to 6 Credit Hour.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

STAT 8001. Probability and Statistics Theory I. 3 Credit Hours.

Topics include basic probability theory and combinatorial problems, generating functions, random variables, probability distributions, law of large numbers, and limit theorems.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

STAT 8002. Probability and Statistics Theory II. 3 Credit Hours.

A comprehensive development of the theory of statistics, including standard distributions, sampling distributions, general theory of estimation, testing of hypotheses, statistical decision theory, order statistics, linear statistical estimation.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

(STAT 8001|Minimum Grade of B-|May not be taken concurrently
AND STAT 8002|Minimum Grade of B-|May not be taken concurrently)

STAT 8003. Statistical Methods I. 3 Credit Hours.

Introduction to applied statistics. Topics include data management, probability distributions, parameter estimation, hypothesis testing, sampling methodologies, graphical display, analysis of variance, and simple and multiple regression. Use of R, S-Plus and SAS statistical software.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

MATH 2031|Minimum Grade of B-|May not be taken concurrently.

STAT 8004. Statistical Methods II. 3 Credit Hours.

Design of experiments, analysis of discrete data, introduction to nonparametric methods, logistic regression, ARIMA time series analysis, bootstrapping, jackknife, robustness, and selected topics in multivariate analysis. Use of R, S-Plus and SAS statistical software.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

STAT 8003|Minimum Grade of B-|May not be taken concurrently.

STAT 8031. Probability and Large Sample Theory. 3 Credit Hours.

An advanced level theoretical course covering measure theoretic probability, some probability inequalities, statistical independence, strong and weak laws of large numbers, convergence in distribution, variance stabilizing transformations, characteristic functions and central limit theorem.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

STAT 8001|Minimum Grade of B|May not be taken concurrently.

STAT 8101. Stochastic Processes. 3 Credit Hours.

This is a first course in stochastic processes, with an emphasis on continuous-time models that support applications in financial mathematics and derivative evaluation. The course covers: fundamentals of probability, limit theorems, conditional expectation, change of measures, Markov chains, random walks, martingales, Brownian motion, the Ito integral, stochastic differential equations, the Black-Scholes model and its use in evaluating a variety of financial derivatives.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

MATH 1031|Minimum Grade of B-|May not be taken concurrently
OR MATH 1931|Minimum Grade of B-|May not be taken concurrently
OR MATH 1041|Minimum Grade of B-|May not be taken concurrently
OR MATH 1941|Minimum Grade of B-|May not be taken concurrently
OR MATH 1038|Minimum Grade of B-|May not be taken concurrently
OR MATH 1042|Minimum Grade of B-|May not be taken concurrently
OR MATH 1942|Minimum Grade of B-|May not be taken concurrently.

STAT 8102. Statistical Methods III. 3 Credit Hours.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

STAT 8004|Minimum Grade of B-|May not be taken concurrently.

STAT 8103. Sampling Theory. 3 Credit Hours.

Theory and application of sampling from finite populations. Topics include random, stratified, cluster, and systematic sampling; estimation of means and variances; optimal allocation of resources; problems of nonsampling errors; and ratio and regression estimation.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

STAT 8003|Minimum Grade of B-|May not be taken concurrently.

STAT 8104. Mathematics for Stat. 3 Credit Hours.

Vector spaces; linear independence of vectors and basis; matrices and algebraic operations on matrices; determinants; rank of a matrix; inverse of nonsingular matrices; linear equations and their solutions; generalized inverse of a matrix; eigen values and vectors of matrices; diagonalization theorems; quadratic forms and their reduction to sum of squares; Jacobians.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

MATH 2101|Minimum Grade of B-|May not be taken concurrently

OR MATH 2103|Minimum Grade of B-|May not be taken concurrently.

STAT 8105. Univariate Time Series Analysis. 3 Credit Hours.

Theory and application of univariate time series analysis. Includes both time domain and frequency domain methods. Considers stationary and nonstationary linear processes, time series model building, forecasting, unit root test, intervention models and outlier detection, spectral theory of stationary processes, spectral windows, and estimation of spectrum.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

STAT 8002|Minimum Grade of B-|May not be taken concurrently.

STAT 8106. Linear Models I. 3 Credit Hours.

