Course ID	Course Title	Equivalent to	Home Dept.	Description	Units	Requisites	Professor	Offered	PhD	Informatics	MS	Cert.	Minor
AREC 559	**Advanced Applied Econometrics**		Agricultural & Resource Economics	Emphasis in the course is on econometric model specification, estimation, inference, forecasting, and simulation. Applications with actual data and modeling techniques are emphasized.	4	AREC 517, ECON 518, ECON 549		Fall	X		X	X	X
BIOS 574B	**Bayesian Statistical Theory and Applications**	ECON 574B, STAT 574B	Epidemiology & Biostatistics	Basic theory of Bayesian inference, including analytical and numerical methods for assessing posterior and predictive distributions, and applications. Topics will include Bayesian analysis of normal linear regression and computational methods including Markov chain Monte Carlo	3	ECON 522A, ECON 522B; concurrent registration, MATH 566 and MATH 571A.	Edward Bedrick	Fall	X	X	X	X	X
BIOS 576B	**Biostatistics for Research**	CPH/EPID 576B	Epidemiology & Biostatistics	Descriptive statistics and statistical inference relevant to biomedical research, including data analysis, regression and correlation analysis, analysis of variance, survival analysis, biological assay, statistical methods for epidemiology and statistical evaluation of clinical literature.	3		Roe, Denise	Spring	X		X	X available online	X
BIOS 576C	**Applied Biostatistics Analysis**	CPH/EPID 576C	Epidemiology & Biostatistics	Integrate methods in biostatistics (EPID 576A, B) and Epidemiology (EPID 573A, B) to develop analytical skills in an epidemiological project setting.	3	BIOS/EPID 576A, BIOS/EPID 576B, EPID 573A, EPID 573B or consent of instructor.	Bell, Melanie	Fall	X		X	X	X
BIOS 576D	**Data Management and the SAS Programming Language**	CPH/EPID 576D	Epidemiology & Biostatistics	This course will introduce students to the fundamentals of data management using the SAS programming language. Emphasis will be placed on data manipulation, including reading, processing, recoding, and reformatting data. The approach will be to teach by example, with an emphasis on hands-on learning.	3	BIOS/EPID 576A, EPID 573A	Degnan, William	Fall	X	X	X	X	X
BIOS 647	**Analysis of Categorical Data**	CPH/EPID 647	Epidemiology & Biostatistics	This course deals with the analysis of categorical data. It emphasizes applications in epidemiology, clinical trials, and other public health research, and will cover concepts and methods for binomial, multinomial, and count data, as well as proportions and incidence rates.	3	BIOS/EPID 576A, BIOS/EPID 576B; one year of college calculus or consent of instructor.	Hu, Chengcheng	Spring	X	X	X	X	X
BIOS 648	**Analysis of High Dimensional Data**	CPH/EPID 648	Epidemiology & Biostatistics	This course deals with the analysis of high dimensional data. It will cover multiple comparison, clustering and classification of high dimensional data, and regression methods involving high dimensional variables. Students will also learn the corresponding computer software.	3	BIOS/EPID 576A, BIOS/EPID 576B; one year of college calculus, a course in matrix algebra, or consent of instructor.	Hu, Chengcheng	Spring (Even)	X	X	X	X	X
BIOS 675	**Clinical Trials and Intervention Studies**	CPH/EPID 675	Epidemiology & Biostatistics	A fundamentals course on issues in the design, operation and analysis of controlled clinical trials and intervention studies. Emphasis on randomized long-term multicenter trials.	3	BIOS/EPID 576A, BIOS/EPID 576B.	Bell, Melanie	Spring	X	X	X	X	X
BIOS 684	**General Linear and Mixed Effects Models**	CPH/EPID 684	Epidemiology & Biostatistics	This course introduces basic concepts of linear algebra that are essential for understanding more advanced statistical modeling methodology. This knowledge is used to understand the General Linear Model (GLM) which includes linear regression, ANOVA, and other special applications and modern methods for the analysis of repeated measures, correlated outcomes and longitudinal data, including the unbalanced and incomplete data sets characteristic of biomedical research. Topics include an introduction to matrices for statistics, general linear models, analysis of correlated data, random effects models, and generalized linear mixed models.	3	BIOS/EPID 576A and BIOS/EPID 576B		Fall	X	X	X	X	X
BIOS 511	**Introduction to Healthcare Data Science**		Epidemiology & Biostatistics	This course introduces you new tools and techniques used in healthcare related data sciences. Topics include, Basic knowledge of large clinical databases focusing on medical records, Cohort definition and extraction, Intro to SQL, Linux basic, Collaborative research using Git/GitHub, High performance computing and cloud computing, Shiny, Docker, TidyVerse, Basic predictive modeling, Select tool from data science for example spark (distributed analysis), TensorFlow.	3			Fall	X	X	X		
BIOS 686	**Survival Analysis**	CPH/EPID 686	Epidemiology & Biostatistics	This course introduces basic concepts and methods for analyzing survival time data obtained from following individuals until occurrence of an event or their loss to follow up. We will begin this course from describing the characteristics of survival data and building the link between distribution, survival and hazard functions. After that we will cover non-parametric, semi-parametric and parametric models and two-sample test techniques. In addition we will also demonstrate mathematical and graphical methods for evaluation goodness of fit and introduce the concept of dependent censoring/competing risk. During the class students will also learn how to use a computer package, SAS, Splus or Stata to analyze survival data.	3	BIOS/EPID 576A and BIOS/EPID 576B	Hsu, Chiu-Hsieh	Spring	X	X	X	X	X
BIOS 696S	**Biostatistics Seminar**	CPH/EPID 696S	Epidemiology & Biostatistics	This is a graduate-level seminar consisting of presentations by diverse speakers on a range of topics in biostatistics and in public health. This is also a forum in which biostatistics students will give presentations.	1	This course is restricted to graduate students in health related fields in Public Health, Medicine, and Biological or Social Sciences.	Sun, Xiaoxiao	All	X		X	X	X
