GRADUATE PROGRAMS IN BIOSTATISTICS

Student Handbook

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Introduction

This handbook is intended for students entering the graduate programs in the Division of Biostatistics in the Institute for Health and Society at the Medical College of Wisconsin. It describes the programs, including detailed course requireme pursuit of a graduate degree in the Division.

The College

The Medical Co

In 2011, the Liaison Committee on Medical Education (LCME) awarded full, eight-year accreditation to the -Medical College, the maximum period of accreditation. The LCME is the -accrediting body of all U.S medical schools.

The Graduate School of Biomedical Sciences

Programs of graduate study in biomedical sciences have been an integral part of the Medical College

- x An average of 80% or greater on the scores of the Quantitative and Verbal components, of the Graduate Record Examination (GRE): <u>http://www.ets.org/gre</u>. Tests must have been taken within five years from the date of application.
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A -based, non-online degree granting program are required to take either an International English Language Testing System (IELTS) or a Test of English as a Foreign Language (TOEFL): <u>http://www.ets.org/toefl</u>. For TOEFL, our Institution Code is 1519, Department code is 0000 (or leave the department code blank). A score of 100 or higher on the internet-based version of the TOEFL or a score of 6.0 or higher on the IELTS is recommended for competitive consideration.

Applicants are also expected to have completed courses in advanced calculus, linear/matrix algebra and scientific programming with minimum grade of B in each of these courses. Those who have not 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 to the above requirements, the applicant must have strong interest in pursuing research in biomedical sciences.

Financial Support

Every entering full time student is supported year round by a Fellowship for the first four semesters (fall and spring of the first year, summer and fall of the second year), followed by a Research Assistantship or a Teaching Assistantship for the remaining part of the program, for a maximum of 5 total years of support. The research assistantships provide students with the opportunity to gain experience in statistical consulting and collaborative research. Both types of support include the cost of tuition and fees, a stipend to cover living expenses, and an allowance toward health insurance. The stipend for the academic year 2023-2024 is \$33,612. The college provides the health insurance to all stipend students, with additional benefits for dental and vision coverage requiring a nominal cost for dental and vision coverage.

During the fellowship period the student is expected to give full time effort to graduate studies, taking minimum 9 credit hours of coursework per semester in the Fall and Spring, and 6 credit hours in the Summer. As a Research Assistant, the student works 20 hours per week on research projects under faculty supervision.

General participation in the activities of the Division and the Graduate Student Association via committee memberships and volunteering is greatly encouraged.

Student Advising

Upon entering the program, the Director of Graduate Studies serves as the st until the student identifies a dissertation advisor with mutual agreement usually at the beginning of

of Graduate Studies and the Division Director. Dissertation advisors are typically chosen from the senior faculty. A junior faculty member who has not previously served as dissertation advisor may do so, provided a more experienced faculty member is chosen as co-advisor. Students are required to spend time reading with two faculty members prior to selecting a dissertation advisor.

requirement are:

BIOE 201 Medical Ethics	2 credits
BIOE 232 Ethics, Policy and Genetic Technology	2 credits
BIOP 215 Medical Physics	1 credit
CDBI 31150 Introductory Cell Biology	1 credit
CDBI 31	

In close consultation with the advisor, the student forms the Dissertation Committee in full accordance with the requirements of the Graduate School. The committee consists of five graduate faculty members including the advisor. Four of the five must be from the Division of Biostatistics (including Joint and Adjunct faculty) and one must be from outside the Division of Biostatistics. The committee must be approved by the Director of Graduate Studies and the Division Director. The process of committee formation, including submission of the appropriate

04240: Statistical inference I	04220: Research Seminar	
Elective or Bioethics		
Fall 2:	Spring 2:	Summer 2:
04233: Statistical/Machine	04275: Applied Survival	04295: Readings &
Learning	04385: Advanced Bayesian	Research
04313: Adv. Statistical Computing	Analysis	Bective
04363: Advanced Statistics	04220: Research Seminar	
24150: Bioinformatics in Omics	04295: Readings & Research	
Analysis	Elective or Bioethics	
04220: Research Seminar		
04295: Readings & Research		
Fall 3:	Spring 3:	Summer 3:
04386: Theory of Survival Analysis	04365: Linear Models	04295: Readings &
04220: Research Seminar	04384: Statistical Genetics	Research
04295: Readings & Research	04220: Research Seminar	Bective
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	Bective	

