REQUEST FOR AUTHORIZATION TO IMPLEMENT A
MASTER OF SCIENCE IN BIOSTATISTICS
AT THE UNIVERSITY OF WISCONSIN (UW)-MILWAUKEE
PREPARED BY UW-MILWAUKEE

ABSTRACT

The University of Wisconsin-Milwaukee (UW-Milwaukee) proposes to establish a Master of Science (M.S.) in Biostatistics. The development of this proposed program responds to ongoing public health challenges in Wisconsin, as well as critical workforce needs in Wisconsin and nationally. The addition of this M.S. degree program in Biostatistics, an indispensable discipline in the field of public health, will provide training opportunities to meet the local and national needs for skilled biostatisticians. The goal of the proposed program will be for students to acquire rigorous theoretical and technical training needed to provide statistical consultation and perform data analysis. Graduates will be prepared for many career paths, including academia, managed care organizations, the pharmaceutical industry, and public service at all levels of local, national and international government. The proposed program will be comprised of 42 credits, comprised of 39 credits of course work and 3 credits of thesis. The curriculum meets the requirements outlined by the national Council on Education for Public Health (CEPH).

PROGRAM IDENTIFICATION

Institution Name
University of Wisconsin-Milwaukee

Title of Proposed Program
Master of Science in Biostatistics

Degree/Major Designations
Master of Science (M.S.)

Mode of Delivery
Single Institution.
Face-to-face.

Projected Enrollments and Graduates by Year Five
Table 1 represents enrollment and graduation projections for students entering the program over the next five years. By the end of Year 5, it is expected that 65 students will have enrolled in the program and 26 students will have graduated from the program. The average student retention rate is projected to be 85% based on current enrollment data in the master's level program in the Zilber School of Public Health.

It is also anticipated that the program will enroll a mix of in-state (50%) and out- of-state (50%) students.

Table 1. Enrollment and graduation projections from Years 1 to 2

Students/Year	Year 1	Year 2	Year 3	Year 4	Year 5
New Students	7	7	8	8	9
Continuing Students	0	6	6	7	7
Total enrollment	7	13	14	15	16
Graduating Students	0	6	6	7	7

Tuition Structure

For students enrolled in the M.S. in biostatistics program, standard tuition and fee rates will apply. For the current academic year, residential tuition and segregated fees total $5,941.81 per semester for a full-time student enrolled in 8 or more credits per semester. Of this amount, $5,193.36 is attributable to tuition and $748.45 is attributable to segregated fees. Nonresident tuition and segregated fees total $12,460.29 per semester for a full-time student enrolled in 8 or more credits per semester. Of this amount, $11,711.84 is attributable to tuition and $748.45 is attributable to segregated fees. For students in the Midwest Student Exchange program, tuition and segregated fees total $8,538.49. Of this amount, $7,790.04 is attributable to tuition and $748.45 is attributable to segregated fees.

Department or Functional Equivalent
Joseph J. Zilber School of Public Health. The school is non-departmentalized.

College, School, or Functional Equivalent
Joseph J. Zilber School of Public Health.

Proposed Date of Implementation
Fall 2019

DESCRIPTION OF PROGRAM

Overview of the program

In the M.S. in Biostatistics is a two-year program, students must complete 39 graduate credits of courses beyond the bachelor's degree, plus an additional 3 credits dedicated toward thesis writing and research, for a total of 42 credits. Coursework focuses on applied biostatistical methods, statistical consulting, computing, and the intersection of public health and statistical research. Completion of a high-quality master thesis based on original research is a key indicator of the student's capacity to integrate and apply various biostatistical methods and public health knowledge in real world problems.

Student Learning Outcomes and Program Objectives

Graduates of the M.S. in Biostatistics will be able to meet the following program competencies:

1. Perform all responsibilities of a statistician in collaborative research; in particular: design studies, manage and analyze data and interpret findings from a variety of

biomedical, clinical or public health experimental and observational studies
2. Communicate statistical information effectively with individuals with varying degrees of statistical knowledge through written and oral presentations
3. Use statistical, bioinformatic and other computing software to organize, analyze, and visualize data
4. Review and critique statistical methods and interpretation of results in published research studies, presentations, or reports
5. Understand and implement modern statistical approaches emerging in the literature to improve biomedical and public health

Graduates will be prepared to be effective collaborators in many settings, including the biomedical industry, academia, and public service at all levels of national and international government. Students will be trained to lead the design and data analysis of health research studies both in applied and academic settings.

