Handbook
PhD Program in Biostatistics
2011-2012

Introduction

This handbook describes general information, requirements, regulations, and procedures for the Indiana University Ph.D. program in Biostatistics offered on the campus of Indiana University Purdue University Indianapolis (IUPUI). This is a joint program of the Indiana University School of Medicine, through its Departments of Biostatistics and of Public Health, together with the Purdue University School of Science at Indianapolis, through its Department of Mathematical Sciences.

This PhD program in biostatistics combines the strength in statistical theory and modeling of the Department of Mathematical Sciences and the biostatistical methods research, health sciences applications, and public health experience of the Department of Biostatistics. This unique collaboration provides an excellent environment for collaborative and interdisciplinary study. With a low student/faculty ratio, this program also offers students many opportunities for close interaction with faculty and careful research guidance.

The program is designed for individuals with strong quantitative and analytical skills and a strong interest in biological, medical and/or health related sciences. It provides rigorous training in statistical theory and methodologies that are suitable for applications in research, collaboration and consulting on a broad spectrum of health and life science problems. The program stresses the theory and concepts underlying statistical methods, the interpretation of results from experimental as well as observational studies, and the practical realities of health-related studies and their analysis. The primary goal is to prepare the students for independent careers as biostatisticians in any professional health-related or biomedical environment, such as in medical research institutes, universities, public health or government agencies and private health-industries or organizations.

Financial support may be available for qualified students. The Biostatistics program offers support through research and teaching assistantships as well as fellowships. The level of scholarship can vary by the type of assignment and may include a tuition remission, health insurance coverage as well as a generous stipend. Support is limited and highly competitive. Student support is limited to a maximum of five years. Please contact info@biostatprog.iupui.edu for more information. Additional information regarding specific policies of the Indiana University Graduate School can be found in the University Graduate School Bulletin.

Program Requirements

Admission Requirements

Any applicant who has a suitable Bachelor's or a Master's degree from an accredited institution and shows promise for successfully completing all the degree requirements will be considered for admission to this program. In addition to satisfying general Indiana University Graduate School requirements for admission, applicants must have at least a B (3.00 GPA) average in courses taken during the last two years of their earlier degree studies, and a grade of B+ (3.50 GPA) in courses required as prerequisites for the program. Students entering this program should have a minimal mathematics background consisting of an undergraduate course sequence in univariate and multivariate calculus (equivalent to MATH 163, 164 and 261 at IUPUI) and a course in linear algebra (including matrix theory). In addition, applicants should have had a calculus-based undergraduate level course in probability or statistics. Prospective applicants who do not have this background must acquire it prior to admission to the program.

Applicants are required to take the Graduate Record Examination (GRE) General Test and those whose native language is not English must also take the Test of English as a Foreign Language (TOEFL) and achieve a score of 570 (or 230 on the computer version of the test, or 79 on the internet based test). Final admission decision will be made by a faculty Admission Committee.

Required Coursework

Every student in the program is required to complete the following 11 courses for a total of 33 credits:

- STAT 51200 Applied Regression Analysis
- BIOS-S 515 Biostatistics Practicum
- STAT 51900 Introduction to Probability *
- STAT 52500 Generalized Linear Model *
- BIOS-S 527 Introduction to Clinical Trials
- STAT 52800 Mathematical Statistics I *
- STAT 53600 Introduction to Survival Analysis *
- BIOS-S 546 Applied Longitudinal Data Analysis *

Any three of the following:

- STAT 61900 Probability Theory
- BIOS-S 621 Advanced Statistical Computing

- STAT 62800 Advanced Statistical Inference
- BIOS-S 636 Advanced Survival Analysis
- BIOS-S 646 Advanced Generalized Linear Models

(* indicates the Program's Core Courses)

In addition, every student must take an additional 12 credit hours of statistics/biostatistics courses. At least six credit hours of these electives must be taken from 600-level courses or above. The remaining 45 credit hours will be taken as additional coursework in a minor area (12 credits), further elective courses, independent studies, and directed dissertation research. This totals to 90 credit hours for the biostatistics program. The minor may be completed in any area related to the health and life sciences disciplines, such as pharmacology and toxicology, epidemiology, genetics, biology, physiology, bioinformatics, public health and health economics, among many others.

