Informatics

Chair

- Juan Pablo Hourcade (Computer Science/Nursing)

Graduate degrees: MS in informatics; PhD in informatics

Graduate certificate: informatics

Faculty: https://cs.uiowa.edu/people

Website: https://informatics.grad.uiowa.edu/

The Interdisciplinary Graduate Program in Informatics (IGPI) was proposed in 2006, largely motivated by the increasing amount of research at the intersection of computational disciplines and the humanities, arts, and the natural, biological, health, and social sciences. The proposal to establish the program emphasized the rapid changes brought about by information technology and how they in turn changed approaches across a wide variety of disciplines. Among these changes were the ability to ask different types of questions and analyze information at scales not previously possible.

The program aimed to fill a gap in training for practitioners and researchers who could provide a bridge between computing and other disciplines. IGPI graduates would receive training in core computational and statistical topics and combine it with coursework in a cognate area.

Changes in computing and how it affects society and scholarship make informatics even more relevant today than it was in 2006. One of the key changes has been in the increasing ubiquity of computer devices that facilitate communication and information access. These trends clearly point toward a near future where most people will be able to communicate with most other people around the world, as well as access any information, anytime, anywhere. The main barriers are likely to be political instead of technological. These changes mean that computers are directly affecting the way most people perceive the world, remember information, pay attention, communicate, learn, and make decisions.

This ubiquity means that it is becoming increasingly difficult to exercise one's basic rights and fulfill basic needs without using interactive technologies. People use computers to vote, to stay informed, and to express and share opinions. In addition, people use computers to ride public transportation, get money from banks, and pay for groceries. Hence, there are increased responsibilities in the design of computing systems, as well as the need to study their impact on society.

One final trend that is germane to informatics is the increasing availability and low cost of digital storage and processing, together with the wide availability and use of sensors, digital instruments, and other forms of capturing digital data. The result has been a tremendous growth in the amount of data available to scientists, businesses, and government. These changes have brought about the need for novel analysis techniques, for researchers and practitioners who can understand the data and these techniques, as well as the need to design these systems so they can enable new discoveries and insights while safeguarding privacy.

This world, where computers are playing a vital role not only in academic disciplines, but in society at large, calls for practitioners and researchers who can understand computing and also interface with other fields. IGPI was developed to fill this gap. The program is interdisciplinary, involving the Graduate College, the Carver College of Medicine, the Tippie College of Business, and the colleges of Dentistry, Engineering, Liberal Arts and Sciences, Nursing, Pharmacy, and Public Health. Students may pursue a Master of Science degree in informatics (with one of three cognates in geoinformatics, health informatics, or human-computer interaction) or a PhD in informatics. University of Iowa graduate students in other programs may elect to earn a Certificate in Informatics in addition to their main program of study. All three programs complete the same core courses, with flexible electives that allow students to focus on the subarea of greatest interest to them.

Geoinformatics provides methods and technologies needed to measure, store, analyze, manage, and visualize information about phenomena occurring on or near the earth's surface. It is an increasingly essential technology for understanding and managing the complex world.

Health informatics uses contemporary information technologies to improve the storage, organization, retrieval, and evaluation of health information in order to support clinical, clinical research, and public health applications.

The human-computer interaction cognate is intended for students interested in designing useful and usable technologies. The cognate's courses provide an interdisciplinary foundation including psychology, sociology, and engineering.

Programs

Graduate Programs of Study

- Master of Science in Informatics
- Doctor of Philosophy in Informatics
- Certificate in Informatics

Courses

Informatics Courses

IGPI:3011 Social Science Approaches to Global Health **3 s.h.**
Review of major components of research in the social sciences as they apply to global health topics; preparation for academic pursuits or careers that utilize research to address global health issues in a systematic way. Same as GHS:3010.

IGPI:3050 Geospatial Programming **3 s.h.**
Introduction to geospatial programming with Python; programming basics, data structures, and algorithms; spatial data models and structures; vector-based and raster-based geoprocessing; automating GIS tasks and models; spatial libraries (e.g., ArcPy, GeoPandas, GDAL, PySAL). Prerequisites: SEES:2050. Same as SEES:3050.

IGPI:3100 Introduction to Mathematical Statistics I **4 s.h.**
Review of mathematical basics for mathematical statistics, descriptive statistics, probability, conditional probability, discrete and continuous univariate and multivariate distributions, and sampling distributions. Prerequisites: MATH:1860 or MATH:1560. Same as STAT:3100.