Covers the basic theory and practice of generalized linear models (GLM), such as the logistic, Poisson and gamma regression, as well as models for multilevel or longitudinal Gaussian responses, such as the hierarchical linear model and linear mixed model. The students will need to work with R and SAS throughout the semester.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

(STAT 8002|Minimum Grade of B-|May not be taken concurrently)

AND (STAT 8004|Minimum Grade of B-|May not be taken concurrently)

AND (STAT 8104|Minimum Grade of B-|May not be taken concurrently)

STAT 8107. Design of Experiments I. 3 Credit Hours.

Principles of experimental designs, completely randomized designs, multiple comparisons, randomized block design, latin square design, missing value problems, analysis of covariance, and factorial experiments.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

STAT 8004|Minimum Grade of B-|May not be taken concurrently.

STAT 8108. Applied Multivariate Analysis I. 3 Credit Hours.

Multivariate normal distribution; marginal and conditional distributions; estimation of population mean vector and dispersion matrix; correlation, partial correlation, and multiple correlation coefficients; Hotelling's T²; MANOVA; discriminant function; repeated measurements analysis; principal components and canonical correlation; factor analysis; and multidimensional scaling.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

(STAT 8004|Minimum Grade of B-|May not be taken concurrently)

AND (STAT 8104|Minimum Grade of B-|May not be taken concurrently)

STAT 8109. Applied Statistics and Data Science. 3 Credit Hours.

PART I: Elements of a scientific problem, including estimands, the role of statistical models, the language of statistical modeling, notions of likelihood, finite vs infinite populations, and types of analysis. PART II: Elements of statistical modeling, including transformation theorems, sufficiency, 1-parameter and multi-parameter models, multivariate Normal models, Dirichlet-multinomial models, hierarchical models, generalized linear models, mixture models, text analysis, social network analysis. PART III: Concepts and algorithms for estimation and inference, including information, statistical efficiency, asymptotic approximations, maximum likelihood estimators, method of moments estimators, Bayesian estimators, empirical Bayes vs full Bayes estimation strategies, expectation-maximization algorithm, Monte Carlo approximations, Gibbs samplers, Metropolis-Hastings samplers, prior and posterior predictive checks, and Bayesian vs. frequentist coverage. Data Science visitors: The course will feature a series of short talks and Q&A sessions with prominent data scientists spanning academia, government, and the Tech industry.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

STAT 5001|Minimum Grade of B-|May not be taken concurrently.

STAT 8111. Survey Techniques for Business Applications. 3 Credit Hours.

Application oriented. A course dealing with statistical and nonstatistical aspects of organizing a sample survey. Included are discussions of objectives, measurement, sample selection, pilot testing, data collection, data editing, summarization and interpretation of results in addition to describing the various sampling schemes. Students may be required to plan and execute a survey.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

STAT 5001|Minimum Grade of B-|May not be taken concurrently.

STAT 8112. Statistical Methods for Business Research I. 3 Credit Hours.

Part I of a doctoral level, one-year sequence of courses for the PhD students in Business Administration program. The course covers a variety of statistical methods useful in business research, such as: multiple regression analysis, ANOVA, linear models, analysis of covariance, logistic regression, principal component analysis, exploratory factor analysis and canonical correlation analysis. Emphases are placed on rationales, assumptions, techniques, and interpretation of results from computer packages. Relevant mathematical results will be presented, but proofs or abstract arguments shall be avoided. The lectures cover computer usages, such as R and/or SAS, and the students are expected to work with SAS (or equivalent packages) throughout the semester.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

STAT 2101|Minimum Grade of B-|May not be taken concurrently
OR STAT 2901|Minimum Grade of B-|May not be taken concurrently
OR STAT 2103|Minimum Grade of B-|May not be taken concurrently
OR STAT 2903|Minimum Grade of B-|May not be taken concurrently
OR MATH 2031|Minimum Grade of B-|May not be taken concurrently
OR MATH 3032|Minimum Grade of B-|May not be taken concurrently.

STAT 8113. Statistical Methods for Business Research II. 3 Credit Hours.

Part II of a doctoral level, one-year sequence of courses for the PhD students in Business Administration program. Topics covered in this course are: discriminant analysis, confirmatory factor analysis and structural equations modeling, time-series intervention analysis, survival (event history) analysis, MANOVA, multivariate profile analysis, hierarchical linear models (HLM), linear mixed models (LMM) for multilevel data.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

STAT 8112|Minimum Grade of B-|May not be taken concurrently.

STAT 8114. Survival Analysis I. 3 Credit Hours.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

STAT 8115. Nonparametric Methods. 3 Credit Hours.