Program Requirements and Curriculum

Applicants with strong quantitative backgrounds are encouraged to apply for the M.S. in Biostatistics. Applicants should have an earned bachelor's degree in any field with a cumulative undergraduate GPA of 3.0. Applicants with a 3.0 (A=4.0) in undergraduate mathematics calculus I and II are preferred. Graduate Record Examination (GRE) scores and three letters of recommendation are required. Students will be asked to identify their primary research areas of interest and faculty with potential shared interests; faculty will be matched to serve as a career mentor and advisor.

The program will meet the above outlined competencies by providing didactic coursework, opportunities to conduct both guided and independent research, and professional development. The curriculum consists of 42 credits to degree completion beyond the bachelor's degree – 39 credits of didactic coursework and 3 credits of independent study toward thesis writing in research. This program meets all of the requirements established by CEPH, including a "rigorous discovery-based paper/project (PH 699), coursework related to scientific and analytic approaches to population-level public health problems, and coursework with an overview of public health (PH 801). Of the 39 total didactic course credits, students will take 30 credits to introduce them to the principles of epidemiology and biostatistical methods and consulting practice (PH 813). The latter course will include training in collaborative research and career development to prepare students for work in public health practice, academic, and biomedical industry settings. The remaining 9 credits include 6 credits of 's'elective coursework in subject matter areas (genomics, clinical trial, biostatistical computing), and 3 credits of coursework in an elective in a public health or biological area that aligns with their research interests. Table 2 below provides a suggested program of study for a full-time student.

Table 2. M.S. in Biostatistics Program Curriculum

Fall 1 (9 credits)
PH702 Introduction to Biostatistics (3 credits)
PH704 Principles & Methods of Epidemiology (3 credits)
PH712 Probability and Statistical Inference (3 credits) (or another elective)
Spring 1 (12 credits)

PH711 Intermediate Biostatistics (3 credits)
PH718 Data Management, Visualization, and Advanced Statistical Computing (3 credits)
PH716 Applied Survival Analysis (3 credits)
PH705 Principles of Public Health Policy & Admin (3 credits) (or another elective)
Fall 2 (12 credits)
PH801 Seminar in Public Health Research (3 credits)
PH715 Applied Categorical Data Analysis (3 credits)
PH717 Applied Longitudinal Analysis (3 credits)
PH714 Statistical Genetics and Genetic Epidemiology (3 credits) (subject matter s'elective)
Spring 2 (9 credits)
PH813 Practice of Biostatistical Consulting (3 credits)
PH990 Master's Thesis (3 credits)
PH721 Intro. To Translational Bioinformatics (3 credits) (subject matter s'lective)

Required Subject Matter "S"electives (Choose two courses, 6 cr.)
PH714 Statistical Genetics and Genetic Epidemiology (3)
PH721 Intro. To Translational Bioinformatics (3)
PH722 An Introduction to Bayesian Statistics (3)
PH723 Clinical Trials (3)
PH812 Statistical Learning and Data Mining (3)
PH818 Statistical Computing (3)
EDPSY823 Structural Equation Modelling (3)
EDPSY832 Theory of Hierarchical Linear Modelling (3)
CS708 Scientific Computing (3)
CS711 Pattern Recognition - Statistical, Neural, and Fuzzy Approaches (3)

Public Health and Biology Courses Electives (Choose 1 course, 3 cr.; other courses as approved)
PH703 Environmental Health Sciences (3)
PH705 Public Health Policy and Administration (3)
PH706 Perspectives in Community and Behavioral Health (3)
BIOL597 RNA structure, function, and metabolism (3)
BIOL490 Molecular Genetics(3)
MCW20240 Translational Genetics (3)
NOTE: Students may apply previous graduate course work towards didactic M.S. credits, contingent on assessment of course equivalencies, in accordance with UW-Milwaukee policies.

Thesis
Near the end of their programs, students will consult with their academic advisor to identify a Biostatistics Track faculty member to be their master's thesis advisor for the applied independent study project. Advising is by mutual agreement between student and faculty member. This faculty

member then supervises and approves the candidate's master thesis. Every student must finalize the thesis advisor and prepare a brief thesis research plan no later than the start of the semester in which the student plans to graduate. It is highly recommended that each student speaks to the potential thesis advisor and find the project of their interest as early as possible. The thesis research plan should include basic background, outline of specific aims and hypotheses, proposed analysis methods, draft timelines, and expected outcomes. Once the approved thesis research and write-up has been completed, the candidate will submit the work to the thesis advisor for review and approval. The candidate will present his/her thesis in a session that is open to the academic community. Once the thesis committee chair has certified completion of all requirements, the candidate will be awarded the M.S. in Biostatistics and encouraged to submit the thesis for publication.