CSC 535	**Probablilistic Graphical Models**			Probabilistic graphical modeling and inference is a powerful modern approach to representing the combined statistics of data and models, reasoning about the world in the face of uncertainty, and learning about it from data. It cleanly separates the notions of representation, reasoning, and learning. It provides a principled framework for combining multiple source of information such as prior knowledge about the world with evidence about a particular case in observed data. This course will provide a solid introduction to the methodology and associated techniques, and show how they are applied in diverse domains ranging from computer vision to molecular biology to astronomy.	3	MATH 223 and MATH 313 or equivalent math background. MATH 464 or alternative course that covers basic discrete and continuous probability. CSC 345 or equivalent preparation in algorithms, data structures, and programming.		Spring every other year	X	X	X	X	X
CSC 550	**Algorithms in Bioinformatics**		Computer Science	This course introduces fundamental results in discrete algorithms for combinatorial problems in bioinformatics and computational biology. The emphasis is on realistic models of computational problems that arise in the analysis of biological data, and practical algorithms for their solution. The content has depth in the area of biological sequence analysis, and breadth in areas such as phylogeny construction, protein structure prediction, and genome rearrangement analysis. Grades are based on homeworks, exams, programming projects, and a class presentation.	3	CSC 545. For both computer science and non-computer science majors, mathematical maturity will be helpful.		Periodically		X			
CSC 580	**Principles of Machine Learning**		Computer Science	Students will learn why machine learning is a fundamentally different way of writing computer programs from traditional programming, and why this is often an attractive way of solving practical problems. Machine learning is all about automatic ways for computers to collect and/or adapt to data to make better predictions and decisions or gain insight; students will learn both advantages and unique risks that this approach offers. They will learn the fundamental frameworks, computational methods, and algorithms that underlie current machine learning practice, and how to derive and implement many of them.	3	Strong background in linear algebra and calculus is necessary. Good amount of programming experience is needed: a significant amount of programming maturity is expected. Some probability theory and statistics will be helpful, but not strictly necessary.		Fall, Spring				X	X
ECE 523	**Engineering Applications of Machine Learning and Data Analytics**		Electrical & Computer Engineering	Machine learning deals with the automated classification, identification, and/or characterizations of an unknown system and its parameters. There are an overwhelming number of application driven fields that can benefit from machine learning techniques. This course will introduce you to machine learning and develop core principles that allow you to determine which algorithm to use, or design a novel approach to solving to engineering task at hand. This course will also use software technology to supplement the theory learned in the class with applications using real-world data.	3	ECE 503		Spring				X	X
ECE 636	**Information Theory**	MATH 636	Electrical & Computer Engineering	Definition of a measure of information and study of its properties; introduction to channel capacity and error-free communications over noisy channels; rate distortion theory; error detecting and correcting codes.	3	ECE 503	Koyluoglu	Spring (Even)		X			
ECE 639	**Detection and Estimation in Engineering Systems**		Electrical & Computer Engineering	Communication, detection and estimation as statistical inference problems. Optimal detection in the presence of Gaussian noise. Extraction of signals in noise via MAP and MMSE techniques.	3	ECE 503	Koyluoglu, Onur Ozan	Spring (Even)	X		X	X *available online*	X
ECOL 518	**Spatio-Temporal Ecology**		Ecology & Evolutionary Biology	May not be taught any more, faculty retiring. August 2021					X		X	X	X

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ECOL 553	**Functional and Evolutionary Genomics**		Ecology & Evolutionary Biology	Computational, functional, and evolutionary approaches to genomics, including bioinformatics and laboratory methods relevant to many modern research approaches in biology. Graduate-level requirements include students completing independently designed lab exercises and relate these to the primary literature in a paper. Undergraduate students will only complete defined lab exercises.	4	Concurrent registration, ECOL 553L for first year IGERT fellows.	Sanderon, Michael / Whiteman, Noah	Fall every other year		X			
ECOL 580	**Mathematical Models in Biology**	MATH 580	Ecology & Evolutionary Biology	For advanced undergraduates and graduate students in biological and ecological sciences, and math students: learn how to apply basic tools of mathematical tools (from simple back-of-the-envelope estimates to formal stability analysis using difference and differential equations) to biological problems including population dynamics, species coexistence, population genetics, links between ecosystems ecology and Global biogeochemistry, and biological scaling.	3	MATH 129		Main Campus Spring	X	X	X	X	X
