

BIostatistics AND MEDICAL INFORMATICS (B M I)

B M I/POP HLTH 451 – INTRODUCTION TO SAS PROGRAMMING FOR POPULATION HEALTH

2 credits.

Use of the SAS programming language for the management and analysis of biomedical data.

Requisites: Declared in the Population Health, Epidemiology or Clinical Investigation graduate program.

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2022

B M I/STAT 541 – INTRODUCTION TO BIOSTATISTICS

3 credits.

Course designed for the biomedical researcher. Topics include: descriptive statistics, hypothesis testing, estimation, confidence intervals, t-tests, chi-squared tests, analysis of variance, linear regression, correlation, nonparametric tests, survival analysis and odds ratio. Biomedical applications used for each topic.

Requisites: Graduate/professional standing. Not open to students with credit for STAT 511 or POP HLTH/B M I 551

Course Designation: Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2022

B M I/STAT 542 – INTRODUCTION TO CLINICAL TRIALS I

3 credits.

Intended for biomedical researchers interested in the design and analysis of clinical trials. Topics include definition of hypotheses, measures of effectiveness, sample size, randomization, data collection and monitoring, and issues in statistical analysis. Statistics graduate students should take B M I/STAT 641.

Requisites: B M I/STAT 541

Course Designation: Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2023

B M I 544 – INTRODUCTION TO CLINICAL AND HEALTHCARE RESEARCH II

3 credits.

Practical training and skills required in clinical and healthcare research; design, implementation, and conduct of clinical trials and health services research studies; protocol and informed consent development using protocol templates; regulatory requirements; human subjects research protections considerations; data and safety monitoring plans; data collection strategies and data management; strategies to recruit/retain diverse and equitable study participants; research study agreements; budget development and justification; federal, institutional, and sponsor-defined requirements; establishment of research infrastructures for participant safety and study success; preparation of investigator-INDs/ IDEs; and investigator responsibilities.

Requisites: STAT/B M I 542

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2022

B M I/POP HLTH 551 – INTRODUCTION TO BIOSTATISTICS FOR POPULATION HEALTH

3 credits.

Designed for population health researcher. Topics include descriptive statistics, elementary probability, probability distributions, one- and two-sample normal inference (point estimation, hypothesis testing, confidence intervals), power and sample size calculations, one- and two-sample binomial inference, underlying assumptions and diagnostic work.

Requisites: Declared in the Population Health, Epidemiology or Clinical Investigation graduate program. Not open to students with credit for STAT/B M I 541

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2022

B M I/POP HLTH 552 – REGRESSION METHODS FOR POPULATION HEALTH

3 credits.

Introduction to the primary statistical tools used in epidemiology and health services research; multiple linear regression, logistic regression and survival analysis.

Requisites: STAT/B M I 541 or POP HLTH/B M I 551

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2023

B M I/COMP SCI 567 – MEDICAL IMAGE ANALYSIS

3 credits.

Present introductory medical image processing and analysis techniques. Topics include medical imaging formats, segmentation, registration, image quantification, classification. Strongly encourage Matlab experience, such as COMP SCI 310 or 368-Matlab.

Requisites: (MATH 320 or 340) and (STAT 511, 541, POP HLTH/B M I 551, STAT 324, 371, or STAT/F&W ECOL/HORT 571) or graduate/professional standing

Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req

Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Fall 2022

B M I 573 – FOUNDATIONS OF DATA-DRIVEN HEALTHCARE

3 credits.

Familiarize students with basic informatics principles and techniques to support clinical research and quality improvement studies from a perspective of data-driven approaches. Content includes information systems for study design; regulatory compliance; use of electronic health records data for research; data collection and acquisition; data security, storage, transfer, processing and analysis.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2023

B M I/COMP SCI 576 – INTRODUCTION TO BIOINFORMATICS

3 credits.