IGPI:3101 Introduction to Mathematical Statistics II **3 s.h.**
Point and interval estimation, testing statistical hypotheses, simple regression, nonparametric methods. Prerequisites: STAT:3100. Same as STAT:3101.

IGPI:3120 Probability and Statistics 4 s.h.
Models, discrete and continuous random variables and their distributions, estimation of parameters, testing statistical hypotheses. Prerequisites: MATH:1560 or MATH:1860. Same as DATA:3120, STAT:3120.

IGPI:3200 Applied Linear Regression 3 s.h.
Regression analysis with focus on applications; model formulation, checking, and selection; interpretation and presentation of analysis results; simple and multiple linear regression; logistic regression; ANOVA; polynomial regression; tree models; bootstrapping; hands-on data analysis with computer software. Prerequisites: STAT:2020 or STAT:2010 or STAT:3120. Same as DATA:3200, ISE:3760, STAT:3200.

IGPI:3212 Bioinformatics for Beginners 3 s.h.
Overview of bioinformatics topics including access to sequence data, pairwise and multiple sequence alignment algorithms, molecular phylogeny, microarray data analysis, protein analysis, proteomics, and protein structure analysis; emphasis on each topic includes biological motivation, computational approach (practical and theoretical), and interpretation of output. Prerequisites: BIOL:2512 or BIOL:2211 or BMB:3120 or MICR:3170. Same as BIOL:3212.

IGPI:3314 Genomics 3 s.h.
Major areas of genomics including genome sequencing, assembly, and annotation; evolutionary genomics, metagenomics, functional genomics, and computational genomics; synthetic biology and genome engineering. Prerequisites: BIOL:1412 and (BIOL:2211 or BIOL:2512 or BIOL:2723 or MICR:3170). Same as BIOL:3314.

IGPI:3330 Introduction to Software Design 3 s.h.
Design of software for engineering systems; algorithm design and structured programming; data structures; introduction to object-oriented programming in JAVA; applications to engineering problems; lab arranged. Prerequisites: ENGR:2730. Same as ECE:3330.

IGPI:3500 Introduction to Environmental Remote Sensing 3 s.h.
Basic concepts and principles of remote sensing; sources of data; georegistration; digital processing and classification of remotely sensed images for extraction of environmental information; linkage of remote sensing techniques with GIS analysis. Same as SEES:3500.

IGPI:3510 Biostatistics 3 s.h.
Statistical concepts and methods for the biological sciences; descriptive statistics, elementary probability, sampling distributions, confidence intervals, parametric and nonparametric methods, one-way ANOVA, correlation and regression, categorical data. Requirements: MATH:0100 or MATH:1005 or ALEKS score of 30 or higher. Same as STAT:3510.

IGPI:3520 GIS for Environmental Applications 3 s.h.
Students learn new, more advanced techniques for the representation and study of human and natural systems using geographic information systems (GIS); application of this new knowledge to environmental management and problem solving. Prerequisites: SEES:2050. Same as SEES:3520.

IGPI:3540 Geographic Visualization 3 s.h.
Concepts and techniques that underlie cartographic representation, interaction, and geovisualization; map symbolization and visual variables; spatiotemporal visualization, multivariate mapping, interactive cartography, animation, geovisual analytics, 3D visualization, virtual and augmented reality. Prerequisites: SEES:2050. Same as SEES:3540.

IGPI:4100 Statistical Inference I 3 s.h.
Review of probability, distribution theory (multiple random variables, moment-generating functions, transformations, conditional distributions), sampling distributions, order statistics, convergence concepts, generating random samples. Prerequisites: MATH:2850 and STAT:3101. Recommendations: undergraduate standing. Same as STAT:4100.

IGPI:4101 Statistical Inference II 3 s.h.
Continuation of STAT:4100; principles of data reduction, point estimation theory (MLE, Bayes, UMVU), hypothesis testing, interval estimation, decision theory, asymptotic evaluations. Prerequisites: STAT:4100. Recommendations: undergraduate standing. Same as STAT:4101.

IGPI:4115 Finite Element I 3 s.h.
One- and two-dimensional boundary value problems; heat flow, fluid flow, torsion of bars; trusses and frames; isoparametric mapping; higher order elements; elasticity problems; use of commercial software. Prerequisites: ENGR:2750. Same as CEE:4533.

