BIOSTATISTICS (BIOSTAT)

BIOSTAT 301-0 Introduction to Epidemiology (1 Unit)
This course introduces epidemiology and its uses for population health research. Concepts include measures of disease occurrence, common sources and types of data, important study designs, sources of error in epidemiologic studies and epidemiologic methods.

BIOSTAT 302-0 Introduction to Biostatistics (1 Unit)
This course introduces principles of biostatistics and applications of statistical methods in health and medical research. Concepts include descriptive statistics, basic probability, probability distributions, estimation, hypothesis testing, correlation and simple linear regression.

BIOSTAT 303-0 Introduction to Probability Theory (1 Unit)
This course introduces probability as the theoretical framework underlying statistical methods. Concepts include random variables, discrete and continuous probability distributions, multivariate distributions, and random variable transformations. A working knowledge of differential / integral calculus and matrix algebra fundamentals is required.

BIOSTAT 305-0 Data Management and Analysis in SAS (1 Unit)
This course provides a thorough working introduction to the statistical programming language SAS. Concepts focus on practical issues relating to data management, statistical data processing and SAS programming. Prerequisites: BIOSTAT 302-0.

BIOSTAT 306-0 R Programming (1 Unit)
This course provides a thorough working introduction to the statistical programming language R. Concepts focus on practical issues including: installing and configuring the RStudio development environment; loading and managing data in R; accessing R packages; writing R functions; writing R scripts; debugging and profiling R scripts; organizing and commenting R code; and developing dynamic analysis reports using R MarkDown. Topics in biostatistical data analysis will provide relevant working examples.

BIOSTAT 390-0 Emerging Topics in Biostatistics (1 Unit)
This course is student interest-driven; the student(s) will each select topic(s) related to clinical trials that they would like to understand in greater depth. The course will function much like a journal club, and each student will present on his/her specified topics. Those not presenting will be responsible for review and critique of the discussion.

BIOSTAT 401-0 Intermediate Epidemiology (1 Unit)
The purpose of this course is to elaborate on concepts introduced in introductory epi, demonstrate how these concepts are frequently applied in biomedical literature, and to provide an overview of the physiology, pathophysiology, and epidemiology of prevalent diseases in the US. Prerequisite: BIOSTAT 301-0.

BIOSTAT 402-0 Intermediate Biostatistics (1 Unit)
This course provides an intermediate-level treatment of linear and logistic regression models, including model estimation and inference, model building and diagnostics, and interpretation of results in the context of epidemiologic and clinical studies. The focus is on practical application of regression models for data analysis. The course uses R statistical software for data analysis. Prerequisites BIOSTAT 302-0 and BIOSTAT 306-0.

BIOSTAT 403-0 Statistical Inference (1 Unit)
This course introduces statistical inference concepts and applied statistical techniques for data analysis in a mathematical framework. Concepts include point and interval estimation, maximum likelihood, large sample theory, hypothesis testing, bootstrap methods, analysis of variance, linear regression, analysis of categorical data and Bayesian methods. A working knowledge of college calculus I and II is essential. Prerequisite: BIOSTAT 303-0.

BIOSTAT 429-0 Systematic Review and Meta-Analysis in the Medical Sciences (1 Unit)
This course covers statistical methods for meta-analysis. Concepts include fixed-effects and random-effects models, measures of heterogeneity, prediction intervals, meta regression, power assessment, subgroup analysis and assessment of publication bias. The course will emphasize basic theory and underlying statistical methods, computational approaches and interpretation of results from published studies.

BIOSTAT 445-0 Introduction to Statistical Learning (1 Unit)
Due to advances in technology and data collection, the ability to analyze complex data sets is a necessary skill for all clinical, translational and population researchers. A variety of data analysis tools exist, some unique to specific domains. This course provides an introduction to the data, analysis tools, ethical considerations, and terminologies from across biomedical data science with an emphasis on clinical, translational and population methods and tools. Prerequisite BIOSTAT 302-0.

BIOSTAT 446-0 Design, Conduct and Analysis of Clinical Trials (1 Unit)
This course introduces commonly used designs for clinical trials, methods for randomization, blinding and sample size determination, choice of controls, collaborative/multicenter trial requirements and operational issues, data management and data quality issues, interim analysis methods, critical review of clinical trial results and statistical techniques for analyzing data. Prerequisite BIOSTAT 305-0 and BIOSTAT 402-0.