ECON 518	**Introduction to Econometrics**	ECON/AREC 518	Economics	Statistical methods in estimating and testing economic models; single and simultaneous equation estimation, identification, forecasting, and problems caused by violating classical regression model assumptions. Graduate-level requirements include a research project that involves applications of econometric methods to the estimating and testing of behavioral models or simulation studies of the statistical properties of an econometric estimation technique. Advanced degree credit available for non-majors only.	3	none	Solon, Gary	Spring			X	X	X
ECON 520	**Theory of Quantitative Methods in Economics**		Economics	Introduction to the basic concepts of statistics and their application to the analysis of economic data. Designed primarily for entering graduate students majoring in economics.	3	Consult department before enrolling.	Aradhyula, Satheesh	Fall				X	X
ECON 522A	**Econometrics**		Economics	The theory of econometric estimation of single and simultaneous equation models.	3	ECON 520	Woutersen, Tiemen	Spring	X		X	X	X
ECON 522B	**Econometrics**		Economics	Additional topics in the theory of econometric estimation of single and simultaneous equation models.	3	ECON 522A	Woutersen, Tiemen	Fall	X		X	X	X
ECON 549	**Applied Econometic Analysis**	ECON/AREC 549	Economics	Econometric model-building, estimation, forecasting and simulation for problems in agricultural and resource economics. Applications with actual data and models emphasized.	3	ECON 518	Aradhyula, Satheesh	Spring	X		X	X	X
EDP 558	**Educational Tests and Measurements**		Educational Psychology	Theoretical and practical application of psychometric techniques to test construction, analysis, and interpretation of test results.	3	none	Burross, Heidi	periodically	X		X	X	X
EDP 646A	**Multivariate Methods in Educational Research**		Educational Psychology	Multivariate statistical procedures, including multiple-regression variations, canonical correlation, discriminant analysis, multivariate analysis of variance/covariance and repeated measures.	3	EDP 548	Smith, Monica	data	X		X	X	X
EDP 658A	**Theory of Measurement**		Educational Psychology	Advanced topics in theoretical and practical issues in psychometrics. Classical test theory including generalizability theory.	3	EDP 548, EDP 558		*not currently available*	X		X	X	X
FSHD 617A	**Advanced Data Analysis: Structural Equation Modeling**		Family Studies & Human Development	This course covers basic and intermediate topics of confirmatory factor analysis and structural equation modeling (SEM). Students will learn the conceptual and mathematical bases of SEM; develop the ability to formulate and evaluate models; become proficient in using Lisrel; and apply these skills to research in FSHD.	3	FSHD 537A, FSHD 537B	Toomey, Russell	Spring	X		X	X	X
FSHD 617B	**Advanced Data Analysis: Dyadic Data Analysis**		Family Studies & Human Development	This course covers analysis of dyadic and small-group data. Students will learn the conceptual and mathematical bases of these approaches; formulate and evaluate models of interdependence; gain experience in writing results of interdependent data analyses; and apply these skills to research in FSHD.	3	FSHD 537A, FSHD 537B		Spring	X		X	X	X
FSHD 617C	**Advanced Data Analysis: Multilevel Modeling**		Family Studies & Human Development	This course provides an introduction to Multilevel Modeling (MLM) and its implementation using SAS PROC MIXED. MLM is used for analyzing clustered data, such as longitudinal data (multiple observations nested within individuals) or data arising from couples or families (individuals nested within families).	3	FSHD 537A, FSHD 537B	Butler, Emily	Fall	X		X	X	X
GEOG 524	**Integrated Geographic Information Systems**		Geography & Development	Addresses the theoretical rationale, current knowledge and methods for achieving a common spatial basis between remote sensing (image) and GIS (non-image) data. Graduate-level requirements include a scholarly semester project. Faculty retiring, course may not be offered Aug 2021.	3	GEOG 583, RNR 517, equivalent coursework or consent of instructor.		Spring		X			
GEOS 585A	**Applied Time Series Analysis**		Geosciences	Analysis tools in the time and frequency domains are introduced in the context of sample data sets drawn from ecology, hydrology, climatology and paleoclimatology. Students optionally use their own data in assignments applying methods.	1-3	An undergraduate statistics course	Meko, David	Spring of odd numbered years	X		X	X	X
HWRS 655	**Stochastic Methods in Surface Hydrology**	CE 655, HWR 655	Hydrology & Atmospheric Sciences	Topics and applications will vary with instructor. Advanced application of statistics and probability to hydrology, time series analysis and synthesis, and artificial neural network methods, as applied in the modeling of hydro-climatic sequences or Bayesian and other analyses in the decision making process of water resources. A combination of theory and application to the fields of hydrology, environmental and water resources engineering, climatic modeling, and other related natural resource modeling.	3	Consult with course instructor.		Fall	X		X	X	X
IMB 521	**Scientific Grantsmanship**		Immunobiology	An interactive graduate-level course focused on written scientific communication and research integrity/ethics. The writing portion of the course is developed with a particular emphasis on NIH-style grant writing to develop the necessary skills to develop and write fellowship and grant applications. Students will work together with faculty and in peer groups to develop scientific hypotheses, aims, and research plans. The students will develop an NIH-style research proposal through the course of the semester. The student will develop skills necessary to for successful scientific writing.	2	2nd year PhD students (and beyond) only.	Sterling, Felicia Goodrum	Spring	X	X			
