Biostatistics

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Courses

MSB 5070 R and Python for Biomedical Sciences
Students will explore data manipulation techniques using Pandas in Python, focusing on leveraging its native functionalities to efficiently handle and analyze biomedical data. Emphasis will be placed on transitioning from traditional looping methods to utilizing Pandas' powerful features for data manipulation tasks. In Python, students will delve into essential libraries including Pandas and NumPy using Jupyter Notebooks, gaining proficiency in data structuring, exploration, and analysis. Through hands-on exercises and projects, students will learn to leverage Python's ecosystem for efficient data handling and visualization, preparing them for real-world applications inbiomedical research and analysis. The course also introduces R programming within the tidyverse framework which includes a number of R packages designed to make data manipulation, visualization, and analysis easier and more intuitive. We will focus on the use of packages including dplyr and ggplot2 for data manipulation and visualization, respectively. Students will learn to harness R's capabilities for basic statistical analysis and visualization, complementing their Python skills and expanding their toolkit for biomedical informatics and biostatistics.
Credit 2 units.
Typical periods offered: Fall, Summer

MSB 5505 Statistical Computing With SAS
Intensive hands-on summer training in SAS (Statistical Analysis System) during seven full weekdays. Students will learn how to use SAS for handling, managing, and analyzing data. Instruction is provided in the use of SAS programming language, procedures, macros, and SAS SQL. The course will include exercises using existing programs written by SAS experts.
Credit 2 units.
Typical periods offered: Fall

MSB 5515 Fundamentals of Genetic Epidemiology
Lectures cover causes of phenotypic variation, familial resemblance and heritability, Hardy-Weinberg Equilibrium, ascertainment, study designs and basic concepts in genetic segregation, linkage and association. The computer laboratory portion is designed as hands-on practice of fundamental concepts. Students will gain practical experience with various genetics computer programs (e.g. SOLAR, MERLIN, QTDT, and PLINK). Auditors will not have access to the computer lab sessions.
Credit 3 units.
Typical periods offered: Fall

MSB 5520 Introduction to Bioinformatics
Provide a broad exposure to the basic concepts, methodology and application of bioinformatics to solve biological problems. Specifically, the students will learn the basics of online genomic/protein databases and database mining tools, and acquire understanding of mathematical algorithms in genome sequence analysis (alignment analysis, gene finding/predicting), gene expression microarray (genechip) analysis, and of the impact of recent developments in the protein microarray technology.
Credit 3 units.
Typical periods offered: Fall

MSB 5530 Biostatistics I
This course is designed for students who want to develop a working knowledge of basic methods in biostatistics. The course is focused on biostatistical and epidemiological concepts and on practical hints and hands-on approaches to data analysis rather than on details of the theoretical methods. We will cover basic concepts in hypothesis testing, will introduce students to several of the most widely used probability distributions, and will discuss classical statistical methods that include t-tests, chi-square tests, regression analysis, and analysis of variance. Both in-class examples and homework assignments will involve extensive use of SAS.
Credit 3 units.
Typical periods offered: Fall

MSB 5540 Biostatistics II
This course is designed for students who have taken Biostatistics I or the equivalent and who want to extend their knowledge of biostatistical applications to more modern and more advanced methods. Biostatistical methods to be discussed include logistic and Poisson regression, survival analysis, Cox regression analysis, and several methods for analyzing longitudinal data. Students will be introduced to modern topics that include statistical genetics and bioinformatics. The course will also discuss clinical trial design, the practicalities of sample size and power computation and meta analysis, and will ask students to read journal articles with a view towards encouraging a critical reading of the medical literature. Both in-class examples and homework assignments will involve extensive use of SAS.
Credit 3 units.
Typical periods offered: Fall

MSB 5555 Computational Statistical Genetics
This course is designed to give the students computational experience with the latest statistical genetics methods and concepts, so that they will be able to computationally implement the method(s)/model(s) developed as part of their thesis. Concentrating on the applications of genomics and computing, it deals with creating efficient new bioinfomatic tools to interface with some of the latest, most important genetic epidemiological analysis software, as well as how to derive, design and implement new statistical genetics models. The course also includes didactic instruction on haplotype estimation and modeling of relationship to phenotype, LD mapping, DNA pooling analysis methods, analysis approaches in pharmacogenomics (with an emphasis on possible genomic role in drug response heterogeneity), and epistasis (GxG) and GxE interactions; data mining methods, including clustering, recursive partitioning, boosting, and random forests; and fundamentals of meta-analysis, importance sampling, permutation tests and empirical p-values, as well as the design of monte-carlo simulation experiments. Permission of the instructor required.
Credit 3 units.
Typical periods offered: Spring

