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 2024
Learning Outcomes: 1. Create and modify SAS datasets using programming structures within the SAS Data Step (e.g. Do loops, If/Then/Else, Functions, and Arrays).
Audience: Graduate

2. Utilize various SAS Procedures to explore SAS datasets, to summarize information in SAS datasets, and to perform basic statistical analyses.
Audience: Graduate

3. Recognize common SAS program errors, identify strategies for debugging SAS programs, and implement general techniques to check and verify your coding.
Audience: Graduate

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 2025
Learning Outcomes: 1. Understand building blocks and fundamentals that support core themes of Biostatistics in the application of biomedicine and public health
Audience: Both Grad & Undergrad

2. Conduct basic statistical analyses of biomedical data
Audience: Both Grad & Undergrad

3. Use R for statistical computing
Audience: Both Grad & Undergrad

4. Critique methods and evidence from others' studies
Audience: Graduate

5. Collaborate effectively with biostatisticians
Audience: Graduate

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.
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 2026
Learning Outcomes: 1. Develop skills to critically review clinical trials literature
Audience: Graduate

2. Formulate focused research questions, specific aims, and key outcomes

Audience: Graduate

3. Recognize the strengths and weaknesses of alternative clinical trials designs and design components
Audience: Graduate

4. Develop related technical skills, including basic sample size calculations and survival analysis
Audience: Graduate

5. Write a clinical trial protocol with all its core components
Audience: Graduate

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 2023
Learning Outcomes: 1. Apply applicable legal and regulatory responsibilities, liabilities, and accountabilities for clinical trials and health services research studies according to IRBs, HIPAA, CGP, FDA, NIH, ClinicalTrials.gov, and other applicable entities
Audience: Graduate

2. Apply and implement best practices for human subjects' protection
Audience: Graduate

3. Apply team science through working with multidisciplinary and interprofessional team
Audience: Graduate

4. Analyze requirements in conduct of a clinical trial or health services research study and implement the use of a protocol to standardize procedures
Audience: Graduate

5. Evaluate and select data collection processes and implement quality control and assurance processes
Audience: Graduate

6. Create a protocol and consent/assent processes and documents for a clinical trial or health services research study, as well as supportive components
Audience: Graduate

B M I/POP HLTH 551 — INTRODUCTION TO BIOSTATISTICS FOR POPULATION HEALTH
4 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: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2025
Learning Outcomes: 1. Identify and recognize statistical and probability terminology, symbols, definitions, and formulas
Audience: Graduate

2. Explain the meaning, assumptions, and interrelationships of statistical and probability concepts and formulas
Audience: Graduate

3. Execute probability and statistical calculations from information provided
Audience: Graduate

4. State assumptions, conclusions and interpretation in terms of statistical and probability computations
Audience: Graduate

B M I/POP HLTH 552 — REGRESSION METHODS FOR POPULATION HEALTH
4 credits.

Introduction to the primary statistical tools used in epidemiology and health services research: logistic regression for binary outcomes, multiple linear regression for continuous outcomes, multinomial regression models for categorical outcomes, and Poisson and negative binomial regression models for count outcomes.
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 2026
Learning Outcomes: 1. State the assumptions underlying linear, logistic, multinomial and Poisson regression models, recognize and address violations of those assumptions, and estimate and interpret regression models to answer epidemiologic and public health research questions.
Audience: Graduate

2. Critique uses of linear, logistic, multinomial and Poisson regression models in the epidemiologic and public health literature.
Audience: Graduate

3. Translate epidemiologic concepts into statistical modeling assumptions, and explain statistical modeling assumptions in epidemiologic terms.
Audience: Graduate

4. Recognize applications that require methods beyond their expertise, and identify resources to learn about more advanced techniques.
Audience: Graduate

B M I/COMP SCI 567 — BIOMEDICAL IMAGE ANALYSIS
3 credits.

