Biostatistics & Genetic Epidemiology

The biostatistics education programs offered by the Division of Biostatistics include three master’s degrees and two graduate certificates: the Master of Science in Biostatistics (https://biostatistics.wustl.edu/education/master-of-science-in-biostatistics-msibs-2/) (MSIBS), the Master of Science in Biostatistics and Data Science (https://biostatistics.wustl.edu/education/master-of-science-in-biostatistics-msibs/) (MSBDS), the Master of Science in Genetic Epidemiology (https://biostatistics.wustl.edu/education/master-of-science-in-genetic-epidemiology-gems/) (GEMS; for postdocs only), the Certificate in Genetic Epidemiology (https://biostatistics.wustl.edu/education/certificate-in-genetic-epidemiology/), and the Certificate in Biostatistics and Data Science (https://biostatistics.wustl.edu/education/certificate-in-biostatistics-and-data-science/). Interested students may pursue individual courses offered by the division.

The Washington University School of Medicine is known for being at the forefront of medical research and primary care; the school engages students in research and practical training so that they can contribute to improving health outcomes. Our programs train students as critical thinkers and collaborators in biostatistics, genetics, and data science. We seek those with undergraduate degrees in the quantitative and biomedical sciences, including fields such as mathematics, statistics, computer science, informatics, and biomedical engineering.

Our programs are designed to teach students how to manage, analyze, and interpret health data using statistical and data science approaches. Internationally renowned faculty from multiple disciplines — including biostatistics, genetics, informatics, medicine, and public health — will train a new generation of quantitative scientists. The curriculum offers a unique training experience that combines core data science learning in statistical and computational methodologies with practical training in real-world data analysis of cutting-edge biomedical and genomics research.

NIH-Sponsored Training Program

The PRIDE Summer Institute in Cardiovascular Genetics and Epidemiology (CVD-CGE) focuses on cardiovascular and other heart, lung, blood, and sleep disorders. This all-expenses-paid summer institute is supported by funding from the National Heart, Lung, and Blood Institute. The goal is to mentor junior faculty from underrepresented minorities as well as faculty with disabilities into independent research careers in the biomedical sciences. For more information, visit the PRIDE CVD-CGE website (https://biostatistics.wustl.edu/education/pridecge/) or email the program administrator (schreierl@wustl.edu).

Academic Calendar

The academic programs begin in early July each year. They start with preparatory workshops, which are followed by intensive summer semester courses. For fall and spring courses, the program follows the Washington University academic calendar (http://bulletin.wustl.edu/washu/calendar/).

Location

The program is located in the Division of Biostatistics, which can be found on the fifth floor of the Bernard Becker Medical Library (660 S. Euclid Ave., St. Louis, MO 63110) in rooms 500 through 508.

Additional Information

Kim Freels
Program Manager
Phone: 314-362-1384
Email: kfreels@wustl.edu

Treva Rice, PhD
Interim Program Director
Email: treva@wustl.edu

Lei Liu, PhD
Associate Program Director
Email: lei.liu@wustl.edu

Washington University School of Medicine
Biostatistics Education Programs
Division of Biostatistics
660 S. Euclid Ave., CB 8067
St. Louis, MO 63110-1093

Phone: 314-362-1384
Email: OHIDS-Education@wustl.edu
Website: https://biostatistics.wustl.edu

Degrees & Offerings

- Master of Science in Biostatistics (http://bulletin.wustl.edu/medicine/degrees-offerings/msibs/)
- Master of Science in Biostatistics and Data Science (http://bulletin.wustl.edu/medicine/degrees-offerings/msbds/)
- Certificate in Biostatistics and Data Science (http://bulletin.wustl.edu/medicine/degrees-offerings/biostats-data-science-cert/)
- Certificate in Genetic Epidemiology (http://bulletin.wustl.edu/medicine/degrees-offerings/genetic-epidemiology-cert/)

Research

Master’s students have multiple opportunities to engage in biomedical research. After completing the first summer semester, students in the MSIBS and MSBDS program are eligible to work as part-time research assistants. These positions are frequently available, both within the Division of Biostatistics as well as in other departments and research institutions.
labs on the Medical School campus. In addition, depending on the degree program, students will intern and/or work on an independent mentored research project to hone their research skills, including study design, data analysis, and interpretation. GEMS students will work on a mentored research project to explore and characterize the interplay between genes and the environment that affects the biological processes underlying disease.

**Faculty**

Randi Foraker, PhD ([https://informatics.wustl.edu/research-lab-randi-foraker/](https://informatics.wustl.edu/research-lab-randi-foraker/))
Division Interim Director
Visit our website for more information about our faculty ([https://biostatistics.wustl.edu/faculty-staff/](https://biostatistics.wustl.edu/faculty-staff/)) and their appointments.

**Courses**

Visit online course listings to view offerings for M21 MSB ([https://courses.wustl.edu/CourseInfo.aspx?sch=M&dept=M21](https://courses.wustl.edu/CourseInfo.aspx?sch=M&dept=M21)).

**M21 MSB 503 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. Contact the Program Managers for details, to register or to obtain permission of the Course Master (biostat-msibs@email.wustl.edu).
Credit 2 units.

**M21 MSB 506 Introduction to R for Data Science**

This is an introduction to the R Statistical Environment for new users. R is “a freely available language and environment for statistical computing and graphics which provides a wide variety of statistical and graphical techniques: linear and nonlinear modeling, statistical tests, time series analysis, classification, clustering, etc.” The goal is to give students a set of tools to perform statistical analysis in medicine, biology, or epidemiology. At the conclusion of this primer, students will be able to manipulate and analyze data, write basic models, understand the R environment for using packages, and create standard or customized graphics. This primer assumes some knowledge of basic statistics as taught in a first-semester undergraduate or graduate sequence. Topics should include: probability, cross-tabulation, basic statistical summaries, and linear regression in either scalar or matrix form. Contact the program manager (biostat-msibs@email.wustl.edu) for details, to register, or to obtain permission from the course director.
Credit 2 units.