INFO 510	**Bayesian Modeling and Inference**		School of Information	Bayesian modeling and inference is a powerful modern approach to representing the statistics of the world, reasoning about the world in the face of uncertainty, and learning about it from data. It cleanly separates the notions of representation, reasoning, and learning. It provides a principled framework for combining multiple source of information such as prior knowledge about the world with evidence about a particular case in observed data. This course will provide a solid introduction to the methodology and associated techniques, and show how they are applied in diverse domains ranging from computer vision to molecular biology to astronomy. Graduate-level requirements include different exams requiring greater depth of understanding of topics, and will be assigned questions based on graduate-student specific assignments topics.	3	1) ISTA 350, or equivalent; 2) MATH 215 or equivalent; and 3) ISTA 311,or MATH 362, or ISTA 421/521 or equivalent 4) Or permission of the instructor		Fall and Spring		X			
INFO 521	**Introduction to Machine Learning**		School of Information	Machine learning describes the development of algorithms which can modify their internal parameters (i.e., "learn") to recognize patterns and make decisions based on example data. These examples can be provided by a human, or they can be gathered automatically as part of the learning algorithm itself. This course will introduce the fundamentals of machine learning, will describe how to implement several practical methods for pattern recognition, feature selection, clustering, and decision making for reward maximization, and will provide a foundation for the development of new machine learning algorithms.	3	Must have taken ISTA 311, MATH 129, AND MATH 313, or equivalent, or consent of instructor. ISTA 116 or comparable is recommended.		Fall	X	X	X	X	X
INFO 557	**Neural Networks**	ISTA 457	Information	Neural networks are a branch of machine learning that combines a large number of simple computational units to allow computers to learn from and generalize over complex patterns in data. Students in this course will learn how to train and optimize feed forward, convolutional, and recurrent neural networks for tasks such as text classification, image recognition, and game playing.	3	Basic programming skills and some experience with analysis of algorithms and data structures. Basic linear algebra skills recommended.		Main Campus Fall	X	X	X	X	X
LING 539	**Statistical Natural Language Processing**	CSC 539	Linguistics	This course introduces the key concepts underlying statistical natural language processing. Students will learn a variety of techniques for the computational modeling of natural language, including: n-gram models, smoothing, Hidden Markov models, Bayesian Inference, Expectation Maximization, Viterbi, Inside-Outside Algorithm for Probabilistic Context-Free Grammars, and higher-order language models. Graduate-level requirements include assignments of greater scope than undergraduate assignments. In addition to being more in-depth, graduate assignments are typically longer and additional readings are required.	3	LING 538	Park, Jungyeul	Spring	X		X	X	X

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LING 582	**Advanced Statistical Natural Language Processing**		Linguistics	This course focuses on statistical approaches to pattern classification and applications of natural language processing to real-world problems	3	LING 539		Fall	X		X	X	X
MATH 523A	**Real Analysis**		Mathematics	Lebesgue measure and integration, differentiation, Radon-Nikodym theorem, Lp spaces, applications.	3	MATH 425A	Sethuraman, Sunder	Fall	X				
MATH 527B	**Principles of Analysis**		Mathematics	Metric spaces, basic properties of normed linear spaces, distributions, the Lebesque intergral and Lebesque spaces, convergence theorems; applications chosen by the instructor.	3	MATH 527A	Gillette, Andrew	Spring	X				
MATH 529	**Topics in Modern Analysis**		Mathematics	Advanced topics in measure and integration, complex analysis in one and several complex variables, probability, functional analysis, operator theory; content varies.	3	none	Friedlander, Leonid	Fall and Spring	X	X	X	X	X
MATH 543	**Theory of Graphs and Networks**	CSC 543	Mathematics	Undirected and directed graphs, connectivity, circuits, trees, partitions, planarity, coloring problems, matrix methods, applications in diverse disciplines. Graduate-level requirements include more extensive problem sets or advanced projects.	3	none	Glasner, Karl	Fall (Even)	X		X	X	X
MATH 565A	**Stochastic Processes**		Mathematics	Stochastic Processes in continuous time: Levy processes, Martingales, Markov processes, introduction to stochastic integrals.	3	Strong probability background	Bhattacharya, Rabindra	Spring (Odd)	X		X	X	X
MATH 565B	**Stochastic Processes**		Mathematics	Stochastic processes in continuous time; Levy processes, martingales, Markov processes, introduction to stochastic integrals.	3	MATH 565A	Sethuraman, Sunder	Fall (Odd)	X		X	X	X
MATH 565C	**Stochastic Differential Equations**		Mathematics	Brownian motion, stochastic integrals, Ito formula, stochastic differential equations, diffusions, applications including: Partial differential equations, filtering, stochastic control	3	MATH 565B, MATH 468/568 or consent of instructor.	Bhattacharya, Rabindra	Spring (Even)	X		X	X	X
MATH 574M	**Statistical Machine Learning**		Mathematics	Basic statistical principles and theory for modern machine learning, high dimensional data analysis, parametric and nonparametric methods, sparse analysis, shrinkage methods, variable selection, model assessment, model averaging, kernel methods, and unsupervised learning.	3	Probability at the level of MATH 464, statistics at the level of MATH 363 or MATH 466, and linear algebra.	Zhang, Hao	Fall	X	X	X	X	X
MATH 575A	**Numerical Analysis**	CSC 575A	Mathematics	Error analysis, solution of linear systems and nonlinear equations, eigenvalue interpolation and approximation, numerical integration, initial and boundary value problems for ordinary differential equations, optimization.	3	MATH 475B or MATH 456.	Kunyansky, Leonid	Fall	X	X	X	X	X