Hands-on introduction to biological and medical image analysis techniques. Topics include medical imaging formats, segmentation, registration, image quantification, and classification.
Requisites: (MATH 320, 340, 341, 345, or 375) and (STAT 511, 541, POP HLTH/B M I 551, MATH 331, MATH/STAT 431, 309, STAT 240, 301, 311, 324, 371, or STAT/F&W ECOL 571) or graduate/professional standing
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 2026
Learning Outcomes: 1. Implement the key principles of ideas from probability, statistics and computer vision algorithms used in medical image analysis
Audience: Undergraduate

2. Recognize which image analysis problems will benefit from which modeling approach
Audience: Undergraduate

3. Apply algorithms about image analysis tasks and implement algorithms and pipelines using a programming language
Audience: Undergraduate

4. Implement the building blocks taught in this course to independently learn and apply new, but related imaging analysis algorithms
Audience: Undergraduate

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 2026
Learning Outcomes: 1. Utilize informatics-based tools in translational research including locate relevant informatics tools; select appropriate informatics tools; and use those tools in research for managing and analyzing biomedical and health information.
Audience: Graduate

2. Describe the essential functions of the major clinical systems (e.g., the EHR-- (electronic health record and its feeder systems, such as radiology and lab) that are relevant to healthcare analytics and quality improvement and the challenges to using these data for research.
Audience: Graduate

3. Explain the role of health information technology standards in the interoperability of research, clinical, and administrative information systems and on secondary use of data for Clinical Translational Research or CTS.
Audience: Graduate

4. Describe the essential information generation, management, analysis, transformation, summarization, and visualization methods that apply to healthcare analytics and quality improvement, such as clinical data; imaging data; consumer and patient reported data; and population-level and environmental exposure data.
Audience: Graduate

5. Identify and describe available methods for handling large-scale data for machine learning and medical language processing.
Audience: Graduate

6. Illustrate the nature of the contributions in consulting and/or collaborating with biomedical and health informaticians throughout the life cycle of clinical and translational research projects: use the terminology and principles of biomedical informatics; discriminate among the different subdomains of biomedical informatics; and enumerate the roles of biomedical informatics specialists.
Audience: Graduate

7. Identify how structure and organization of information in a domain can affect quality research foci through fundamental data categories and elements, terminologies and taxonomies, and ontologies.
Audience: Graduate

8. Identify, retrieve, and manage biomedical and health science knowledge through literature searches using advanced search techniques (MeSH, PubMed, Google Scholar, etc.).
Audience: Graduate

9. Discuss the fundamental principles and practices that address the ethical, legal, social, privacy, and security implications of bio- medical and health informatics.
Audience: Graduate

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 2025
Learning Outcomes: 1. Explain the biology and significance of the most commonly measured molecules in molecular biology.
Audience: Undergraduate

2. Identify the primary computational problems associated with each type of biological data.
Audience: Undergraduate

3. Explain the major algorithms and approaches used to address the computational problems.
Audience: Undergraduate

4. Implement efficient algorithms for bioinformatic tasks through the use of the discussed approaches.
Audience: Undergraduate

5. Apply the discussed algorithms to novel but closely-related tasks.
Audience: Undergraduate

6. Understand the methods covered such that parts of the methods sections of published biological papers are interpretable.
Audience: Undergraduate

7. Begin to gain the qualifications of a bioinformatician.
Audience: Undergraduate

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: Fall 2025
Learning Outcomes: 1. Recall and state the formal definitions of the mathematical objects and their properties in systems biology (e.g., reaction networks, reaction rate equations, mass-action kinetics models, detailed balanced and complex balanced systems, Lyapunov functions, etc.).
Audience: Both Grad & Undergrad

2. Use such definitions to argue that a mathematical object does or does not have the condition of being a particular type or having a particular property (e.g., reversible, weakly reversible, mass-action, detailed balanced, complex balanced, globally stable, oscillatory, persistent, permanent, etc.).
Audience: Both Grad & Undergrad

3. Recall and state the standard theorems of the field (e.g., the Horn-Jackson theorem, the deficiency zero theorem, theorems on characterization of mass-action systems, theorems on persistence and permanence, theorems on dynamical equivalence, etc.) and recall the arguments for these theorems and the underlying logic of their proofs.
Audience: Both Grad & Undergrad

4. Construct mathematical arguments related to the above definitions, properties, and theorems, including the construction of examples and counterexamples.
Audience: Both Grad & Undergrad

5. Convey arguments using English and appropriate mathematical terminology, notation and grammar.
Audience: Both Grad & Undergrad

6. Model real biological systems by means of systems of differential equations, and be able to use software (such as Matlab) for visualization of their dynamics. Example models could include: (i) Enzymes, substrates and saturating kinetics, (ii) Glycolytic oscillations, (iii) Cell cycle control, budding yeast cell cycle models, (iv) Activator-inhibitor and positive feedback systems.
Audience: Both Grad & Undergrad

7. Identify applications of course content in current areas of research.
Audience: Graduate

B M I/STAT 620 — STATISTICS IN HUMAN GENETICS
3 credits.