Assessment of Objectives

Student learning outcomes will be assessed both at the course and program level. At the course level, learning objectives will be developed that align with the competencies listed above (see Student Learning Outcomes), and learning will be assessed via problem sets, consulting projects, oral presentations, in-class participation, exams and written assignments. Faculty will also use the thesis research and paper as documentation for the CEPH accreditation criterion for academic master's degree programs.

At the program level, student learning will be assessed through competency self-assessment surveys. Students will provide a self-assessment of competencies achieved at the end of the first year and at the end of the program. Students will discuss progress and future goals for achieving competencies with their faculty advisors. The Zilber School of Public Health staff will also administer an alumni survey at least six months after graduation to ask students how well prepared they were for their positions. The Zilber School Evaluation Workgroup and Graduate Program Committee will summarize survey results, review findings and recommend improvements on a yearly basis.

Diversity

The Zilber School at UW-Milwaukee was founded in 2009 with an explicit commitment to "advancing population health, health equity, and social and environmental justice among diverse communities in Milwaukee, the state of Wisconsin, and beyond." Consistent with this mission, the access mission of the UW-Milwaukee, the UW System Mission, as well as the UW-Milwaukee Select Mission statements, we aim, with this Biostatistics M.S. program, to provide academic opportunities for a diverse student body that reflects the social and racial/ethnic composition of the surrounding community. To this end, we have an explicit goal of recruiting and admitting students from populations that have been systematically underrepresented in higher education including women, financially or educationally disadvantaged individuals and other marginalized groups.

Biostatistics Track faculty also strive to integrate divergent theoretical, methodological, and computational approaches to biostatistical practices that aim to design research studies and translate complex data into meaningful information for a broad range of biomedical and public health applications including genomics, biomarker discovery, electronic medical record, precision medicine, clinical trial, as well as all facets of population health (e.g., chronic

diseases, environmental health, aging, health economics, policy). In addition, the proposed M.S. program explicitly employs pedagogical approaches designed to train students not only to provide biostatistical solutions but also to become effective collaborators to promote health in Milwaukee, Wisconsin, nationally, and worldwide.

Collaborative Nature of the Program

There is strong collaboration across the different biostatistics programs within the Zilber School. The M.S. in Biostatistics shares 16 required credits with the MPH in Biostatistics, and at least 25 credits for the M.S. in Biostatistics could be counted toward the PhD program in Biostatistics. Faculty collaborate across the five program areas at the Zilber School. The proposed M.S. requires 3 credits of epidemiology as well as at least one 3-credit non-Biostatistics elective public health course. There are also increasing efforts to foster collaboration across campus. Depending on research interests, students may enroll in elective coursework in other programs on the UW- Milwaukee campus. The 6 credits of electives could be taken either in the Biostatistics Track or in other programs, such as educational psychology, mathematics, and the mathematical statistics and computer science programs.

Projected Time to Degree

The average time to degree completion for fulltime students is anticipated to be two years beyond the bachelor's degree (see Suggested Course Plan above). Average time to degree completion will be shorter for full-time students who previously earned a master's degree, depending on previous coursework (e.g., one to one and a half years).

Program Review Process

The internal program review process for the M.S. in Biostatistics will involve the annual collection of feedback from faculty and students regarding curriculum, advising, and job placement. Quantitative and qualitative data will be used to improve courses, assess whether students achieved program competencies, measure time to graduation, and provide input about processes. The Zilber School Biostatistics Track faculty, Graduate Program Committee, and Evaluation Workgroup will ensure that a schedule of specific evaluation activities is maintained and that improvement actions are carried out in a timely manner. This review will be coordinated with campus and school accreditation cycles. Review of the Biostatistics M.S. program will also be incorporated into the school's overall evaluation plan, which is designed to provide data for specific measurable objectives and ensure quality improvement.

The M.S. in Biostatistics program will be reviewed in accordance with UW-Milwaukee's graduate program review process. The first full-scale Graduate School review will take place after five years. Zilber School faculty and staff will complete a self- study report of the M.S. program in coordination with the Zilber School Graduate Program Committee, and external reviewers will prepare a site visit report. These materials will be presented to the UW-Milwaukee Graduate Faculty Committee for recommendations.