IGPI:4150 Health and Environment: GIS Applications 3 s.h.
Introduction to how geographic information systems (GIS) and spatial statistics are used in the study of patterns of health and disease in space and time. Same as GHS:4150, SEES:4150.

IGPI:4159 Air Pollution Control Technology 3 s.h.
Sources, environmental and health impacts, regulations, modeling of air pollution; processes and alternative strategies for control; global climate considerations. Same as CBE:4459, CEE:4159.

IGPI:4200 Statistical Methods and Computing 3 s.h.
Methods of data description and analysis using SAS; descriptive statistics, graphical presentation, estimation, hypothesis testing, sample size, power; emphasis on learning statistical methods and concepts through hands-on experience with real data. Recommendations: graduate standing in non-statistics or less quantitative major. Same as STAT:4200.

IGPI:4213 Bioinformatics 2,4 s.h.
Overview of bioinformatics topics, including access to sequence data, pairwise and multiple sequence alignment algorithms, molecular phylogeny, microarray data analysis, protein analysis, proteomics and protein structure analysis; emphasis on each topic includes biological motivation, computational approach (practical and theoretical), and interpretation of output. Prerequisites: BMB:3120 or MICR:3170 or BIOL:2512 or BMB:3110. Recommendations: grade of B-plus or higher in BIOL:2512 or graduate standing. Same as BIOL:4213, GENE:4213.

IGPI:4373 Molecular Evolution: Genes, Genomes, and Organisms 3 s.h.
Theory underlying phylogenetic analysis with application of these methods to molecular data sets; analysis of multigene data, organellar, and nuclear genome sequences to reconstruct the history of cells. Prerequisites: BIOL:3172 with a minimum grade of C-. Same as BIOL:4373.

IGPI:4500 Advanced Remote Sensing 4 s.h.
Theory and practice of remote sensing and digital image processing; practical applications to human-environment interactions. Requirements: SEES:3100 or SEES:3500 or CEE:3783. Same as SEES:4500.

IGPI:4520 GIS for Environmental Studies: Applications 3 s.h.
Project-driven course to advance student knowledge of geographic information systems (GIS); application of GIS to environmental change analysis, environmental assessment, hazard/risk analysis, and environmental decision-making. Prerequisites: SEES:3520. Same as SEES:4520.

IGPI:4522 Bayesian Statistics 3 s.h.
Bayesian statistical analysis, with focus on applications; Bayesian and frequentist methods compared; Bayesian model specification, choice of priors, computational methods; hands-on Bayesian data analysis using appropriate software; interpretation and presentation of analysis results. Prerequisites: STAT:3200 and (STAT:3101 or STAT:4101 or STAT:3120). Same as PSQF:4520, STAT:4520.

IGPI:4540 Statistical Learning 3 s.h.
Introduction to supervised and unsupervised statistical learning, with a focus on regression, classification, and clustering; methods will be applied to real data using appropriate software; supervised learning topics include linear and nonlinear (e.g., logistic) regression, linear discriminant analysis, cross-validation, bootstrapping, model selection, and regularization methods (e.g., ridge and lasso); generalized additive and spline models, tree-based methods, random forests and boosting, and support-vector machines; unsupervised learning topics include principal components and clustering. Requirements: an introductory statistics course and a regression course. Recommendations: prior exposure to programming and/or software, such as R, SAS, and Matlab. Same as BAIS:4540, DATA:4540, STAT:4540.

IGPI:4580 Data Visualization and Data Technologies 3 s.h.
Introduction to common techniques for visualizing univariate and multivariate data, data summaries, and modeling results; how to create and interpret these visualizations and assess effectiveness of different visualizations based on an understanding of human perception and statistical thinking; data technologies for obtaining and preparing data for visualization and further analysis; students learn how to present results in written reports and use version control to manage their work. Requirements: an introductory statistics course and a regression course. Recommendations: prior exposure to basic use of statistical programming software (e.g., R or SAS) as obtained from a regression course strongly recommended. Same as DATA:4580, STAT:4580.

IGPI:4581 Introduction to Geographic Databases 3 s.h.
Introduction to basic building blocks of spatial database design, spatial data models, structures, relationships, queries (SQL), indexing, and geoprocessing; design and construction of various types of spatial databases, including relational and big data approaches such as ArcGIS geodatabase, PostGIS/PostgreSQL, and MongoDB. Prerequisites: SEES:2050. Same as SEES:4580.