Provides a comprehensive survey of statistical methods in human genetics research. Covered topics include linkage analysis, genome-wide association study, rare variant association analysis, meta-analysis, genome and variant annotation, heritability estimation, multi-trait modeling techniques, multi-omic data integration, and genetic risk prediction.
Requisites: STAT 333, 340, 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 2026
Learning Outcomes: 1. Recognize problems in human genetics that are appropriate for statistical modeling
Audience: Both Grad & Undergrad

2. Identify appropriate statistical procedures and computational algorithms for different tasks
Audience: Both Grad & Undergrad

3. Gain practical experience in applying a select set of statistical methods on real data and evaluate its outputs
Audience: Both Grad & Undergrad

4. Evaluate the strengths and weaknesses of different statistical and computational approaches designed for a specific biological problem
Audience: Graduate

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.
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 2025

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 2025
Learning Outcomes: 1. Summarize key concepts of statistical methods in epidemiology study: study design, association, causation
Audience: Both Grad & Undergrad

2. Build parametric or semiparametric model for analyzing categorical data and survival data
Audience: Both Grad & Undergrad

3. Utilize model design tools for model performance assessment
Audience: Both Grad & Undergrad

4. Build semiparametric model for analyzing categorical data and survival data
Audience: Graduate

B M I/STAT 643 — CLINICAL TRIAL DESIGN, IMPLEMENTATION, AND ANALYSIS
3 credits.

Gain an understanding of fundamental elements of clinical trials (such as objectives, endpoints, surrogate endpoints, and statistical decisions) and statistical design considerations (such as randomization and blinding). Designs of clinical trials for Phase I, II, and III studies including single-arm, two-arm, and drug combination trials. Introduction to adaptive designs for precision medicine and master protocol designs such as umbrella trials and basket trials.
Requisites: STAT 609, 610, B M I/STAT 641, 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: Fall 2024
Learning Outcomes: 1. Summarize the objectives of clinical trials and key statistical design components
Audience: Both Grad & Undergrad

2. Design the clinical trials and investigate the operating characteristics of the design to implement clinical trials
Audience: Both Grad & Undergrad

3. Write the protocol section of statistical considerations and communicate the design of clinical trials to both statisticians and clinicians
Audience: Both Grad & Undergrad

4. Build sequential and adaptive methods for clinical trials
Audience: Graduate

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: Fall 2025
Learning Outcomes: 1. Extend the knowledge of regression analysis beyond ordinary linear models
Audience: Graduate

2. Describe the features of correlated data and their implications in drawing inference
Audience: Graduate

3. Construct proper linear and generalized linear models for longitudinal and clustered data
Audience: Graduate

4. Describe the assumptions needed for estimation and inference
Audience: Graduate

5. Implement the inference procedures to solve real-world problems using statistical packages such as SAS and R
Audience: Graduate

6. Use diagnostic tools to assess model fit
Audience: Graduate

7. Interpret and present the analytic results to answer substantive questions
Audience: Graduate

B M I/POP HLTH 694 — APPLIED BIOMEDICAL INFORMATICS & REAL-WORLD DATA FOR PRECISION MEDICINE & POPULATION HEALTH
2 credits.

Provides an introduction to key concepts, methods, and tools of biomedical and health informatics used in precision medicine and population health, with emphasis on collection, management, and analysis of real-world data.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Learning Outcomes: 1. Demonstrate understanding of biomedical informatics concepts, methods, and tools used in precision medicine and population health.
Audience: Graduate

2. Demonstrate understanding of real-world data (patient-generated, clinical, and genomic) and data standards used in biomedical research.
Audience: Graduate

3. Demonstrate understanding of FAIR Guiding Principles for scientific data management and stewardship.
Audience: Graduate

4. Demonstrate understanding of regulations for using protected health information (PHI) data in health research, and ability to recognize potential ethical and compliance issues.
Audience: Graduate

B M I 699 — INDEPENDENT STUDY
1-8 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: Spring 2026
Learning Outcomes: 1. Apply concepts learned in coursework to real biomedical applications
Audience: Both Grad & Undergrad

2. Read and effectively analyze scientific literature
Audience: Both Grad & Undergrad

3. Develop critical, analytical, and independent thinking skills
Audience: Both Grad & Undergrad

4. Create literature reviews and publications
Audience: Graduate

B M I/COMP SCI/E C E/MED PHYS 722 — COMPUTATIONAL OPTICS AND IMAGING
3 credits.

