Informatics Courses (IGPI)

This is a list of all informatics courses. For more information, see Informatics.

**IGPI:3011 Identifying and Developing a Global Health Project**

Preparation for an international experience (study abroad, service learning, volunteering, internship, or independent research project); addressing a global health issue in a systematic way. Same as GHS:3010.

**IGPI:3100 Introduction to Mathematical Statistics I**

Descriptive statistics, probability, discrete and continuous distributions, sampling, sampling distributions. Prerequisites: MATH:1860 or MATH:1560. Same as STAT:3100.

**IGPI:3101 Introduction to Mathematical Statistics II**

Estimation, testing statistical hypotheses, linear models, multivariate distributions, nonparametric methods. Prerequisites: STAT:3100. Same as STAT:3101.

**IGPI:3120 Probability and Statistics**

Models, discrete and continuous random variables and their distributions, estimation of parameters, testing statistical hypotheses. Prerequisites: MATH:1560 or MATH:1860. Same as STAT:3120.

**IGPI:3200 Applied Linear Regression**

Regression analysis with focus on applications; model formulation, checking, selection; interpretation and presentation of analysis results; simple and multiple linear regression; logistic regression; ANOVA; hands-on data analysis with computer software. Prerequisites: STAT:2020 or STAT:2010. Same as IE:3760, STAT:3200.

**IGPI:3314 Genomics**

Major areas of genomics, including DNA and protein sequence analysis, structural diversity of whole genomes, microarray applications, proteomics; computer workshop experience in applying bioinformatics tools. Prerequisites: BIOL:2512 or BIOC:3120. Same as BIOL:3314.

**IGPI:3330 Introduction to Software Design**

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:3510 Biostatistics**

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:3540 Introduction to Geographic Visualization**

Introduction of basic concepts and techniques that underlie cartographic representation, interaction, and geovisualization; map symbolization and visual variables; spatiotemporal visualization, multivariate mapping, interactive cartography, animation, geovisual analytics, 3-D visualization, virtual and augmented reality. Prerequisites: GEOG:1050. Same as GEOG:3540.

**IGPI:4100 Mathematical Statistics I**

Probability, conditional probability, random variables, distribution and density functions, joint and conditional distributions, various families of discrete and continuous distributions, mgf technique for sums, convergence in distribution, convergence in probability, central limit theorem. Prerequisites: MATH:2850 and MATH:2700. Same as STAT:4100.

**IGPI:4101 Mathematical Statistics II**

Transformations, order statistics, point estimation, sufficient statistics, Rao-Blackwell Theorem, delta method, confidence intervals, likelihood ratio tests, applications. Prerequisites: STAT:4100. Same as STAT:4101.

**IGPI:4115 Finite Element I**

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, ME:4115.

**IGPI:4159 Air Pollution Control Technology**

Sources, environmental and health impacts, regulations, modeling of air pollution; processes and alternative strategies for control; global climate considerations. Prerequisites: CEE:2150. Same as CBE:4459, CEE:4159.

**IGPI:4200 Statistical Methods and Computing**

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**

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: BIOC:3120 or MICR:3170 or BIOL:2512. Recommendations: grade of B+ or higher in BIOL:2512 or BIOC:3120, or graduate standing. Same as BIO:4213, GENE:4213.

**IGPI:4273 Population Genetics and Molecular Evolution**

Nucleotide sequences, genes, and mutation; rates and patterns of nucleotide substitution; selection at the molecular level and the neutral theory; population genetics theory; genome evolution. Prerequisites: BIOL:2512 with a minimum grade of C- or BIOL:2211 with a minimum grade of C. Requirements: grade of C- or higher in BIOL:2211 or BIOL:2512, or graduate standing. Recommendations: grade of C- or higher in BIOL:3172. Same as BIOL:4273.
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: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 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; students learn 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. 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 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: GEOG:1050. Same as GEOG: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:2700 or MATH:2550) and (STAT:2010 or STAT:2020 or STAT:4200). 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: M.A. or Ph.D. standing in political science. Same as POLI:5001.

IGPI:5010 Research for Master's Thesis arr.
Requirements: admission to M.S. program.

IGPI:5015 Independent Study arr.

IGPI:5020 Seminar in Bioinformatics 1 s.h.
Forum for research presentations by scientists with national and international prominence; broad range of research topics in bioinformatics, genomics, and high-throughput biology; sponsored by the NIH T32 Bioinformatics Predoctoral Training Program at the University of Iowa. Same as BME:5020.

IGPI:5043 Contextual Foundations - Special Libraries 3 s.h.
Management, organizational structures, collections, client services in special libraries; site visits to a variety of special libraries, information centers; projects that apply theoretical principles. Prerequisites: SLIS:5010. Corequisites: SLIS:5010, if not taken as a prerequisite. Same as SLIS:5043.

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, and an introduction to mixed models; designed for non-biostatistics majors. Offered spring semesters and summer sessions. Prerequisites: BIOS:4120. Same as BIOS:5120, STAT:5610.

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

IGPI:5200 Health Informatics I 3 s.h.
Technological tools that support health care administration, management, and decision making. Same as HMP:5370, IE:5860, MED:5300, SLIS:5900.

IGPI:5203 User Education - Multimedia 3 s.h.
Develop multimedia projects for educational use in libraries; develop a portfolio of projects using multimedia technology; explore applications of multimedia for teaching and learning; explore and evaluate platforms for delivering multimedia in educational environments. Same as SLIS:5200.