IGPI:4740 Large Data Analysis 3 s.h.
Current areas that deal with problem of big data; techniques from computer science, mathematics, statistics; high performance and parallel computing, matrix techniques, cluster analysis, visualization; variety of applications including Google PageRank, seismology, Netflix-type problems, weather forecasting; fusion of data with simulation; projects. Prerequisites: (CS:1210 with a minimum grade of C- or ENGR:2730 with a minimum grade of C-) and (MATH:3800 or CS:3700) and (STAT:3200 or IE:3760 or IGPI:3200). Same as CS:4740, MATH:4740, STAT:4740.

IGPI:5001 Introductory Methodology 3-4 s.h.
Introduction to quantitative techniques in political science; set theory, probability distributions, estimation, testing; emphasis on acquiring mathematical skills for more advanced quantitative work in political science. Requirements: MA or PhD standing in political science. Same as POLI:5001.

IGPI:5015 Independent Study arr.

IGPI:5110 Introduction to Informatics 3 s.h.
Fundamentals of computer science: algorithms, complexity, relational databases, systems concepts, programming in Python. Same as CS:5110.

IGPI:5120 Regression Modeling and ANOVA in the Health Sciences 3 s.h.
Continuation of BIOS:4120; correlation, simple and multiple linear regression, confounding, interactions, model selection, single and multiple factor ANOVA (analysis of variance) models, contrasts, multiple comparisons, nested and block designs; introduction to mixed models; for non-biostatistics majors. Offered spring semesters. Prerequisites: BIOS:4120. Same as BIOS:5120, STAT:5610.

IGPI:5130 Applied Categorical Data Analysis 3 s.h.
Analysis of proportions, risk measures, and measures of association; Mantel-Haenszel method; logistic regression for binary responses and for matched data; logistic regression for multi-category responses; analysis of count data (Poisson regression and negative binomial regression); analysis of clustered data (generalized estimating equations and generalized linear mixed effects model); special topics include the application of propensity score methods; designed for non-biostatistics majors. Offered fall semesters. Prerequisites: BIOS:5120. Same as BIOS:5130.

IGPI:5199 Applied Statistics I 4 s.h.
Descriptive statistics, basic inferential methods (confidence intervals, chi-square tests); linear models (regression and ANOVA models—specification and assumptions, fitting, diagnostics, selection, testing, interpretation); nonlinear models, logistic regression. Prerequisites: STAT:3101. Corequisites: STAT:4100 or STAT:5100. Requirements: facility with matrix algebra. Same as STAT:5200.

IGPI:5206 Medical Imaging Physics 3 s.h.
Physics and data acquisition techniques of major medical imaging modalities (X-ray, CT, MR, ultrasound, PET, SPECT); physical interactions of energy with living tissue; principles and methods for acquiring imaging data and subsequent image construction; how individual modalities influence image quality; MATLAB programming required. Second in a medical imaging sequence. Prerequisites: BME:2200 and BME:2210. Same as BME:5210, ECE:5470.

IGPI:5211 Genes, Genomes, and the Human Condition Graduate Lecture 3 s.h.
Organization, expression, and evolution of genes in context of genomes; focus on human genome; distribution and transmission of variation in human population. Recommendations: BIOL:1411 highly recommended. Same as BIOL:5211.

IGPI:5212 Biomedical Signal Processing 3 s.h.
Application of signal processing methods (e.g., Fourier, Laplace, z-transforms) to biomedical problems, such as analysis of cardiac signals, circadian rhythm, the breathing cycle; computer simulation lab. Same as BME:5200.

IGPI:5251 Advanced Biosystems 3 s.h.
Biological systems unique to systems analysis; operation under nonequilibrium conditions; tools for systems analysis developed from models of systems at equilibrium (i.e., mechanical systems); fundamental difference between biological and mechanical systems that impact systems analysis; expand knowledge of linear systems and begin work with nonlinear systems; various modeling and analysis approaches useful in biomedical and biomedical engineering research. Prerequisites: BME:2200. Same as BME:5251.

IGPI:5270 Pathogenesis of Major Human Diseases 3 s.h.
Critical analysis of pathogenesis models in a series of major human diseases; clinical presentation, analysis of cellular and molecular events leading to the disease, discussion of key papers. Offered spring semesters. Same as MMED:5270, PATH:5270.