Computational imaging includes all imaging methods that produce images as a result of computation on collected signals. Learn the tools to design new computational imaging methods to solve specific imaging problems. Provides an understanding of the physics of light propagation and measurement, and the computational tools to model it, including wave propagation, ray tracing, the radon transform, and linear algebra using matrix and integral operators and the computational tools to reconstruct an image, including linear inverse problems, neural networks, convex optimization, and filtered back-projection. Covers a variety of example computational imaging techniques and their applications including coded apertures, structured illumination, digital holography, computed tomography, imaging through scattering media, compressed sensing, and non-line-of-sight imaging.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2024
Learning Outcomes: 1. Apply ray and wave based light propagation models
Audience: Graduate

2. Explain the process of image formation in conventional imaging systems using theory and computational models
Audience: Graduate

3. Select and combine the different components required in an imaging system to perform light manipulation, collection, and image reconstruction

Audience: Graduate

4. Apply the linear matrix and integral operators that model light propagation
Audience: Graduate

5. Apply the linear inverse algorithms that allow an imaging system to reconstruct properties of the scene from collected data
Audience: Graduate

6. Simulate different computational imaging systems and perform computation on simulated datasets
Audience: Graduate

7. Understand the most common computational imaging techniques and be able to use and adapt them for their own applications
Audience: Graduate

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
Last Taught: Fall 2025
Learning Outcomes: 1. Analyze longitudinal data in a variety of settings and with a variety of outcome variables
Audience: Graduate

2. Apply statistical methods in fitting longitudinal data models for addressing scientific questions
Audience: Graduate

3. Perform longitudinal data analyses in statistical softwares such as R and/or SAS
Audience: Graduate

4. Interpret and communicate the scientific meanings of the results to both statisticians and non-statisticians (such as clinicians and scientists)
Audience: Graduate

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 2026
Learning Outcomes: 1. Identify ethical issues and recognize challenges to integrity that arise during the course of planning and conducting research or reporting research results.
Audience: Graduate

2. Formulate a justified response to an ethical issue or integrity challenge, using ethical decision-making approaches and concepts.
Audience: Graduate

3. Identify where to find professional resources that provide guidance for resolving ethical and research integrity issues.
Audience: Graduate

4. Conduct improved discussions about ethical issues.
Audience: Graduate

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 2026
Learning Outcomes: 1. Summarize the features of censored data and their implications in drawing inference
Audience: Graduate

2. Implement proper non- and semi-parametric methods for analysis of various types of data
Audience: Graduate

3. Recognize and check the assumptions needed for estimation and inference
Audience: Graduate

4. Implement the inference procedures to solve real-world problems using statistical packages such as R (or SAS)
Audience: Graduate

5. Interpret and present the analytic results in a clear and coherent way to answer substantive questions
Audience: Graduate

B M I/COMP SCI 767 — COMPUTATIONAL METHODS FOR MEDICAL IMAGE ANALYSIS
3 credits.

Review of advanced medical image analysis techniques. Covers advanced segmentation and registration methods. Describes the use and extension of statistical and machine learning methods for medical image analysis tasks.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2026
Learning Outcomes: 1. Implement advanced ideas from machine learning, statistics, and computer vision for medical image analysis tasks.
Audience: Graduate

2. Develop a deep technical understanding of the machine learning and statistical ideas being utilized in contemporary research in this area, and identification of blockers where research efforts can be focused
Audience: Graduate

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.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2026
Learning Outcomes: 1. Implement the key concepts of biomedical image processing and analysis
Audience: Graduate

2. Describe the key concepts of statistical inference procedures for single and multiple images
Audience: Graduate

3. Apply scalable computation in breaking bigger imaging problems into smaller computable problems
Audience: Graduate

4. Describe functional data analysis (FA), geometric data analysis (GDA) and topological data analysis (TDA) methods in analyzing biomedical images
Audience: Graduate