Algorithms for computational problems in molecular biology. Studies algorithms for problems such as: genome sequencing and mapping, pairwise and multiple sequence alignment, modeling sequence classes and features, phylogenetic tree construction, and gene-expression data analysis.

Requisites: (COMP SCI 320 or 400) and MATH 222, graduate/professional standing, or declared in the Capstone Certificate in Computer Sciences for Professionals

Course Designation: Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Fall 2022

B M I/BIOCHEM/BMOLCHEM/MATH 609 – MATHEMATICAL METHODS FOR SYSTEMS BIOLOGY

3 credits.

Provides a rigorous foundation for mathematical modeling of biological systems. Mathematical techniques include dynamical systems and differential equations. Applications to biological pathways, including understanding of bistability within chemical reaction systems, are emphasized.

Requisites: MATH 415 and (MATH 320, 340, 341, or 375) or graduate/professional standing or member of the Pre-Masters Mathematics (Visiting International) Program

Course Designation: Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2022

B M I/ I SY E 617 – HEALTH INFORMATION SYSTEMS

3 credits.

Provides grounding in core concepts of health information systems. Major applications include clinical information systems, language and standards, decision support, image technology and digital libraries. Evaluation of IE tools and perspectives designed to improve the quality, efficiency and effectiveness of health information.

Requisites: I SY E 417, graduate/professional standing, or member of Engineering Guest Students

Course Designation: Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2016

B M I/STAT 641 – STATISTICAL METHODS FOR CLINICAL TRIALS

3 credits.

Statistical issues in the design of clinical trials, basic survival analysis, data collection and sequential monitoring. Intended for statistics graduate students; those with medical backgrounds should take STAT/B M I 542.

Requisites: STAT/MATH 310 or graduate/professional standing

Course Designation: Breadth - Natural Science

Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2022

B M I/STAT 642 – STATISTICAL METHODS FOR EPIDEMIOLOGY

3 credits.

Methods for analysis of case-control, cross sectional, and cohort studies. Covers epidemiologic study design, measures of association, rates, classical contingency table methods, and logistic and Poisson regression.

Requisites: STAT/MATH 310 or graduate/professional standing

Course Designation: Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2023

B M I/POP HLTH 651 – ADVANCED REGRESSION METHODS FOR POPULATION HEALTH

3 credits.

Extension of regression analysis to observational data with unequal variance, unequal sampling and propensity weights, clusters and longitudinal measurements, using different variance structures, mixed linear models, generalized linear models and GEE. Matrix notation will be introduced and underlying mathematical and statistical principles will be explained. Examples use data sets from ongoing population health research.

Requisites: POP HLTH/B M I 552**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Spring 2023**B M I/POP HLTH 652 – TOPICS IN BIOSTATISTICS FOR EPIDEMIOLOGY**

1-3 credits.

Each module will adopt an in-depth focus on a biostatistical method of particular relevance to epidemiology such as measurement error, missing data, intermediate variables, complex study designs, meta-analysis, splines, propensity scores, causal inference, spatial statistics and resampling. One or more modules will be offered every spring semester.

Requisites: POP HLTH/B M I 552**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** Yes, unlimited number of completions**Last Taught:** Spring 2015**B M I 699 – INDEPENDENT STUDY**

1-3 credits.

Directed study to pursue knowledge beyond curriculum.

Requisites: Consent of instructor**Course Designation:** Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions**Last Taught:** Summer 2023**B M I/STAT 727 – THEORY AND METHODS OF LONGITUDINAL DATA ANALYSIS**

3 credits.

Theory and methods of fundamental statistical models for the analysis of longitudinal data, including repeated measures analysis of variance, linear mixed models, generalized linear mixed models, and generalized estimating equations. Introduction of how to implement these methods in statistical softwares such as in R and/or SAS, within the context of appropriate statistical models and carry out and interpret analyses.

Requisites: STAT 610**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**B M I 738 – ETHICS FOR DATA SCIENTISTS**

1 credit.