**M21 MSB 512 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. Contact the program manager for details, to register, or to obtain permission of the course director (by email (biostat-msibs@email.wustl.edu) or phone: 314-362-1384).
Credit 2 units.

**M21 MSB 515 Fundamentals of Genetic Epidemiology**

In this course, 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 for the hands-on practice of fundamental concepts. Students will gain practical experience with various genetics computer programs (e.g., SOLAR, MERLIN, QDT, PLINK). Auditors will not have access to the computer lab sessions. Prerequisite: M21 506. Contact the program manager for details, to register, or to obtain permission from the course master (biostat-msibs@email.wustl.edu).
Credit 3 units.

**M21 MSB 5483 Human Genetic Analysis**

Basic Genetic Concepts: meiosis, inheritance, Hardy-Weinberg equilibrium, linkage, segregation analysis; Linkage Analysis: definition, crossing over, map functions, phase, LOD scores, penetrance, phenocopies, liability classes, multipoint analysis, nonparametric analysis (sibpairs and pedigrees), quantitative trait analysis, determination of power for Mendelian and complex trait analysis; Linkage Disequilibrium Analyses: allelic association (case control designs and family bases studies), QQ and Manhattan plots, whole genome association analysis; population stratification; Quantitative Trait Analysis: measured genotypes and variance components. Hands-on computer lab experience doing parametric linkage analysis with the program LINKAGE, model free linkage analyses with GeneHunter and Merlin, power computations with SLINK, quantitative trait analyses with SOLAR, LD computations with Haploview and WGAViewer, and family-based and case-control association analyses with PLINK and SAS. The methods and exercises are coordinated with the lectures, and students are expected to understand underlying assumptions and limitations and the basic calculations performed by these computer programs. Auditors will not have access to the computer lab sessions. Prerequisite: M21-515 Fundamentals of Genetic Epidemiology. For details, to register, and to receive the required permission of the course director, contact the MSIBS program manager (by email (biostat-msibs@email.wustl.edu) or phone: 314-362-1384).
Same as L41 Biol 5483
Credit 3 units.

**M21 MSB 550 Introduction to Bioinformatics**

This course provides 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 they will acquire understanding of mathematical algorithms in genome sequence analysis (alignment analysis, gene finding/predicting), of gene expression microarray (genechip) analysis, and of the impact of recent developments in protein microarray technology. Prerequisite: M21 506. Contact the program manager for details, to register, or to obtain permission from the course master (biostat-msibs@email.wustl.edu).
Credit 3 units.
M21 MSB 560 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. Prerequisite: M21 503 Statistical Computing with SAS®, or student must have good practical experience with SAS®. Students are required to participate in the "Computing/Unix" workshops offered free of charge prior to this course. For details, to register, and/or to obtain the required permission of the course master, contact the program manager at ohids-admissions@wustl.edu. Credit 3 units.

M21 MSB 570 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 toward encouraging a critical reading of the medical literature. Both in-class examples and homework assignments will involve extensive use of SAS. Prerequisite: M21 560, Biostatistics I or its equivalent as judged by the course directors. For details, to register, and/or to obtain the required permission of the course director, contact the program manager (by email (biostat-msibs@email.wustl.edu) or phone: 314-362-1384). Credit 3 units.

M21 MSB 600 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 masters will submit a one-page Abstract of the work performed as part of the Internship. 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 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 masters will submit a one-page Abstract of the work performed as part of the Internship. 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 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 masters will submit a one-page Abstract of the work performed as part of the Internship. 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 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 masters will submit a one-page Abstract of the work performed as part of the Internship. 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 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 masters will submit a one-page Abstract of the work performed as part of the Internship. 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 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 masters will submit a one-page Abstract of the work performed as part of the Internship. 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 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 masters will submit a one-page Abstract of the work performed as part of the Internship. 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 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 masters will submit a one-page Abstract of the work performed as part of the Internship. 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 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 masters will submit a one-page Abstract of the work performed as part of the Internship. 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 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 masters will submit a one-page Abstract of the work performed as part of the Internship. 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 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 masters will submit a one-page Abstract of the work performed as part of the Internship. 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 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 masters will submit a one-page Abstract of the work performed as part of the Internship. 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 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 masters will submit a one-page Abstract of the work performed as part of the Internship. 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 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 masters will submit a one-page Abstract of the work performed as part of the Internship. 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 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 masters will submit a one-page Abstract of the work performed as part of the Internship. 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 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 masters will submit a one-page Abstract of the work performed as part of the Internship. 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 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 masters will submit a one-page Abstract of the work performed as part of the Internship. 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 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 masters will submit a one-page Abstract of the work performed as part of the Internship. 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 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 masters will submit a one-page Abstract of the work performed as part of the Internship. 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 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 masters will submit a one-page Abstract of the work performed as part of the Internship. 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 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 masters will submit a one-page Abstract of the work performed as part of the Internship. 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 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 masters will submit a one-page Abstract of the work performed as part of the Internship. 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 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 masters will submit a one-page Abstract of the work performed as part of the Internship. 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 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 masters will submit a one-page Abstract of the work performed as part of the Internship. 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 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 masters will submit a one-page Abstract of the work performed as part of the Internship. 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 presentat