MATH 575B	**Numerical Analysis II**	CSC 575B	Mathematics	Error analysis, solution of linear systems and nonlinear equations, eigenvalue interpolation and approximation, numerical integration, initial and boundary value problems for ordinary differential equations, optimization.	3	MATH 575A	Brio, Moysey	Spring		X			
MCB 516A	**Statistical Bioinformatics and Genomic Analysis**	ABE/BIOC/ECOL/GENE	Molecular & Cellular Biology	The course introduces statistical methods and algorithms for analysis of high-throughput experiments in molecular biology using analysis of gene expression microarrays as a leading example. The course provides hands-on experience with data analysis, critical review of literature and communication of the results. Graduate-level requirement include a research project, written report, and a class presentation.	3	Basic statistical knowledge and programming experience.	An, Lingling (Guang Yao Spring 2021)	Spring	X	X	X	X	X
MGMT 582D	**Multivariate Analysis in Management**		Management & Organizations	Analysis of variance and covariance, principal components, discriminant analysis, canonical correlation.	3	MGMT 552. MGMT 582C is not prerequisite to MGMT 582D.	Kugler, Tamar	Spring	X		X	X	X
MIS 510	**Web Computing and Mining**		Management Information Systems	This course introduces data structures and algorithms that are suited for developing Internet-based information systems in business intelligence, search engines, digital libraries, knowledge management systems, web/data/text mining, national security, and biomedical informatics. The course contains lectures, readings, programming assignments, lab sessions, and a large-scale hands-on system development project. The course will begin with select fundamental yet useful data structures (e.g., stacks, queues, lists, trees, and graphs) and sorting and searching algorithms. Newer and more robust web/data/text mining algorithms (e.g., neural networks, decision trees, genetic algorithms, spreading activation, information retrieval, natural language processing) are then introduced in the context of modern and emerging information systems in business, engineering, and bioinformatics.	3	Java programming	Leroy, Gondy	Spring		X			
NURS 646	**Healthcare Informatics: Theory and Practice**	IRLS 646	Nursing	Focuses on the theoretical basis of healthcare informatics with an emphasis on management and processing of healthcare data, information, and knowledge. Healthcare vocabulary and language systems, and basic database design concepts are addressed.	3	none	Estrada, Nicolette	Spring		X		X *available online*	X
OPTI 637	**Principles of Image Science**		Optical Sciences	Mathematical description of imaging systems and noise; introduction to inverse problems; introduction to statistical decision theory; prior information; image reconstruction and radon transform; image quality; applications in medical imaging; other imaging systems.	3	OPTI 508, OPTI 512R, OPTI 604.	Clarkson, Eric	Spring	X		X	X	X
PHCL 595B	**Scientific Writing, Presentation & Bioethics**	BME 595B, CBIO 595B, NRSC 595B, PCOL 595B, PS 595B	Pharmacology	This course is intended for students enrolled in a PhD program or who have completed a Ph. D. or MD and will need to extensively use writing and presentation skills in their career. The class emphasizes writing; manuscripts, manuscript and grant reviews, scientific presentations, and applications for awards, future employment etc. Significant class participation is mandatory. This course satisfies the bioethics requirement of NIH funded grants. Signature of Course Director is required for individuals who do not meet the pre-requisite requirement.	2	none		Spring	X	X			
PHPR 817	**Introduction to Informatics**		Pharmacy Practice & Science	Internet terms, concepts, tools, utilities, and resources. Application of Internet technologies for the delivery of pharmaceutical care and the accessing health care information is emphasized.	2	none	Gilkey, John	Fall		X			
PHYS 528	**Statistical Mechanics**		Physics	Physical statistics; the connection between the thermodynamic properties of a macroscopic system and the statistics of the fundamental components; Maxwell-Boltzmann, Fermi-Dirac, Einstein-Bose statistics.	3	PHYS 476	Stafford, Charles	Fall	X		X		
PLS 565	**Practical Skills for Next Generation Sequencing Data Analysis**		School of Plant Sciences	This course is intended to introduce the application of NGS in modern systems biology and to teach the students the practical skills on operating high-performance computers (HPC) and using the bioinformatic tools for NGS data analysis.	3	none		*not currently available*	X	X	X	X	X
PSY 507B	**Statistical Methods in Psychological Research**		Psychology	Statistical research design, methods and metascience. Application of the structural equations modeling to manifest variable (path analysis) and latent variable (multivariate) causal analysis, confirmatory and exploratory factor analysis, and hierarchical (variance component) linear models, including generalizability theory, meta-analytic, and growth curve parameter models.	3	PSY 510, EDP 541, or equivalent. Alternatively, students may opt to take a screening exam to place out of these requirements.	Figueredo, Aurelio	*not currently offered*	X		X		
PSY 507C	**Research Design & Analysis of Variance**		Psychology	This course provides an overview of research design and statistical analysis with a special focus on Analysis of Variance. Various designs including between subjects, repeated measures, mixed, hierarchical and Latin Square designs are covered. Other topics addressed are contrasts among means and trends analysis.	3	PSY 510		Fall, Spring	X		X	X	X
PSY 597G	**Graphical Exploratory Data Analysis**		Psychology	Explores graphical methods for displaying and understanding data. Topics include displaying data, robust descriptive measures, re-expressing or transforming data, understanding residuals, time-series and growth curves, and using graphical methods in conjunction with hypothesis testing. Enrollees will explore a data set of their own throughout the course.	3	PSY 507A		*not currently offered*	X		X	X	X