IGPI:5206 Medical Imaging Physics 3 s.h.
Physics and data acquisition techniques of major 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.
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:5220 Principles of Public Health Informatics 3 s.h.
Systematic applications of information science, computer science, and technology to public health practice, research, and learning; methods of disease surveillance, data collection, analysis, and reporting with health informatics. Same as EPID: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 of even years. Same as 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. Offered fall and spring semesters. Recommendations: prior programming experience with C, C++, Python, Java, or other. Same as BIOS:5310, STAT:5810.

IGPI:5321 Bioinformatics Techniques 3 s.h.
Informatics tools and techniques applied to modern problems in biomedicine and basic life sciences; common tools, experience applying tools in contemporary problem settings; genomics and genetics, how to sequence a genome, transcription and expression, SNPs, Perl, BioPerl, Perl modules, Ensembl API, BLAST/BLAT, NCBI, UCSC, Ensembl Genome browsers, linkage, association, disease gene identification.
Prerequisites: BIOL:1411 and (ENGR:2730 or CS:2110 or ECE:3330). Same as BME:5320, ECE:5220.

IGPI:5330 Computational Genomics 3 s.h.
Introduction to computational methods used in genome analysis and functional genomics; biological sequence analysis, sequence database search, microarray data analysis, biological network analysis; in-depth coverage of principal genome science challenges and recent solutions.
Prerequisites: (BIOS:4120 or STAT:3510) and BME:5320 and (CS:5110 or ENGR:1300). Same as BIOL:5320, BME:5330, ECE:5220, GENE:5173.

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 STAT:5400.

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 images; various satellite sensors used for monitoring of different atmospheric processes and constituents. Same as CBE:5415.

IGPI:5450 Pattern Recognition 3 s.h.
Mathematical foundations and practical techniques of pattern recognition; adaptation, learning, description; statistical pattern recognition; syntactic pattern recognition, neural networks for recognition; fuzzy logic for recognition; nonstandard and combined pattern recognition approaches.
Prerequisites: ECE:2400. 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 BME:5220, 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, ME:5362.
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; introduction to biostatistics majors. Offered fall semesters. Requirements: one semester 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:6100 Data Management and Visualization 3 s.h. Design and development of database-driven applications, including data preparation using common command line tools, database modeling and design, web-based application development using software development environments and standard libraries, web-based data visualization techniques; focus on widely used open source relational database tools. Prerequisites: SLIS:5020. Same as SLIS:6100.

IGPI:6110 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:6110.

IGPI:6120 Natural Language Processing 3 s.h. Tools and techniques for computational processing of text, including lexical analysis, part-of-speech tagging, named entity recognition, relationship extraction, topic detection and tracking, sentiment analysis, question answering; example corpora and applications drawn from multiple disciplines including biomedicine, digital humanities, and social science. Prerequisites: SLIS:5020. Same as SLIS:6120.

IGPI:6140 Digital Environments 3 s.h. Methods and models for building digital libraries; organization with metadata; standards such as those for object identifiers, open access, building cross-linkages between collections; automatic harvesting of content. Prerequisites: SLIS:5020. Same as SLIS:6140.

IGPI:6151 Environmental Systems Modeling 3 s.h. Mathematical modeling of environmental systems, including rivers, lakes, estuaries, treatment systems for conventional and toxic pollutants. Prerequisites: CEE:5152 and CEE:2150 and CEE:3155. Same as CEE:6151.

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

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

IGPI:6511 Applied Generalized Regression 3 s.h. Applications of semiparametric models, generalized linear models, nonlinear normal errors models, correlated response models; use of statistical packages, especially R and SAS. Requirements: introductory statistics and applied linear models. Same as STAT:6510.


IGPI:6530 Environmental and Spatial Statistics 3 s.h. Methods for sampling environmental populations, sampling design, trend detection and estimation, geostatistics, kriging, variogram estimation, lattice data analysis, analysis of spatial point patterns. Prerequisites: STAT:4101 and STAT:3200. Same as STAT:6530.
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 Comparative Effectiveness Research Methods for Observational Data  3 s.h.
Concepts of causal inference, counterfactuals, confounding, causal graphs, internal/external validity, heterogeneity of treatment effect; methods covered include propensity score matching (optimal pair, multiple control and full matching; near-exact, fine-balance, and risk set matching) and stratification; covariate balance checks; sensitivity analysis; inverse probability of treatment weighted estimation; doubly robust estimators; mediation analysis; marginal structural models. Offered fall semesters of odd years. Prerequisites: BIOS:5720 and BIOS:5730 and ((STAT:4100 and STAT:4101) or (STAT:5100 and STAT:5101)). Same as BIOS:6650.

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 spring semesters of odd years. Prerequisites: BIOS:5720 and ((STAT:4100 and STAT:4101) or (STAT:5100 and STAT:5101)). Same as BIOS:6650.

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. Requirements: proficiency in Fortran or C or C++ or Java. Same as STAT:7400.

IGPI:7450 Magnetic Resonance Imaging Systems  3 s.h.
Mathematical foundations and practical implementation for magnetic resonance imaging (MRI); principles of image formation using Fourier and projection techniques, non-Cartesian sampling, tomographic image reconstruction, sources of artifacts and their correction. Prerequisites: ECE:5460 and ECE:5480. Same as ECE:7450.

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