IGPI:5310 Research Data Management 3 s.h.
Introduction to data management techniques and problems encountered in gathering and processing data from biomedical investigations; introduction to SAS, techniques taught in SAS; designed for non-biostatistics majors. Recommendations: prior programming experience with C, C++, Python, Java, or other. Same as BIOS:5310, STAT:5810.

IGPI:5311 Informatics for Sustainable Systems 3 s.h.
Introduction to fundamental and advanced environmental informatics concepts and procedures including automated data collection, data management, data transformations, and processing to support modeling and analysis; scientific visualization of environmental data to support management of food, energy, and water (FEW) resources; sustainability in FEW systems. Same as CEE:5310, URP:5310.

IGPI:5331 Graph Algorithms and Combinatorial Optimization 3 s.h.
Combinatorial optimization problems; time complexity; graph theory and algorithms; combinatorial optimization algorithms; complexity theory and NP-completeness; approximation algorithms; greedy algorithms and matroids. Prerequisites: ECE:3330. Same as ECE:5330.

IGPI:5400 Computing in Statistics 3 s.h.
R; database management; graphical techniques; importing graphics into word-processing documents (e.g., LaTeX); creating reports in LaTeX; SAS; simulation methods (Monte Carlo studies, bootstrap, etc.). Prerequisites: CS:1210 and STAT:3200 and (STAT:3120 or STAT:3101 or STAT:4101). Corequisites: STAT:5100 and STAT:5200 if not already completed. Same as DATA:5400, STAT:5400.

IGPI:5415 Satellite Image Processing and Remote Sensing of Atmosphere 3 s.h.
Introduction to principles of atmospheric radiation and techniques for satellite image processing; hands-on experience with data calibration, image registration and enhancement, noise filtering and (supervised and unsupervised) multi-spectral classification of satellite imageries; various satellite sensors used for monitoring of different atmospheric processes and constituents. Same as CBE:5415.

IGPI:5417 Physical Meteorology and Atmospheric Radiative Transfer 3 s.h.
Physical processes for weather and climate including radiative transfer, cloud and precipitation formation, and atmospheric electricity; theory of scattering by atmospheric particles (e.g., clouds, aerosols, molecules), atmospheric radiative transfer equations, and numerical techniques and tools to solve these equations. Requirements: senior or graduate standing. Same as CBE:5417, CEE:5417.

IGPI:5450 Machine Learning 3 s.h.
Fundamentals of machine learning theory including regression, classification, neural networks, clustering, and principal component analysis; engineering applications. Prerequisites: ECE:2400 or BME:2200. Same as ECE:5450.

IGPI:5460 Digital Signal Processing 3 s.h.
Theory, techniques used in representing discrete-time signals; system concepts in frequency and sampling domains; FIR and IIR digital filter theory, design and realization techniques; theory, application of discrete Fourier transforms/FFT. Prerequisites: ECE:3400. Same as ECE:5460.

IGPI:5480 Digital Image Processing 3 s.h.
Mathematical foundations and practical techniques for digital manipulation of images; image sampling, compression, enhancement, linear and nonlinear filtering and restoration; Fourier domain analysis; image pre-processing, edge detection, filtering; image segmentation. Prerequisites: ECE:2400 or BME:2200. Same as ECE:5480.

IGPI:5510 Biostatistical Computing 2 s.h.
Introduction to computer programming using SAS and R statistical software packages; programming language syntax, constructs, procedures, and techniques for data management, data analysis, and statistical programming commonly encountered in biostatistics; designed for first-year biostatistics majors. Offered fall semesters. Corequisites: BIOS:5710. Same as BIOS:5510.

IGPI:5641 Computer-Based Control Systems 3 s.h.
Discrete and digital control systems; application of computers in control; sampling theorem; discrete time system models; analysis and design of discrete time systems; control design by state variable and input/output methods; advanced topics in digital controls; lab. Prerequisites: ECE:5600. Same as ECE:5640.

IGPI:5710 Biostatistical Methods I 4 s.h.
Probability distributions, moments, estimation, parametric and nonparametric inference for one-sample and two-sample problems, analysis of frequency data; emphasis on use of computers; designed for first-year biostatistics majors. Offered fall semesters. Requirements: two semesters of calculus. Same as BIOS:5710.