BIOSTAT 499-0 Independent Study (0.5-1 Unit)
The Independent Study provides practical training using statistical consultation projects. After a brief introduction of the data, students will check the data, perform preliminary data analysis, orally present their statistical approach, modeling, findings, and interpretation of the result, and write a report. Students will be evaluated by the quality of their oral presentation and project report.

BIOSTAT 501-0 Advanced Epidemiology (1 Unit)
This course builds on material learned in previous Biostatistics and Epidemiology courses. Concepts are applied to the design, implementation, analysis, and interpretation of observational epidemiologic studies (cross-sectional, case-control and cohort). Students enrolled in a degree program outside of the MS in Biostatistics must have the consent of the instructor.
Prerequisites: BIOSTAT 305-0, BIOSTAT 401-0, BIOSTAT 402-0.

BIOSTAT 502-0 Advanced Biostatistics (1 Unit)
This course covers analysis of correlated response data arising from longitudinal studies. Concepts include marginal and mixed-effects regression models for continuous and discrete outcomes measured repeatedly over time, model building techniques, robust inference procedures and problems associated with missing data. All modeling and numerical analyses will be done using SAS.
Prerequisites: BIOSTAT 302-0, BIOSTAT 305-0, BIOSTAT 402-0, or instructor approval.

BIOSTAT 521-0 Survival Data Analysis (1 Unit)
This courses provides an introduction to the fundamental concepts and methods developed for analysis of survival data for which incompleteness, including censoring, is a primary feature. Classic non-parametric estimation approaches will be discussed, as will semi-parametric and parametric hazard regression modeling techniques that

allow incorporation of covariates. Analysis examples using both R and SAS will be discussed.
Prerequisite: BIOSTAT 403-0.

BIOSTAT 522-0 Network Data Analysis (0.5 Unit)
This course introduces analytic methods and computational resources for network data analysis. It provides an overview dealing computationally with graph and network data structures, describing networks through node and edges statistics and overall topology, and identifying cliques and clusters in graphs. Gaussian graphical models, subnetwork identification and differential network analysis will be introduced.
Prerequisites: BIOSTAT 302-0, BIOSTAT 306-0, BIOSTAT 402-0.

BIOSTAT 527-0 Statistical Methods for Missing Data (0.5 Unit)
This course provides students with a basic knowledge of the potential implications of missing data on their data analyses as well as potential solutions. A major focus of the course is multiple imputation including discussions of the general framework, different models and algorithms, and the basic theory. Statistical programming is performed in R.
Prerequisites: BIOSTAT 306-0, BIOSTAT 402-0, BIOSTAT 403-0.

BIOSTAT 529-0 Statistical Genetics and Genomic Data Analysis (0.5 Unit)
This course equips students with key principles and practical skills to analyze genetic data. Topics range from linkage analysis using pedigree data to machine learning techniques using next-generation sequencing data. Statistical programming is performed in R.
Prerequisites: BIOSTAT 306-0, BIOSTAT 403-0, or instructor approval.

BIOSTAT 560-0 Statistical Consulting (0.5 Unit)
This course prepares students for collaboration and communication with scientists of various disciplines, emphasizing analytical tools, verbal and written communication skills and presentation skills. Concepts include sample size and power calculation, handling of various data structures, data presentation, selecting appropriate statistical methods, time and project management, reproducible research, report writing and grant writing.
Prerequisites: BIOSTAT 302-0 and BIOSTAT 402-0.

BIOSTAT 561-0 Thesis (0.5 Unit)
All MS in Biostatistics students are required to submit a master's thesis focusing on a collaborative data analysis or a statistical methodology advancement. Thesis projects are proposed in the fall, and content is developed primarily in late fall / winter. Written, poster and oral presentations are due in the spring.

BIOSTAT 565-0 Clinical Database Management (0.5 Unit)
This course serves as an introduction to data management in the clinical research setting. The Research Electronic Data Capture (REDCap) platform is used to understand basic database design, data management and quality monitoring concepts for studies ranging from simple cross-sectional designs to complex multi-center clinical trials. Students enrolled in this course must complete CITI training through the Northwestern University IRB Office before the first class session.