Typical sequence for the completion of required courses (starting in odd year)

Fall 1:	Spring 1:	Summer 1:
04224: Biostat Computing	04232: Models & Methods II	04222: Statistical
04231: Models & Methods I	04241: Statistical inference II	Consulting
04220: Research Seminar	04275: Applied Survival	04295: Readings &
04240: Statistical inference I	04221: Biomedical Applications	Research
Elective or Bioethics	and Consulting	
	04220: Research Seminar	
Fall 2:	Spring 2:	Summer 2:
04214: Oinical Trials	04285: Intro. Bayesian Analysis	04295: Readings &
04233: Statistical/Machine	04365: Linear Models	Research
Learning	04384: Statistical Genetics	Bective
04386: Theory of Survival Analysis	04220: Research Seminar	
24150: Bioinformatics in Omics	04295: Readings & Research	
Analysis	Elective or Bioethics	
04220: Research Seminar		
04295: Readings & Research		
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Dissertation Research Requirements

The student begins his/her dissertation research during the third year. The initial step consists of identifying a topic that is of mutual interest to the student and a member of the faculty who serves as the dissertation advisor. Courses, talks and presentations by the faculty assist the student in this

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3 credits
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3 credits
3 credits
3 credits
3 until spring, 2024; 3.5 credits
from fall, 2024
3 credits
3 credits

B. Writing Requirement. Students are required to write a thesis. Topics could be statistical methodology development, statistical simulation studies, or

Credit Requirements

Students must complete at least 31 credit hours of coursework. The curriculum consists of 8 core, required biostatistics courses which have been identified as an essential knowledge base for all students in the program. Also required, is an Ethics and Integrity in Science course. The capstone project course can be taken throughout multiple semesters but at least 3 credit hours are required for graduation. The program allows for students to choose two or more elective courses which best reflect their personal interests. Students may pursue the degree on a full-time or part-time basis.

Required Courses (25 credits)

BIOE 10222 Ethics and Integrity in Science	1 credit
BIOS 04224 Biostatistical Computing	3 credits
BIOS 04221 Biomedical Applications and Consulting	3 credits
BIOS04231 Statistical Models and Methods I	3 credits
BIOS04232 Statistical Models and Methods II	3 credits
BIOS 04233 Introduction to Statistical and Machine Learning	3 credits
BIOS24160 Concepts in Probability and Statistics	3 credits
BIOS 24150 Bioinformatics in Omics Analysis	3 credits
BIOS 24297 Capstone Project	3 credits

Elective Courses (at least 6 credits)

BIOS04214* Design and Analysis of Clinical Trials	3 credits
BIOS04285* Introduction to Bayesian Analysis	3 credits
BIOS04275* Applied Survival Analysis	3 credits
BIOS04222 Statistical Consulting	3 credits
PUCH 19210 Health and Medical Geography	3 credits
PUCH 19229 Survey Research Methods	3 credits
PUCH 19150 Introduction to Epidemiology	3 credits
CTS 20151 Introduction to Epidemiology	3 credits
PUBH 18201 Principles of Epidemiology (online)	3 credits

* NOTE: One of the three elective courses - either BIOST 04214, or 04285, or 04275 - is required.

Description of Courses

04200 Biostatistics I. *3 credits.* This is an introductory course in

mathematical level. Topics include introduction to study designs, descriptive statistics, probability, estimation, test of hypothesis, regression and correlation.

04214 Design and Analysis of Clinical Trials. 3 credits.

Prerequisites: Statistical Models and Methods I or concurrent registration

This course covers topics in clinical trials including the clinical trial protocol; sources of bias in treatment evaluation; blinding; randomization; sample size and power calculation; phase I, phase II, phase III and hybrid trials; covariate adjustment; interim analysis; stochastic curtailment; safety monitoring; factorial and crossover designs.