IGPI:5720 Biostatistical Methods II 4 s.h.
Continuation of BIOS:5710; multi-factor ANOVA (analysis of variance), multiple comparisons, orthogonal contrasts, linear regression and correlation, regression diagnostics and remedial measures, model selection, and mixed models; designed for first-year biostatistics majors. Offered spring semesters. Prerequisites: BIOS:5710. Requirements: one semester of linear algebra. Same as BIOS:5720.

IGPI:5730 Biostatistical Methods in Categorical Data 3 s.h.
Estimation of proportions, rates, risks, relative risks, and odds ratios; Mantel-Haenszel method; logistic regression (including ordinal logistic regression and multi-category nominal logistic regression); Poisson regression and negative binomial regression; methods for correlated or clustered data (conditional logistic regression, generalized estimating equations, and mixed effects models); special topics include an introduction to generalized linear models and likelihood-based inferential techniques in this framework; designed for first-year biostatistics majors. Offered spring semesters. Prerequisites: BIOS:5510 and BIOS:5710. Corequisites: BIOS:5720. Same as BIOS:5730.

IGPI:6140 Academic User Services and Technology **3 s.h.**
Information and technological needs of academic library users; methods and models of reference and technical support services; standards for user interface (UI)/user experience (UX), including web content accessibility guidelines (WCAG); communicating about and ethical implications of academic library technologies. Same as SLIS:6140.

IGPI:6155 Information Visualization **3 s.h.**
Introduction to theories, techniques, and examples of information visualizations for different presentations of data. Prerequisites: SLIS:5020. Same as SLIS:6155.

IGPI:6210 Applied Survival Analysis **3 s.h.**
Nonparametric, parametric, and semi-parametric methods for time-to-event data; types of censoring; Kaplan-Meier estimation; Cox proportional hazards models, including methods for assessing adequacy of the proportional hazards assumption; time varying covariates; sample size calculations for comparison of two or more groups; focus on analysis of real data sets and examples using statistical software. Offered spring semesters. Prerequisites: BIOS:5120 or BIOS:5720. Same as BIOS:6210.

IGPI:6216 Finite Element II **3 s.h.**
Computer implementation; plate and shell elements; mixed and hybrid formulations; nonlinear analysis; recent development; introduction to boundary element method. Prerequisites: CEE:4533. Same as CEE:6532, ME:6215.

IGPI:6310 Introductory Longitudinal Data Analysis **3 s.h.**
Introduction to statistical models and estimation methods for outcome variables (normal and non-normal) clustered or measured repeatedly in time or space; focus on applications and computer software methods for ANOVA based methods, hierarchical linear models, linear mixed models, correlated regression models, generalized estimating equations, and generalized linear mixed models. Offered fall semesters. Prerequisites: BIOS:5120 or STAT:3200. Same as BIOS:6310, STAT:6550.

IGPI:6420 Advanced Database Management and Big Data **3 s.h.**
Advanced database management topics; basics of semi-structured data and web services; how to retrieve real-world big data sets from web services; use of SQL and PL/SQL to analyze data in relational databases; big data related topics (e.g., Hadoop, Hive). Same as BAIS:6420.

IGPI:6480 Knowledge Discovery **3 s.h.**
Knowledge discovery process including data reduction, cleansing, and transformation; advanced modeling techniques from classification, prediction, clustering, and association; evaluation and integration. Same as BAIS:6480.

IGPI:6490 Information Policy and Ethics **3 s.h.**
Recent developments in production, use, and organization of information have created new opportunities and raised ethical challenges that demand responses from information professionals; exploration of major ethical frameworks and their relevance for addressing ethical issues arising in information-intensive environments; practice-based assignments that provide opportunities for students to apply ethical theories to key ethical issues faced in various information-intensive contexts. Same as SLIS:6490.

IGPI:6501 Seminar in Spatial Analysis and Modeling **1-3 s.h.**
Research themes in spatial analysis, GIScience, simulation, remote sensing. Same as SEES:6500.

IGPI:6510 Readings in Informatics **arr.**
Topics not covered in other courses; individual study.

IGPI:6515 Independent Study **arr.**

IGPI:6520 Research for Dissertation **arr.**
Requirements: PhD candidacy.

IGPI:6530 Environmental and Spatial Statistics **3 s.h.**
Geostatistics kriging, variogram estimation, trend estimation, sampling design, extensions to river networks and the globe, lattice data analysis, analysis of spatial point patterns. Prerequisites: STAT:4101 and STAT:3200. Same as STAT:6530.