A thorough course in nonparametric statistics. Estimation and testing of hypothesis when the function form of the population distribution function is not completely specified.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

STAT 8002|Minimum Grade of B-|May not be taken concurrently.

STAT 8116. Categorical Data Analysis. 3 Credit Hours.

Sampling models and analyses for discrete data: Fisher's exact test; Logistic regression; ROC analysis; Log-linear models and Poisson regression; Conditional logistic regression; Cochran-Mantel-Haenszel test; Measures of agreement between observers; Quasi-independence; Multinomial logit models; Proportional odds model; Association models; generalized estimating equations (GEE); generalized linear mixed model (GLIMMIX); GSK models; Composite link functions. The students will need to work with R and SAS throughout the semester.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

STAT 8002|Minimum Grade of B-|May not be taken concurrently.

STAT 8117. Clinical Trials. 3 Credit Hours.

Introduction to the special problems associated with medical trials on humans. Topics include randomization, sample-size determination, methods for early trial termination, and tests for superiority, equivalence, and non-inferiority. Also discussed are choice of endpoints, control, side effects, use of historical data, meta-analysis and ethics of experimentation on humans.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

STAT 8002|Minimum Grade of B-|May not be taken concurrently

OR STAT 8004|Minimum Grade of B-|May not be taken concurrently.

STAT 8121. Statistical Computing. 3 Credit Hours.

Use of computers in the solution of statistical problems. Topics include: floating point architecture, random number generation, design of statistical software, computational linear algebra, numerical integration, optimization methods.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

STAT 8004|Minimum Grade of B-|May not be taken concurrently.

STAT 8122. Advanced SAS Programming. 3 Credit Hours.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

(MATH 1042|Minimum Grade of B-|May not be taken concurrently

OR MATH 1942|Minimum Grade of B-|May not be taken concurrently)

AND (STAT 8001|Minimum Grade of B-|May not be taken concurrently)

AND (STAT 8002|Minimum Grade of B-|May not be taken concurrently)

STAT 8123. Time Series Analysis and Forecasting. 3 Credit Hours.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

(STAT 8002|Minimum Grade of B-|May not be taken concurrently
OR STAT 8101|Minimum Grade of B-|May not be taken concurrently)
AND (ECON 8009|Minimum Grade of B-|May not be taken concurrently
OR MATH 3032|Minimum Grade of B-|May not be taken concurrently)

STAT 8207. Design and Analysis of Complex Experiments. 3 Credit Hours.

Experimentation has become a strategic foundation for modern corporations. This course focuses on strategies for designing, executing, and analyzing experiments on large populations, as well as dealing with large collections of concurrent experiments. We will consider settings where units of analysis may be assigned treatment in multiple experiments that are running concurrently. The course is largely based on critical reading of recent articles and technical reports. The emphasis will be on the design of complex field experiments that produce actionable results, and in working with experimentation platforms at large IT companies.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

(STAT 8303|Minimum Grade of B-|May not be taken concurrently)
AND (STAT 8109|Minimum Grade of B-|May not be taken concurrently)

STAT 8515. Data Wrangling and Curation. 3 Credit Hours.

This course will explore advanced tools and techniques for cleaning "raw" data. Real data is ubiquitous, but it is almost always "dirty". Analysis of "dirty" data can significantly distort results, which can reduce or eliminate the benefits from an analytic solution. The first step in extracting actionable information from data is to "clean" the data, and this process frequently occupies the majority of the analysis time. In this course, we will provide an in-depth look at the techniques that can be used to identify and deal with problematic data. Even after data have been "scrubbed", datasets are frequently not in the correct configuration for analysis, and we will explore techniques for merging and summarizing datasets, extracting subsets of data, and transforming variables. We will also discuss procedures for ensuring data quality and reliability in data collection.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

STAT 8003|Minimum Grade of B|May be taken concurrently.

STAT 8982. Independent Study. 1 to 3 Credit Hour.

Special study in statistics theory and methods under the supervision of a graduate faculty member.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

STAT 9001. Advanced Statistical Inference I. 3 Credit Hours.

Background: Matrix Theory Estimation: Sufficiency, Completeness, UMVU Estimation, Information Inequality, Invariance Principle, Bayes Estimation, Admissibility, Maximum Likelihood Estimation, Large Sample Properties of Estimators.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

(MATH 1042|Minimum Grade of B-|May not be taken concurrently
OR MATH 1942|Minimum Grade of B-|May not be taken concurrently)
AND (STAT 8001|Minimum Grade of B-|May not be taken concurrently)
AND (STAT 8002|Minimum Grade of B-|May not be taken concurrently)

STAT 9002. Advanced Statistical Inference II. 3 Credit Hours.