RNR 520	**Advanced Geographic Information Systems**	GEOG 520	Renewable Natural Resources	Examines various areas of advanced GIS applications such as dynamic segmentation, surface modeling, spatial statistics, and network modeling. The use of high performance workstations will be emphasized. Graduate-level requirements include a more extensive project and report.	3	RNR 517	Wissler, Craig	Spring	X	X	X	X	X
SIE 520	**Stochastic Modeling I**		Systems & Industrial Engineering	Modeling of stochastic processes from an applied viewpoint. Markov chains in discrete and continuous time, renewal theory, applications to engineering processes.	3	SIE 321		Spring	X	X	X	X *available online*	X
SIE 522	**Engineering Decision Making Under Uncertainty**		Systems & Industrial Engineering	Application of principles of probability and statistics to the design and control of engineering systems in a random or uncertain environment. Emphasis is placed on Bayesian decision analysis. Graduate-level requirements include a semester research project.	3	none	Bruyere, Donald	Fall	X		X	X *available online*	X
SIE 525	**Queuing Theory**		Systems & Industrial Engineering	Application of the theory of stochastic processes to queuing phenomena; introduction to semi-Markov processes; steady-state analysis of birth-death, Markovian, and general single- and multiple-channel queuing systems.	3	none			X		X	X *available online*	X

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SIE 531	**Simulation Modeling and Analysis**		Systems & Industrial Engineering	Discrete event simulation, model development, statistical design and analysis of simulation experiments, variance reduction, random variate generation, Monte Carlo simulation. Graduate-level requirements include a library research report.	3	none	Lin, Wei	Fall, Spring	X		X	X *available online*	X
SIE 533	**Fundamentals of Data Science for Engineers**		Systems & Industrial Engineering	This course will provide senior undergraduate and graduate students from a diverse engineering disciplines with fundamental concepts, principles and tools to extract and generalize knowledge from data. Students will acquire an integrated set of skills spanning data processing, statistics and machine learning, along with a good understanding of the synthesis of these skills and their applications to solving problem. The course is composed of a systematic introduction of the fundamental topics of data science study, including: (1) principles of data processing and representation, (2) theoretical basis and advances in data science, (3) modeling and algorithms, and (4) evaluation mechanisms. The emphasis in the treatment of these topics will be given to the breadth, rather than the depth. Real-world engineering problems and data will be used as examples to illustrate and demonstrate the advantages and disadvantages of different algorithms and compare their effectiveness as well as efficiency, and help students to understand and identify the circumstances under which the algorithms are most appropriate.	3	SIE 530, equivalent courses such as SIE 500A taken in parallel or consent of instructor.		Fall			X	X	X
SIE 536	**Experiment Design and Regression**		Systems & Industrial Engineering	Planning and designing experiments with an emphasis on factorial layout. Includes analysis of experimental and observational data with multiple linear regression and analysis of variance.	3	SIE 530						X *available online*	X
SIE 545	**Fundamentals of Optimization**		Systems & Industrial Engineering	Unconstrained and constrained optimization problems from a numerical standpoint. Topics include variable metric methods, optimality conditions, quadratic programming, penalty and barrier function methods, interior point methods, successive quadratic programming methods.	3	SIE 340	Cheng, Jianqiang	Fall	X	X	X	X *available online*	X
SIE 574	**Information Analytics and Decision-Making in Engineering**		Systems & Industrial Engineering	Recent advances in computational and information technology allow the collection and evaluation of vast volumes of data. This explosion in information has amplified the need to understand the value of information and how to use available information to make better decisions that in turn affect the environment. For example, consider the following questions: * How should a firm optimally experiment among different website designs before deciding on a single one, with the goal to maximize user traffic or revenue? * How should a company choose its bid for mining rights if it has access to exclusive probing data, in order to maximize its profit? * How should a buyer interpret online feedback and ratings before deciding on which product to buy? * How should a doctor decide which medical tests to perform on a patient to deliver the most effective care? The course will cover information valuation, decision-making, and information economics in non-strategic and strategic settings.	3	Students should be comfortable with basic distributions, conditional probabilities, and coding small programs for activities.		*Discontinued as of Fall 2021*			X		
SIE 575	**Bayesian Machine Learning and Optimal Learning I**		Systems & Industrial Engineering	We consider optimization problems whose objective functions are unknown and hence have to be learned from data. Such problems are pervasive in science and industry, e.g., when - designing prototypes in engineering, - automated tuning of machine learning algorithms, e.g., in deep learning, - optimizing control policies in robotics, - developing pharmaceutical drugs, and many more. Bayesian optimization methods are popular in the machine learning community due to their high sample-efficiency and have become a key technique in the area of "automatic machine learning". We introduce a general framework in which to understand and formulate such optimal learning problems, and provide a survey of problems, methods, and theoretical results.	3						X		