Accreditation

The Zilber School is currently accredited by CEPH, the accrediting body for schools of public health nationally. Accreditation applies to the school itself rather than to individual programs within the school. The Zilber School is engaged in an ongoing self-study process to

assess and document the extent to which each student has met the competencies outlined for the M.S. in Biostatistics. This process will include student competency self-assessment, graduation, and alumni surveys and interviews with employers. The next self-study process will begin in 2020- 21 for reaccreditation in 2022.

JUSTIFICATION

Rationale and Relation to Mission

An M.S. in Biostatistics in the Zilber School will contribute to fulfilling UWM's mission to be a top- tier research university. The program also aligns well with the UWM Select Mission Statement in the following ways:

- The M.S. in Biostatistics will be a high-quality degree delivered by faculty with established success in research and teaching. A master's-level research degree in biostatistics is an important offering for the only comprehensive school of public health in Wisconsin.
- Master's-level statisticians and biostatisticians are a critical component of many research teams. The M.S. in Biostatistics will help to fulfill the need for this skill set in research efforts at UWM and beyond.
- Biostatistics is an extremely marketable degree, which will attract high-caliber students interested in pursuing careers in a wide range of settings, including government, hospital systems, and pharmaceutical companies.
- Projects and internships undertaken by M.S. students in local organizations, such as health departments or hospital systems, will help to build relationships between those organizations and the Zilber School as well as at UWM as a whole.

Institutional Program Array

The Zilber School offers both applied public health and research-focused degrees through five program areas: Epidemiology, Community and Behavioral Health Promotion, Biostatistics, Public Health Policy and Administration, and Environmental Health Sciences. The school currently offers an MPH degree with a specialization in each of the above areas. It also offers a PhD in Public Health with a focus in either Community and Behavioral Health or Biostatistics, a PhD in Epidemiology, as well as a PhD in Environmental Health Sciences. The proposed M.S. in Biostatistics will be the only such program at UW-Milwaukee.

Other Programs in the University of Wisconsin System

There is currently no other UW System school that offers a M.S. in Biostatistics. The UW-Madison Department of Statistics in collaboration with the Department of Biostatistics and Medical Informatics in the School of Medicine and Public Health offers a M.S. in Statistics with an emphasis in Biostatistics. UW-Madison also offers M.S. in Biometry and M.S. in Biomedical Data Science. The proposed program of M.S. in Biostatistics at the Zilber School is distinct from these existing degree programs as the only program at a CEPH-accredited school of public health. The proposed M.S. at UWM will complement the UW-Madison M.S. degree by emphasizing curriculum and applications in public health.

Need as Suggested by Market Demand

The M.S. in Biostatistics is fast growing, and the number of applications among U.S. and international students is increasing quickly. Currently, the 74 biostatistics programs that offer

M.S. degrees nationwide awarded 693 degrees during 2017, an increase of >100% from 2010 in which 327 degrees were conferred[1]. We anticipate that the M.S. degree will attract more students locally and internationally than the current MPH degree track in biostatistics.

Students with an M.S. in Biostatistics are employable in a wide variety of settings, including in the governmental sector, at research universities and non-profit institutions, in the pharmaceutical and biomedical industry, and within health systems, such as health insurance companies, hospitals, and other large healthcare companies. According to the Bureau of Labor Statistics, there were 37,200 jobs available for statisticians/biostatisticians in 2017, with a median annual income of $84,060. Jobs are projected to increase 34% during the next 10 years[2]. The typical entry-level educational requirement for a job as a statistician or biostatistician is an M.S. degree. The skills gained in this new M.S. program will enable students to be competitive in this robust job market.

Need as Suggested by Student Demand
While no systematic student survey has been done to determine potential student demand for the program, informal expressions of student interest have been gathered. Additionally, at other CEPH-accredited schools of public health offering both an M.P.H. and M.S. in Biostatistics, student demand is much greater for the M.S. program. For example, according to 2017 data from the Association of Schools and Programs of Public Health, 413 students enrolled in M.S. in Biostatistics compared to 314 in the M.P.H. in Biostatistics. This trend is expected to be similar for the Zilber School of Public Health.

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[1] http://community.amstat.org/blogs/steve-pierson/2014/02/09/largest-graduate-programs-in-statistics

[2] http://www.bls.gov/ooh/math/statisticians.htm