Testing of Hypotheses: Neyman-Pearson Fundamental Lemma; Uniformly Most Powerful Tests, Confidence Intervals, Likelihood Ratio Tests; Asymptotic Tests, Multiple Hypotheses Testing.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

STAT 9090. Special Topics. 1 to 6 Credit Hour.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

College Restrictions: Must be enrolled in one of the following Colleges: Business & Mngmnt, Fox School.

Repeatability: This course may be repeated for additional credit.

STAT 9101. Multivariate Time Series Analysis. 3 Credit Hours.

Theory and application of multiple time series analysis and special topics. Covers transfer function models, time series regression with autocorrelated errors, ARCH and GARCH models, vector time series models, cointegration, state space models, long memory processes and nonlinear processes, time series aggregation and disaggregation.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

STAT 8105|Minimum Grade of B-|May not be taken concurrently.

STAT 9103. Stat Lrng & Data Mining. 3 Credit Hours.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

(STAT 8001|Minimum Grade of B-|May not be taken concurrently)

AND (STAT 8002|Minimum Grade of B-|May not be taken concurrently)

AND (STAT 8003|Minimum Grade of B-|May not be taken concurrently)

AND (STAT 8004|Minimum Grade of B-|May not be taken concurrently)

STAT 9106. Linear Models II. 3 Credit Hours.

Continuation of Stat 8106, covers the theory and practice of analyzing multivariate repeated/correlated non-Gaussian responses, with or without missing observations. Missing at random (MAR) models; informative missingness; EM algorithm; multiple imputations; quasi-likelihood estimation; generalized estimating equations (GEE); transition models; Gibbs sampling; Markov Chain Monte-Carlo (MCMC) technique. The students will need to work with R, SAS and WinBugs throughout the semester.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

STAT 8106|Minimum Grade of B-|May not be taken concurrently.

STAT 9107. Design of Experiments II. 3 Credit Hours.

Covers symmetric and asymmetrical factorial experiments, fractional replication, split plot design, balanced and partially balanced incomplete block designs without and with recovery of interblock information and lattice designs.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

STAT 8107|Minimum Grade of B-|May not be taken concurrently.

STAT 9108. Multivariate Analysis II. 3 Credit Hours.

A study of specialized topics in multivariate analysis.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

(STAT 8002|Minimum Grade of B-|May not be taken concurrently)
AND (STAT 8108|Minimum Grade of B-|May not be taken concurrently)

STAT 9114. Survival Analysis II. 3 Credit Hours.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

STAT 8114|Minimum Grade of B-|May not be taken concurrently.

STAT 9116. Statistical Genetics: An Advanced Graduate Course. 3 Credit Hours.

An advanced level graduate course in statistical genetics covering the basic concepts of allele, gene, genotype, phenotype, Hardy-Weinberg equilibrium, linkage analysis, QTL mapping using marker analysis, functional mapping for longitudinal traits, analysis of ultra-high dimensional data, genome-wide association studies.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

(STAT 8001|Minimum Grade of B|May not be taken concurrently)
AND (STAT 8002|Minimum Grade of B|May not be taken concurrently)
AND (STAT 8003|Minimum Grade of B|May not be taken concurrently)
AND (STAT 8004|Minimum Grade of B|May not be taken concurrently)

STAT 9180. Seminar in New Topics in Statistics. 3 Credit Hours.

Special topics in Statistics.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

STAT 9183. Directed Study in Statistics. 1 to 6 Credit Hour.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

STAT 9190. Seminar in New Topics in Statistics. 3 Credit Hours.

Special topics in Statistics.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

STAT 9994. Preliminary Examination Preparation. 1 Credit Hour.

Preparation for preliminary examinations.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

STAT 9998. Pre-Dissertation Research. 1 Credit Hour.

Proposal design. Registration required until approved proposal is on file at the Graduate School.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

STAT 9999. Dissertation Research. 1 to 12 Credit Hour.

For students elevated to candidacy and doing their dissertation research. Registration required until successful defense and graduation.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Student Attribute Restrictions: Must be enrolled in one of the following Student Attributes: Dissertation Writing Student.

Repeatability: This course may be repeated for additional credit.