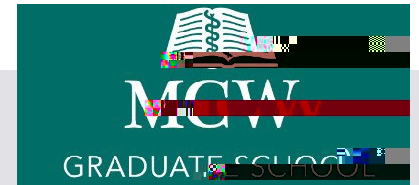## 2024-25
BIOSTATISTICS
Degree Offered: Doctor of Philosophy

Program Description

The PhD program in Biostatistics is designed for students having strong quantitative and computing skills with interest in applying cutting-edge biostatistical research techniques to biological and medical sciences. In this program, students will receive in-depth training on theoretical/methodological/collaborative research in biostatistics and the use of state-of-the-art software. The Division of Biostatistics is a highly collaborative unit and provides lots of opportunities to participate in numerous research projects within MCW and its affiliates.

Admission Requirements

In addition to the general Graduate School admission requirements, this program has additional specific requirements.

Any graduate of an accredited college or university with an undergraduate degree in mathematics or closely related fields with strong preparation in mathematics is eligible for admission. Applicants are expected to have completed and performed well in courses in advanced calculus, linear/matrix algebra, and scientific programming. Those who haven't done so may be considered for admission to the program upon approval of the biostatistics admission committee, and if admitted, these requirements must be completed during the first year of study. In addition, the applicant must have strong interest in pursuing statistical research in biomedical sciences.

Fields of Study

- x Survival and competing risks data analysis
- x Big data analysis
- x High dimensional data analysis
- x Bayesian statistics and Bayesian machine learning
- x Clinical trials
- x Machine learning
- x Statistical genetics
- x Bioinformatics
- x Personalized medicine, causal inference
- x Image data analysis
- x Missing data

Credits Required to Graduate

60 credits minimum

BIOE 10222 Ethics and Integrity in Science. *1   credit.*
This course provides the basis for understanding the ethical issues related to basic scientific and medical research, including animal and human subject research, fraud, and misconduct, and governmental, institutional, and researcher responsibilities. Bioethics   10222 is offered during the spring and summer terms   only.

BIOS 04231 Statistical Models and Methods I. *3 credits* .
Prerequisite: Three semesters of calculus and one semester of linear algebra

BIOS 04285 Introduction to Bayesian Analysis. *3 .5 credits.*
Prerequisites: 04231 Statistical Models and Methods I
This course introduces basic concepts with computational tools f22.63 8s

BIOS 04385 Advanced Bayesian Analysis. *3.5 credits.*
Prerequisites: Introduction to Bayesian Analysis, Applied Survival Analysis
A combination of advanced Bayesian principles, tools and methods. Emphasis is on modern computations for parametric and nonparametric models with a deeper dive into NIMBLE/Stan and state-of-the-art sampling techniques, convergence diagnostics, goodness-of-fit, etc. Topics include Bayes factors, HPD regions, conjugate/non-informative priors, the generalized linear models, hierarchical/mixed models, multivariate data, restricted parameter spaces/time-to-event analysis with censored data, Dirichlet Process Mixtures, Gaussian Processes, Bayesian Additive Regression Trees (BART), advanced computational techniques like stochastic gradient descent and illustrative examples of Bayesian analyses for complex biomedical data.

BIOS 04386 Theory of Survival Analysis. *3 credits.*
Prerequisites: 04275 Applied Survival Analysis, Statistical Inference II*
Thiscourse will provide students with a solid foundation in both classical and modern theory of survival analysis including mathematical theory of counting processes, martingales, and empirical processes; asymptotic properties for estimation of the survival, cumulative hazard, and cumulative incidence functions; extensions of k-sample nonparametric tests to survival data; sample size and power calculation; proportional hazards, additive hazards, and proportional subdistribution hazards regression models; multivariate survival analysis; methods for high dimensional data analysis and machine learning may also be covered.

BIOS 04399 Doctoral Dissertation. *1-9 credit(s).*
This course is required for the completion of the PhD degree. The PhD candidate must submit a dissertation based on original research of a high scholarly standard that makes a significant contribution to knowledge in their chosen field.

BIOS 24150 Bioinformatics in Omics Analysis. *3 credits.*
Prerequisites: 04231 Statistical Models and Methods I and 04224 Biostatistical Computing, or consent of instructor.
The course aims to introduce modern statistical and computational methods in high-throughput data analysis. The first half of the course focuses on fundamental statistical and computational methods applicable in different types of high-throughput omics data. The second half covers selected important topics in bioinformatics and aims to give students a systematic view of the omics data analysis. The goals of the course include: (1) to motivate students from quantitative fields into omics research (2) to familiarize students from biological fields with a deeper understanding of statistical methods (3) to promote inter-disciplinary collaboration atmosphere in class. Students are required to have a basic statistical training (i.e., elementary statistics courses, basic calculus, and linear algebra) and basic programming proficiency (R programming is required for homework and the final project).

*Taken at UW -Milwaukee

Courses taken at UW -Milwaukee
MTHSTAT 871 Mathematical Statistics I. *3 credits.*
MTHSTAT 872 Mathematical Statistics II. *3 credits.*

BIOS 04002 Master's Thesis Continuation.   *0 credits.*
Prerequisite: 04299 Master's Thesis
This is a form of registration available to students who have completed all of the required coursework, including thesis credits but have not yet completed the writing of the Thesis. Continuation   status is limited to three consecutive terms following the completion of Thesis credits.

BIOS 04003 Doctoral Dissertation Continuation.   *0 credits.*