SIE 578	**Artificial Intelligence for Health & Medicine**		Systems & Industrial Engineering	The practice of modern medicine in a highly regulated, complex, sociotechnical enterprise is a testament to the future healthcare system where the balance between human intelligence and artificial expertise will be at stake. The goal of this course is to introduce the underlying concepts, methods, and the potential of intelligent systems in medicine. We will explore foundational methods in artificial intelligence (AI) with greater emphasis on machine learning and knowledge representation and reasoning, and apply them to specific areas in medicine and healthcare including, but not limited to, clinical risk stratification, phenotype and biomarker discovery, time series analysis of physiological data, disease progression modeling, and patient outcome prediction. As a research and project-based course, student (s) will have opportunities to identify and specialize in particular AI methods, clinical/healthcare applications, and relevant tools.	3	Course suitable for Majors: APPL, BME, ECE, MEE, CSC, SIE, STAT, IS, MIS., or obtain instructor consent. Basic foundation in linear algebra, discrete mathematics, probability & statistics, and data structures recommended for this course.		Spring	X	X	X		
SIE 606	**Advanced Quality Engineering**		Systems & Industrial Engineering	Advanced techniques for statistical quality assurance, including multivariate statistical inference, multiple regression, multivariate control charting, principal components analysis, factor analysis, multivariate statistical analysis for process fault diagnosis, and select papers from the recent literature.	3	SIE 530, SIE 506	Liu, Jian	Every other spring	X		X	X *available online*	X
SIE 645	**Nonlinear Otimization**		Systems & Industrial Engineering	This course is devoted to structure and properties of practical algorithms for unconstrained and constrained nonlinear optimization.	3	SIE 544 or SIE 545		Generally Spring					X
SOC 570B	**Social Statistics**		Sociology	Latent variable models, pooled cross-section models, event history models.	3	none	Fiel, Jeremy	Spring	X		X	X	X
STAT 563	**Probability Math**	MATH 563	Mathematics	Random variables, expectation and integration, Borel-Cantelli lemmas, independence, sums of independent random variables, strong law of large numbers, convergence in distribution, central limit theorem, infinitely divisible distributions.	3	MATH 523B or MATH 527B or consent of instructor	Holcomb, Diane	Fall	X		X	X	X
STAT 564	**Theory of Probability**	MATH 564	Mathematics	Probability spaces, random variables, weak law of large numbers, central limit theorem, various discrete and continuous probability distributions. Graduate-level requirements include more extensive problem sets or advanced projects.	3	Calculus through multivariable/vector calculus (at the level of MATH 125, MATH 129, MATH 223).	Niu, Yue	Fall	X	X	X	X *available online*	X
STAT 566	**Theory of Statistics**	MATH 566	Mathematics	Sampling theory. Point estimation. Limiting distributions. Testing Hypotheses. Confidence intervals. Large sample methods.	3	STAT/MATH 564	Zhang, Hao	Spring	X	X	X	X *available online*	X
STAT 567A	**Theoretical Statistics**	MATH 567A	Mathematics	Basic decision theory. Bayes' rules for estimation. Admissibility and completeness. The minimax theorem. Sufficiency. Exponential families of distributions. Complete sufficient statistics. Invariant decision problems. Location and scale parameters. Theory of nonparametric statistics. Hypothesis testing. Neyman-Pearson lemma. UMP and UMPU tests. Two-sided tests. Two-sample tests. Confidence sets. Multiple decision problems.	3	MATH 466	Hao, Ning	Spring (Even)	X		X	X	X
STAT 567B	**Theoretical Statistics II**	MATH 567B	Mathematics	Large sample theory of estimation: modes of convergence, central limit theorems, consistency and asymptotic distribution of estimators,asymptotic relative efficiencies of estimators, autoregressive time series, Cramer-Rao bounds and asymptotic efficiency of the MLE, asymptotic theory of Bayes estimators, semi-parametric linear regression, nonparametric regression and density estimation. Large sample theory of tests: likelihood ratio and Wald's tests in parametric models, the chisquare tests for multinomials, tests for goodness of fit, asymptotic relative efficiencies of tests, nonparametric one- and two-sample tests. Statistical computation: nonparametric bootstrap, Markov Chain Monte Carlo and Bayes theory, hierarchical models.	3	STAT/MATH 567A		Fall (Even)	X		X	X	X
STAT 568	**Applied Stochastic Processes**	MATH 568	Mathematics	Applications of Gaussian and Markov processes and renewal theory; Wiener and Poisson processes, queues. Graduate-level requirements include more extensive problem sets or advanced projects.	3		Sethuraman, Sunder	Spring	X		X	X	X

Course ID	Course Title	Equivalent to	Home Dept.	Description	Units	Requisites	Professor	Offered	PhD	Informatics	MS	Cert.	Minor
STAT 571A	**Advanced Statistical Regression Analysis**	MATH 571A	Mathematics	Regression analysis including simple linear regression and multiple linear regression. Matrix formulation and analysis of variance for regression models. Residual analysis, transformations, regression diagnostics, multicollinearity, variable selection techniques, and response surfaces. Students will be expected to utilize standard statistical software packages for computational purposes.	3	MATH 410 or MATH 413, or equivalent; MATH 461 or MATH 466, or equivalent.	Piegorsch, Walt	Fall	X	X	X	X *available online*	X
STAT 571B	**Design of Experiments**	MATH 571B	Mathematics	Principles of designing experiments. Randomization, block designs, factorial experiments, response surface designs, repeated measures, analysis of contrasts, multiple comparisons, analysis of variance and covariance, variance components analysis.	3	MATH 223 or equivalent; MATH 571A.	An, Lingling	Spring	X	X	X	X *available online*	X