04220 Research Seminar. 1 credit.

Prerequisites: Concurrent registration

Students present plans for an analysis of research projects and research data. Projects and examples from classical and current literature are discussed by students and faculty.

04221 Biomedical Applications and Consulting. 3 credits.

Prerequisites: Statistical Models and Methods I

Theory of consulting, communication, and statistical techniques most often used in consulting and biomedical applications, practical experience in the real consulting setting and writing statistical reports.

04222 Statistical Consulting. 1-3 credit(s).

Prerequisites: Statistical Models and Methods I & II

This course is designed for students to gain experience in statistical consulting by working with the biostatistics faculty members on various consulting projects.

04224 Biostatistical Computing. 3 credits.

Prerequisites: Statistical Models and Methods I or concurrent registration This course will cover the details of manipulating and transforming data required for graphical displays and/or statistical analysis. It will cover the techniques necessary to write R functions and SAS macros for developing new/modified data analysis methods. Students are expected to be somewhat facile in the use of computers before they take this course. UNIX/Linux and working with a cluster are also emphasized. SQL, C/C++ and LaTeX will be introduced as time permits.

04231 Statistical Models and Methods I. 3 credits.

Prerequisite: Three semesters of calculus and one semester of linear algebra This course will cover statistical techniques for basic statistics. Topics include one-sample/two-sample tests, analyses for count data and contingency tables, basic nonparametric methods including sign/ranksum/signedQq0.00000912 0 612 792 reW* nBT/F1 11.04 Tf1 0 0 1 72.024 206./0eG[W* n BD1 15(n)4(9 Tm0 gs,sa)9(m)m

04233 Introduction to Statistical and Machine Learning. 3 credits.

Prerequisite: Statistical Models and Methods II

This course will provide an introduction to statistical learning. Core topics include variable selection, penalized linear regression such as lasso, dimension reduction including principal component analysis, flexible regression techniques including kernel smoothing/smoothing splines/generalized additive models/regression trees, support vector machine, clustering, random forests, and deep learning. Other topics that can be covered include but are not limited to ridge regression, group lasso, fused lasso, adaptive lasso, SCAD, Bayesian lasso, Bayesian group lasso, Bayesian CART, BART, neural network, feature screening, graphical models, boosting, and quantile regression.

MTHSTAT 761 * Mathematical Statistics I. 3 credits. (UWM registration)

Fundamentals of probability, independence, distribution and density functions, random variables, moments and moment-generating functions, discrete and continuous distributions, exponential families, location and sca9q0.0.03(, in2 2 08-2(lu)16(ste)-3(rin)6(g)4(T)5(u)3(es)-4(in)5(d 1 72.[. 2 re16(ste)-3(rin)5(m)0 G[g)4(en)

This course introduces basic concepts with computational tools for Bayesian statistical methods extolling the dynamism of the likelihood, prior, posterior and predictive distributions. Topics covered include one and two sample inference, regression models and comparison of several populations with normal, dichotomous and count data. An introduction to modern Bayesian software such as NIMBLE and

computations for parametric and nonparametric models with a deeper dive into NIMBLE/Stan and state-of-the-

24297 Capstone Project. 3 credits

Prerequisites: Statistical Models and Methods II

The course is the culmination of the MA program in Biostatistics. Students will complete a project integrating their statistical analysis, data science, and application domain knowledge. A large and complex dataset will be provided to learners, and the analysis will require the application of a variety of methods and techniques introduced in the previous courses, including exploratory data analysis through data visualization and numerical summaries, statistical inference, and modeling as well as interpretations of these results in the context of the data and the research question. The project results

about statistics and data science in written and oral form using both technical and nontechnical language. In addition, the project will enable students to expand their professional portfolio of coding samples, written reports and presentations. Faculty & Their Research Interest:

The Division of Biostatistics currently has 17 full-time faculty members, 1 adjunct faculty member, all dedicated to specific areas of statistical methodology. Please visit their personal faculty pages on the Biostatistics webpage here: https://www.mcw.edu/departments/biostatistics/people/faculty

Kwang Woo Ahn, PhD, Professor

The University of Iowa (Statistics) 2008

Professor Kwang Woo Ahn joined the Division of Biostatistics in August 2008. His research interests include survival/competing risks data analysis, missing data, high dimensional data analysis, and statistical/machine learning. For collaborative research, he has been collaborating with CIBMTR. Dr. Ahn published more than 100 methodology and collaborative papers.