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 2025
Learning Outcomes: 1. Demonstrate their understanding of basic theories, current approaches, key concepts, and common practices in the area of deep learning for computer vision.
Audience: Graduate

2. Recognize and distinguish among a variety of visual recognition problems in computer vision, including their problem formulations and evaluation metrics.
Audience: Graduate

3. Utilize and implement deep learning models to solve visual recognition problems.
Audience: Graduate

4. Design deep learning models for visual recognition problems, conduct experiments to evaluate the proposed model, and analyze and interpret the results.
Audience: Graduate

5. Communicate effectively through written reports, oral presentations, and discussions.
Audience: Graduate

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 2026
Learning Outcomes: 1. Recognize the various types and sources of health data, and the key issues involved in processing health data including security, privacy, noise, and missingness
Audience: Graduate

2. Conduct observational studies using data that are centered around answering research questions
Audience: Graduate

3. Implement basic programming and data manipulation using R, and be familiar with a variety of techniques such as descriptive analysis, regression methods, prediction models, phenotyping, and natural language processing
Audience: Graduate

4. Apply common tools for managing, accessing and mapping health data, including data standards, controlled vocabularies, and ontologies
Audience: Graduate

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 2025
Learning Outcomes: 1. Recognize problems in molecular biology that are appropriate for network modeling
Audience: Graduate

2. Identify appropriate network algorithms for different tasks
Audience: Graduate

3. Evaluate the strengths and weaknesses of different network algorithms designed for a specific biological problem
Audience: Graduate

4. Gain practical experience in applying a select set of network algorithms on real data and evaluate its outputs
Audience: Graduate

5. Understand the algorithmic and statistical concepts of different network-based approaches
Audience: Graduate

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 2026
Learning Outcomes: 1. Select and implement appropriate algorithms and probabilistic models for analyzing genomes, RNA, proteins, and biological networks
Audience: Graduate

2. Write a manuscript describing a bioinformatics research study, including the motivation for the research, the scientific outcomes, and the detailed methods required to reproduce the study
Audience: Graduate

3. Read a bioinformatics research paper to identify the key computational techniques and assess the evidence supporting the paper's claims
Audience: Graduate

4. Identify emerging biological data types and data processing (e.g., single cell biology) and how the data can contribute to their research
Audience: Graduate

B M I 800 — BECOMING A BIOMEDICAL DATA SCIENTIST
1 credit.

Learn how to conduct research as an interdisciplinary scientist at the interface of biomedical sciences and data science. Consider the diverse career trajectories available to an individual scientist. Gain an overview of problems in the field, approaches and practices in biomedical research, and different examples of approaches and paths taken from conceptualization to implementation of computational/statistical/data science tools to address specific biomedical research problems.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2025
Learning Outcomes: 1. Explain the breadth of research in biomedical data science.
Audience: Graduate

2. Describe the approaches, resources and environment available to conduct interdisciplinary research at UW.
Audience: Graduate

3. Describe the high-level goals of research programs of individual faculty trainers in the Biomedical Data Science program.
Audience: Graduate

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 2025
Learning Outcomes: 1. Design, implement, and evaluate a graduate level independent research project that applies or extends these theories, concepts, and methods
Audience: Graduate

B M I/STAT 828 — SEMIPARAMETRIC METHODS IN DATA SCIENCE
3 credits.

Review of statistical convergence modes, M-estimation, and basics of Hilbert space. Introduction of how to derive the nuisance tangent space, its complement, and the corresponding efficient influence function, from the geometric perspective of semiparametric models. Introduction of how to estimate nuisance functions using machine learning methods, and their implementations in R and/or Python. Introduction of a variety of semiparametric models in missing data analysis, causal inference, dimension reduction, precision medicine, semi-supervised learning, transfer learning and domain adaptation.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2024
Learning Outcomes: 1. Derive the nuisance tangent space, its complement, and the corresponding efficient influence function in semiparametric models
Audience: Graduate

2. Apply a variety of semiparametric methods and models in applications ranging from biomedical studies to social sciences
Audience: Graduate

3. Perform machine learning algorithms for estimating nuisance functions in software such as R and/or Python
Audience: Graduate

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 2025

B M I/STAT 877 — STATISTICAL METHODS FOR MOLECULAR BIOLOGY
3 credits.