STAT 574B	**Bayesian Statistical Theory and Applications**	ECON 574B	Economics	Basic theory of Bayesian inference, including analytical and numerical methods for assessing posterior and predictive distributions, and applications. Topics will include Bayesian analysis of normal linear regression and computational methods including Markov chain Monte Carlo.	3	ECON 522A, ECON 522B; concurrent registration, STAT/MATH 566 and STAT/MATH 571A.		Spring	X	X	X	X	X
STAT 574C	**Categorical Data Analysis**	SOC 574C	Statistics	Analysis of contingency tables. Generalized Linear Models including logistic regression and log-linear models. Matched-pair models. Repeated categorical responses. Students will be expected to utilize standard statistical software packages for computational purposes.	3	STAT/MATH 571A or equivalent.		Spring	X	X	X	X	X
STAT 574E	**Environmental Statistics**	BIOS 574E, CPH 574E, MATH 574E	Mathematics	Statistical methods for environmental and ecological sciences, including nonlinear regression, generalized linear models, temporal analyses, spatial analyses/kriging, quantitative risk assessment.	3	STAT/MATH 571B, or PSYC 507C, or equivalent.		*not currently available*	X		X	X	X
STAT 574G	**Introduction to Geostatistics**	GEOG 574G, MATH 574G	Geography & Development	Exploratory spatial data analysis, random function models for spatial data, estimation and modeling of variograms and covariances, ordinary and universal kriging estimators and equations, regularization of variograms, estimation of spatial averages, non-linear estimators, includes use of geostatistical software. Application of hydrology, soil science, ecology, geography and related fields.	3	Linear algebra, basic course in probability and statistics, familiarity with DOS/Windows, UNIX.		Spring (Odd)	X	X	X	X	X
STAT 574S	**Survey Sampling**		Statistics	Techniques of statistical sampling in finite populations with applications in the analysis of sample survey data. Topics include simple random sampling for means and proportions, stratified sampling, cluster sampling, ratio estimates, and two-stage sampling.	3	MATH 509C		Fall	X		X	X	X
STAT 574T	**Time Series Analysis**	MATH 574T	Mathematics	Methods for analysis of time series data. Time domain techniques. ARIMA models. Estimation of process mean and autocovariance. Model fitting. Forecasting methods. Missing data. Students will be expected to utilize standard statistical software packages for computational purposes.	3	none		Fall, Spring	X		X	X	X
STAT 579	**Spatial Statistics and Spatial Econometrics**	ECON 579, GEOG 577, GEOG 579, PLG 577, PLG 579	Geography & Development	This course provides the statistical and econometric techniques required for the analysis of geocoded data. Identification of spatial heterogeneity and inclusion in a formal regression model. An important aspect of the course is to gain hands-on experience in applying the appropriate techniques and using state-of-the-art software.	3	none		Spring	X		X	X	X
STAT 675	**Statistical Computing**		Statistics	Techniques of advanced computational statistics. Numerical optimization and integration pertinent for statistical calculations; simulation and Monte Carlo methods including Markov chain Monte Carlo (McMC); bootstrapping; smoothing/density estimation; and other modern topics.	3	STAT/MATH 566. Knowledge of a computer programming language.	Hu, Chengcheng	Spring	X	X	X	X	X
STAT 687	**Theory of Linear Models**	BIOS 687, CPH 687, EPID 687	Epidemiology & Biostatistics	Theory of linear models including full-rank models and less than full rank fixed effects models. Topics will include distributional properties of quadratic forms, estimation methods, tests of hypothesis and confidence intervals as well as an introduction to computational aspects.	3	STAT/MATH 566. Knowledge of a computer programming language.	Bedrick, Edward	Fall	X	X	X	X	X
STAT 688	**Statistical Consulting**	BIOS 688	ABE/CPH	The goal of this course is to teach statistics students to be effective statistical consultants. This is an advanced course in the selection and use of tools and statistical methods to analyze and interpret scientific, business and medical studies. This course will provide students with the ability to effectively and accurately acquire and convey information in verbal and written presentations.	3	MATH 564 and MATH 566. (MATH 571A and MATH 571B) or (BIOS/EPID 576A and BIOS/EPID 576B).	Billheimer, David	Fall	X	X	X	X	X
STAT 696E	**Econometric Modeling I**	ECON 696E	Economics	The development and exchange of scholarly information, usually in a small group setting. The scope of work shall consist of research by course registrants, with the exchange of the results of such research through discussion, reports, and/or papers.	3	none		Spring	X	X	X	X	X
TLS 571	**Introduction to Item Response Theory: Modeling and Applications**	EDP658B	Tch, Lrn & Sociocultural Stdy	An introduction to item response theory (IRT), the leading measurement theory in educational and psychological measurement. IRT is an advanced statistical framework for modeling item response patterns as a function of underlying traits. Topics covered are: Essential concepts and terminology of IRT; the mathematical and theoretical rationale underlying IRT; commonly used statistical models for dichotomous and polytomous item responses, parameter estimation, standard error of measurement; applications of IRT to common assessment problems (linking, differential item functioning, computerized adaptive testing); relevant statistical software. The course includes a series of assignments that focus on carrying out and interpreting basic item and scale calibrations as well as linking or DIF analyses and a final project, but no final examination. This course is designed for graduate students with an interest in measurement, instrument development, and quantitative empirical research.	3			Fall, Spring	X		X	X	X