Designed to educate data scientists, particularly those who work with biomedical data, about ethical and regulatory issues that may arise in the course of their research and professional interactions.

Requisites: Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Spring 2023**B M I/STAT 741 – SURVIVAL ANALYSIS THEORY AND METHODS**

3 credits.

Theory and practice of analytic methods for censored survival data, including nonparametric and parametric methods, the proportional hazards regression model, and a review of current topics in survival analysis.

Requisites: Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Spring 2023**B M I/COMP SCI 767 – COMPUTATIONAL METHODS FOR MEDICAL IMAGE ANALYSIS**

3 credits.

Study of computational techniques that facilitate automated analysis, manipulation, denoising, and improvement of large-scale and high resolution medical images. Design and implementation of methods from computer Vision and Machine Learning to efficiently process such image data to answer biologically and clinically meaningful scientific questions. Students are strongly encouraged to have programming skills and basic proficiency in calculus and linear algebra, such as MATH 340.

Requisites: Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Fall 2016**B M I/STAT 768 – STATISTICAL METHODS FOR MEDICAL IMAGE ANALYSIS**

3 credits.

Introduce key statistical methods and concepts for analyzing various medical images. Analyze publicly available and student/instructor supplied imaging data using the most up-to-date methods and tools. Aimed at graduate student and researchers with strong quantitative background.

Requisites: Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Spring 2023

B M I/COMP SCI 771 – LEARNING BASED METHODS FOR COMPUTER VISION

3 credits.

Addresses the problems of representation and reasoning for large amounts of visual data, including images and videos, medical imaging data, and their associated tags or text descriptions. Introduces deep learning in the context of computer vision. Covers topics on visual recognition using deep models, such as image classification, object detection, human pose estimation, action recognition, 3D understanding, and medical image analysis. Emphasizes the design of vision and learning algorithms and models, as well as their practical implementations. Strongly recommended to have knowledge in computer vision or machine learning [such as COMP SCI 540] or medical image analysis [such as B M I / COMP SCI/ B M I 567].

Requisites: Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Fall 2022**B M I 773 – CLINICAL RESEARCH INFORMATICS**

3 credits.

Course will familiarize students with basic informatics principles and techniques to support clinical research. Content includes information systems for protocol design; regulatory compliance; approaches for patient recruitment; efficient protocol management; data collection and acquisition; data security, storage, transfer, processing and analysis.

Requisites: Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Spring 2022**B M I/COMP SCI 775 – COMPUTATIONAL NETWORK BIOLOGY**

3 credits.

Introduces networks as a powerful representation in many real-world domains including biology and biomedicine. Encompasses theory and applications of networks, also referred to as graphs, to study complex systems such as living organisms. Surveys the current literature on computational, graph-theoretic approaches that use network algorithms for biological modeling, analysis, interpretation, and discovery. Enables hands-on experience in network biology by implementing computational projects.

Requisites: Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Fall 2022**B M I/COMP SCI 776 – ADVANCED BIOINFORMATICS**

3 credits.

Advanced course covering computational problems in molecular biology. The course will study algorithms for problems such as: modeling sequence classes and features, phylogenetic tree construction, gene-expression data analysis, protein and RNA structure prediction, and whole-genome analysis and comparisons.

Requisites: Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Spring 2022**B M I 826 – SPECIAL TOPICS IN BIOSTATISTICS AND BIOMEDICAL INFORMATICS**

1-3 credits.

Covers advanced topics in the areas of biostatistics and biomedical informatics. Includes reading and discussion of original literature and individual student projects.

Requisites: Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** Yes, unlimited number of completions**Last Taught:** Spring 2023**B M I/COMP SCI/PSYCH 841 – COMPUTATIONAL COGNITIVE SCIENCE**

3 credits.

Studies the biological and computational basis of intelligence, by combining methods from cognitive science, artificial intelligence, machine learning, computational biology, and cognitive neuroscience. Requires ability to program.