Statistical and computational methods in statistical genomics for human and experimental populations. Review methods for quality control, experimental design, clustering, network analysis, and other downstream analysis of next-generation sequencing studies along with methods for genome wide association studies.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2024
Learning Outcomes: 1. Understand the statistical and computational background underlying many state-of-the-art techniques for the pre-processing and analysis of high-throughput genomics datasets
Audience: Graduate

2. Identify the appropriateness and limitations of such methods in a variety of settings.
Audience: Graduate

3. Discuss scientific problems and identify the statistical and computational aspects embedded in the processing and analysis of genomics datasets.
Audience: Graduate

4. Become proficient in select software packages commonly used in analysis of next-generation sequencing data.
Audience: Graduate

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 2025
Learning Outcomes: 1. Critically evaluate quantitative approaches in the scientific literature
Audience: Graduate

2. Articulate the biological context of a research question and the scientific relevance of analysis results
Audience: Graduate

3. Identify and articulate the strengths and weaknesses of different study designs and analysis methods, including potential biases in research data sets
Audience: Graduate

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
Learning Outcomes: 1. Critically evaluate quantitative approaches in the scientific literature
Audience: Graduate

2. Articulate the biological context of a research question and the scientific relevance of analysis results
Audience: Graduate

3. Identify and articulate the strengths and weaknesses of different study designs and analysis methods, including potential biases in research data sets
Audience: Graduate

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 2025
Learning Outcomes: 1. Describe the review processes for journal articles and research grant proposals
Audience: Graduate

2. Write clear, well-formed journal articles and research grant proposals
Audience: Graduate

3. Provide a clear oral presentation of their research work
Audience: Graduate

4. Demonstrate understanding of research on unconscious bias (for example, in reviewing papers/grants, in writing/evaluating recommendation letters, and in hiring/promotion) and assumptions and strategies to overcome them
Audience: Graduate

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: Fall 2025
Learning Outcomes: 1. Prepare a web-based profile of their research efforts and products
Audience: Graduate

2. Describe good practices for research scientists' participation in social media
Audience: Graduate

3. Define sexual harassment and describe practices for handling sexual harassment
Audience: Graduate

4. Describe strategies for forming and managing scientific collaborations
Audience: Graduate

5. Construct a personal website for networking and self-promotion
Audience: Graduate

6. Identify employment opportunities at universities and in industry and demonstrate understanding of strategies for applying and interviewing for such positions
Audience: Graduate

7. Describe and compare different teaching practices and methods for motivating students
Audience: Graduate

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: Spring 2026
Learning Outcomes: 1. Develop critical, analytical, and independent thinking skills to support the development of independent research
Audience: Graduate

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 2026
Learning Outcomes: 1. Discuss how methods from computer science, statistics, information science and engineering are applied to problems in biology, medicine and population health
Audience: Graduate

2. Recognize and be able to define applications in translational bioinformatics, clinical informatics and public health informatics
Audience: Graduate

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 2026
Learning Outcomes: 1. Describe main concepts and challenges in health informatics.
Audience: Graduate

2. Identify the different aspects of electronic health records.
Audience: Graduate

3. Recognize medical safety issues related to chart maintenance and poor systems.
Audience: Graduate

4. Instruct patients in proper use of a personal health record (PHR).
Audience: Graduate

5. Compare and contrast the concept of learning health systems that is patient-centered, population-based, and promotes learning from data.
Audience: Graduate

6. Define population-based care and the informatics underlying it.
Audience: Graduate

7. Recognize different types of clinical decision support.
Audience: Graduate

8. Describe the area of quality measurement and improvement.
Audience: Graduate

9. Formulate how the area of quality measurement and improvement applies to clinical practice.
Audience: Graduate

10. Recognize the types and limitations of different types of quality measures.
Audience: Graduate

11. Formulate a clinical question as an answerable one, and then be able to select the appropriate resource and make optional use of it.
Audience: Graduate

12. Recognize growing role of genomics and personalized medicine in care.

Audience: Graduate

13. Describe and manage ethical issues in privacy and security.
Audience: Graduate

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: Spring 2026
Learning Outcomes: 1. Develop skills to design, implement and apply
computational and statistical frameworks to address diverse biomedical
questions
Audience: Graduate