MSB 5560 Ethics in Biostatistics and Data Science
This course prepares biostatisticians to analyze and address ethical and professional issues in the practice of biostatistics across the range of professional roles and responsibilities of a biostatistician. The primary goals are for biostatisticians to recognize complex situational dynamics and ethical issues in their work and to develop professional and ethical problem-solving skills. The course specifically examines ethical challenges related to research design, data collection, data management, ownership, security, and sharing, data analysis and interpretation, and data reporting and provides practical guidance on these issues. The course also examines fundamentals of the

broader research environment in which biostatisticians work, including principles of ethics in human subjects and animal research, regulatory and compliance issues in biomedical research, publication and authorship, and collaboration in science. By the conclusion of the course, participants will understand the ethical and regulatory context of biomedical research; identify ethical issues, including situational dynamics that serve to foster or hinder research integrity, in the design and conduct of research and the management, analysis, and reporting of data; and utilize strategies that facilitate ethical problem-solving and professionalism.

Credit 2 units.

Typical periods offered: Spring

MSB 5565 Survival Analysis

This course will cover the basic applied and theoretical aspects of models to analyze time-to-event data. Basic concepts will be introduced including the hazard function, survival function, right censoring, and the Cox-proportional hazards (PH) model with fixed and time dependent covariates. Additional topics will include regression diagnostics for survival models, the stratified PH model, additive hazards regression models and multivariate survival models. Permission of the Course Instructor required.

Credit 3 units.

Typical periods offered: Spring

MSB 5570 Study Design and Clinical Trials

The course will focus on statistical and epidemiological concepts of study design and clinical trials. Topics include: different phases of clinical trials, various types of medical studies (observational studies, retrospective studies, adaptive designs, and comparative effectiveness research), and power analysis. Study management and ethical issues are also addressed. Students will be expected to do homework and practice power analysis during lab sessions. Permission of the Course Instructor is required.

Credit 3 units.

Typical periods offered: Fall, Spring

MSB 5571 Directed Independent Study

A faculty member will work with the student in specific areas related to the student's primary needs.

Credit 6 units.

Typical periods offered: Fall, Spring, Summer

MSB 5575 Biomedical Data Mining

This course introduces methods and applications of biomedical data mining. Various computational and statistical methods will be presented, such as model selection and regularization, resampling methods, tree-based methods, and artificial intelligence. In addition to the common applications of the covered methods in biomedical sciences, this course will prepare students for future challenges and opportunities in data science.

Credit 3 units.

Typical periods offered: Spring

MSB 5580 Internship

The primary goal of the Internship program is for students to acquire critical professional experience so that they will be well prepared to enter the job market upon graduation. This provides an opportunity for students to develop contacts, build marketable skills and perceive likes and dislikes in the chosen field. Students will have an opportunity to work with experienced mentors (PIs) on a range of projects that may include data management, data analysis, study design, and protocol development among other things. Students may have opportunities to contribute to and participate in the preparation of publishable quality manuscripts. As part of the Internship requirements, each student will submit a one-page Abstract of the work performed as part of the internship and will give a presentation of the Internship experience. The grade (pass/fail) for each student will be determined in consultation with the mentor.

Credit 1-6 units.

Typical periods offered: Fall, Spring, Summer

MSB 5585 Mentored Research

Student undertakes supervised research in a mentor's lab. The goal is to acquire important research skills as well as good writing and presentation skills. The student finds a mentor and they together identify a research topic. A written thesis based on the research, prepared in the format of an actual scientific publication, must be submitted and presented to a select audience. The course instructor will organize a few meetings throughout to facilitate the whole process. The course instructor will determine the grade (pass/fail) in consultation with the mentors. Permission of the course instructor is required.

Credit 1-6 units.

Typical periods offered: Fall, Spring, Summer

MSB 7883 Master's Continuing Student Status

Full-Time Graduate Research

Credit 0 units.

Typical periods offered: Fall, Spring, Summer