IGPI:6600 Linear Programming **3 s.h.**
Mathematical programming models; linear and integer programming, transportation models, large-scale linear programming, network flow models, convex separable programming. Requirements: calculus and linear algebra. Same as BAIS:6600, ISE:6600.

IGPI:6610 Statistical Methods in Clinical Trials **3 s.h.**
Survey of statistical methods commonly used in clinical trials; primary focus on methodologic perspective for the design, conduct, analysis, and interpretation of all phases of clinical trials; logistical and operational aspects of conducting multisite clinical trials; designed for biostatistics majors. Offered spring semesters. Prerequisites: BIOS:5720. Requirements: familiarity with SAS and R programming. Same as BIOS:6610.

IGPI:6650 Causal Inference **3 s.h.**
Causal inference overview, emphasis on inference in observational research; conceptual issues (e.g., counterfactuals, causal graphs, time-varying treatments/confounding), methods (e.g., inverse probability weighting, doubly robust estimators), and related applications (e.g., causal mediation analysis, quantitative bias analysis); for advanced biostatistics or epidemiology students. Prerequisites: (BIOS:5720 and BIOS:5730) or (EPID:6400 and EPID:5241 and EPID:5610). Same as BIOS:6650, EPID:6655.

IGPI:6700 Discrete Optimization **3 s.h.**
Introduction to modeling and solving discrete optimization problems; integer programming, network flows, dynamic programming. Prerequisites: BAIS:6600. Same as BAIS:6700.

IGPI:7000 Business Analytics Topics **3 s.h.**
Same as BAIS:7000.

IGPI:7210 Survival Data Analysis **3 s.h.**
Types of censoring and truncation; survival function estimation; parametric inference using exponential, Weibull, and accelerated failure time models; nonparametric tests; sample size calculation; Cox regression with stratification and time-dependent covariates; regression diagnostics; competing risks; topics may include analysis of correlated survival data and/or recurrent events; designed for biostatistics and statistics majors. Offered fall semesters of odd years. Prerequisites: BIOS:5720 and ((STAT:4100 and STAT:4101) or (STAT:5100 and STAT:5101)). Same as BIOS:7210, STAT:7570.

IGPI:7310 Longitudinal Data Analysis **3 s.h.**
Statistical models and estimation methods for outcome variables (normal and non-normal) clustered or measured repeatedly in time or space; includes ANOVA based methods, hierarchical linear models, linear mixed models, error structures, generalized estimating equations, and generalized linear mixed models; may include Bayesian approaches; designed for biostatistics and statistics majors. Offered spring semesters of odd years. Prerequisites: (BIOS:5720 and STAT:4100 and STAT:4101) or (STAT:5100 and STAT:5101). Same as BIOS:7310.

IGPI:7400 Computer Intensive Statistics 3 s.h.
Computer arithmetic, random variate generation, numerical optimization, numerical linear algebra, smoothing techniques, bootstrap methods, cross-validation, MCMC, EM and related algorithms; other topics per student/instructor interests. Prerequisites: (BIOS:5710 or STAT:5200) and STAT:3101 and STAT:5400. Requirements: proficiency in Fortran or C or C++ or Java. Same as DATA:7400, STAT:7400.

IGPI:7470 Image Analysis and Understanding 3 s.h.
Mathematical foundations and practical techniques of digital image analysis and understanding; image segmentation (from edges and regions), object description (from boundaries, regions, scale, scale insensitive descriptions, 3D shape, texture) pattern recognition (statistical and syntactic methods, cluster analysis), image understanding (knowledge representation, control strategies, matching, context, semantics), image analysis and understanding systems; lab arranged. Prerequisites: ECE:5480. Same as ECE:7470.

IGPI:7480 Advanced Digital Image Processing 3 s.h.
Advanced local operators (scale-space imaging, advanced edge detection, line and corner detection), image morphology (binary/gray scale operators, morphological segmentation and watershed), digital topology and geometry (binary/fuzzy digital topology, distance functions, skeletonization), color spaces, wavelets and multi-resolution processing (Haar transform, multi-resolution expansions, wavelet transforms in one or two dimensions, fast wavelet transform, wavelet packets), image registration (intensity correlation, mutual information, and landmark-based deformable registration methods). Prerequisites: ECE:5460 and ECE:5480. Same as ECE:7480.

IGPI:7600 Advanced Biostatistics Seminar 0-3 s.h.
Current topics; supervised experience in reading and interpreting biostatistical literature. Same as BIOS:7600.