Requisites: Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Spring 2022**B M I/STAT 877 – STATISTICAL METHODS FOR MOLECULAR BIOLOGY**

3 credits.

Develop statistical problems in gene mapping, high throughput -omics data analysis, phylogenetics and sequence analysis. Introduce ideas of key methods using published data. Statisticians learn statistical basis for research methodology. Collaboration among students and with biologists is encouraged through projects.

Requisites: STAT 610 or MATH/STAT 710**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Spring 2022

B M I 881 – BIOMEDICAL DATA SCIENCE SCHOLARLY LITERATURE**1**

2 credits.

Critical evaluation of the scholarly literature is a crucial skill for researchers. Through this course, students will develop this valuable skill by focused reading and discussion of a variety of journal articles of present or historical importance from the biomedical sciences literature, including biostatistics, biomedical informatics, and relevant topics in statistics and computer science.

Requisites: Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Fall 2022**B M I 882 – BIOMEDICAL DATA SCIENCE SCHOLARLY LITERATURE****2**

2 credits.

Critical evaluation of the scholarly literature is a crucial skill for researchers. Through this course, students will develop this valuable skill by focused reading and discussion of a variety of journal articles of present or historical importance from the biomedical sciences literature, including biostatistics, biomedical informatics, and relevant topics in statistics and computer science.

Requisites: B M I 881**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Spring 2023**B M I 883 – BIOMEDICAL DATA SCIENCE PROFESSIONAL SKILLS 1**

1 credit.

A variety of skills that are important for a successful research career are often left to students to develop on their own. This course attempts to fill many of those gaps, including writing and reviewing papers, securing research funding, giving talks, presenting posters, making a personal website, job opportunities in universities and industry, and teaching.

Requisites: Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Fall 2022**B M I 884 – BIOMEDICAL DATA SCIENCE PROFESSIONAL SKILLS 2**

1 credit.

A variety of skills that are important for a successful research career are often left to students to develop on their own. This course attempts to fill many of those gaps, including writing and reviewing papers, securing research funding, giving talks, presenting posters, making a personal website, job opportunities in universities and industry, and teaching.

Requisites: B M I 883**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Spring 2023**B M I 899 – PRE-DISSERTATOR RESEARCH**

1-12 credits.

Pre-dissertator Research. Course is open to pre-dissertator students only.

Requisites: Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** Yes, unlimited number of completions**Last Taught:** Summer 2023**B M I 901 – FUNDAMENTALS OF INFORMATICS IN CLINICAL RESEARCH**

2 credits.

Become familiar with basic informatics principles and techniques to support clinical research. Content includes information systems for protocol design; regulatory compliance; approaches for patient recruitment; efficient protocol management; data collection and acquisition; data security, storage, transfer, processing and analysis.

Requisites: MED SC-M 810, 811, 812, and 813**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**B M I/B M E/BIOCHEM/CBE/COMP SCI/GENETICS 915 – COMPUTATION AND INFORMATICS IN BIOLOGY AND MEDICINE**

1 credit.

Participants and outside speakers will discuss current research in computation and informatics in biology and medicine. This seminar is required of all CIBM program trainees.

Requisites: Consent of instructor**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** Yes, unlimited number of completions**Last Taught:** Spring 2023**B M I/MEDICINE 918 – HEALTH INFORMATICS FOR MEDICAL STUDENTS ELECTIVE**

2 credits.

Biomedical Informatics is an interdisciplinary field that combines knowledge of information sciences and medical sciences to optimize the use and application of biomedical data across the spectrum from molecules to individuals to populations. Offers an overview of the field of health informatics by providing students with the fundamental knowledge of the concepts of health informatics and how technology can be used in the delivery of health care.

Requisites: Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** Yes, unlimited number of completions**Last Taught:** Spring 2023**B M I 990 – DISSERTATOR RESEARCH**

1-3 credits.

Dissertator Research. Course is open to dissertators only.

Requisites: Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** Yes, unlimited number of completions**Last Taught:** Summer 2023