Paul L. Auer, PhD, Professor

Purdue University (Statistics) 2010

Dr. Paul Auer is a Professor in the Division of Biostatistics at the Medical College of Wisconsin and the Director of the Biostatistics Shared Resource at the Froedtert and Medical College of Wisconsin Cancer Center. He joined the division in the Summer of 2021. Dr. Auer's research expertise is in statistical genetics and the analysis of complex genomic data. His work has focused on the analysis of rare genetic variation and its influence on complex traits, large-scale meta-analyses, multi-omic data analysis, imputation of genetic data in Qq0.014(c)8(0u2 0 0 0 14 dat4(cr9 1 .04 TJET 612 es)P99 Ts00000t 1 725 Tm0 1 418575.26

Professor Ruta Brazauskas joined the Division of Biostatistics in June 2008 coming from the Marquette University where she served as Assistant Professor. Her research interests include survival analysis and competing risks. Most recent methodological work on the issues of paired studies in survival analysis was funded by the CTSA supplemental grant awarded to a group of faculty members at the Division.

Zhongyuan Chen, Assistant Professor Rice University (Statistics) 2019 Dr. Zhongyuan Chen is an Assistant Professor techniques such as 3C/ ChIP/ RT-qPOR, 3D-FISH and CRISPR/ Cas9; 3) Adapting/ applying genome-wide omics-seq techniques in patient tissues to identify epigenetic-driven therapeutic targets and biomarkers.

Purushottam W. (Prakash) Laud, PhD, Professor (Adjunct)

University of Missouri-Columbia (Statistics) 1977

Professor Laud joined the Division of Biostatistics in the spring of 1994. He was previously in the Department of Mathematical Sciences at Northern Illinois University. His methodological research has spanned many areas of Bayesian statistics: nonparametric models for survival analysis, model selection in linear and generalized linear models, computational methods, semi-parametric models for

Rodney Sparapani, PhD, Associate Professor

Medical College of Wisconsin (Biostatistics) 2011

Dr. Sparapani joined the Division of Biostatistics in December 2013 coming from the Center for Patient Care and Outcomes Research (currently Center for Advancing Population Science) at MCW where he served as the Sr. Biostatistician. His research focuses on applying Bayesian methodology to modern biostatistical problems such as survival analysis, health services research, causal inference, comparative effectiveness research and big data/omics.

Aniko Szabo, PhD, Professor

The University of Memphis (Applied Statistics) 1998

Aniko Szabo is Associate Professor and Director of the Biostatistics Consulting Service. She joined the Division of Biostatistics in the summer of 2007. Prior to joining the Medical College of Wisconsin, she was an Assistant Professor at the Huntsman Cancer Institute and Department of Oncological Sciences at University of Utah. Dr. Szabo's research interests are in statistical modeling of biomedical data. She has worked on developing tree models of oncogenesis, nonparametric models of clustered discrete data, and population level models of the effect of screening on prostate cancer incidence.

Sergey Tarima, PhD, Associate Professor

University of Kentucky (Statistics) 2005

Professor Tarima joined the Division of Biostatistics in the fall of 2005. In a pre-doctoral position he worked on missing data problems in the Injury Research Center at the University of Kentucky. Professor Tarima's current research interests include methods for using additional information in statistical estimation, estimation with missing, censored and partially grouped data, and survey data analysis.

Kai Yang, PhD, Assistant Professor

University of Florida (Biostatistics) 2021 Dr. Yang is an Assistant Professor024 400.2730 has close collaborations with biomedical scientists as well as other statisticians, data scientists and mathematical modelers.