Qualifying Examination

Students must pass an initial qualifying examination on the five core courses: STAT 51900, 52500, 52800, 53600 and BIOS-S 546. The qualifying examination is a written examination offered once a year during a two-day Qualifier Exam Session the week before classes start in August and is administered in two sections – Theoretical Biostatistics and Applied Biostatistics. The preparation and the administration of the qualifying examination is overseen by the Graduate Examination Committee. Students are expected to have completed and passed both sections of the qualifying examination on or before their qualifier deadline.

Deadline for full-time students:

The deadline for passing the qualifying examination for full-time students who enter the program with a master's degree or equivalent is August at the end of their second year; the deadline for full-time students who enter the program without a master's degree is August at the end of their third year.

Deadline for part-time students:

The deadline for passing the qualifying examination for part-time students who enter the program with a master's degree or equivalent is August at the end of their third year; the deadline for part-time students who enter the program without a master's degree is August at the end of their fourth year.

If students do not pass both sections of the examination by their qualifier deadline, they will have their privilege to continue in the program terminated.

A student will have at most two attempts to pass the examination. The first attempt must include the entire examination, i.e. both the Theoretical and Applied sections. If one or both sections are not passed on the first attempt, then a second attempt on or before the deadline is allowed.

During the final attempt, the student may only sit for the section(s) not passed in the first attempt.

A student's first attempt at the qualifying examination will result in one of the following three outcomes:

1. **Pass Both Sections:** The student has demonstrated fundamental understanding of the core material and the examination committee believes he/she will be successful in completing the Ph.D. program.
2. **Pass One Section:** The student has demonstrated fundamental understanding of one section, but lacks adequate understanding of the other section. The student must sit for the section not passed at a future examination session.
3. **Fail:** The student has failed to demonstrate an adequate understanding of the material from the core courses and thus fails the examination. The student must sit for both sections at a future examination session.

A student's second and final attempt at the qualifying examination will result in one of the following two outcomes:

1. **Pass:** The student has demonstrated fundamental understanding of the core material and the examination committee believes he/she will be successful in completing the Ph.D. program.
2. **Fail:** The student has failed to demonstrate an adequate understanding of the material from the core courses and thus fails the examination, with privilege to continue in the program terminated.

Minor Area

In addition to the 45 credits of formal statistics/biostatistics coursework, the student must complete a Life Sciences minor (12 credits) in an area related to any life sciences disciplines. The minor may be obtained in areas such as pharmacology and toxicology, epidemiology, genetics, biology, physiology, bioinformatics, public health and health economics, among many others, and it must be approved by the student's advisory committee. The minor must contain a minimum of four graduate level courses (12 credits) in the chosen area. Examples of Plans of Study for a minor area can be found in Appendix A.

Ph.D. Advisor and Advisory Committee

Within one year of passing the qualifying exam, each student should identify an advisory committee, consisting of at least two members of the program's graduate training faculty, and at least one member from outside the program, preferably from the student's minor area. At least one member of the committee from the program's faculty will serve as the student's primary (co)advisor.

Preliminary Examination and Research Committee

A student becomes eligible to take the Preliminary Examination after passing the qualifying examination. The student must prepare and pass a preliminary examination, which consists of an oral presentation on an advanced research topic suggested by the student to an appointed committee of at least four faculty members, including the student's advisor and at least one member from the student's minor area. The committee may consist of the same members as the student's original advisory committee, but is not required to. This committee will serve as the research committee for the student, and must be approved by the program's director. Prior to the examination, the student must provide the committee with a paper (10 – 15 pages) outlining the topic to be covered, clearly indicating the scope and depth of the planned research along with relevant references. In the examination, the student is expected to display an in-depth understanding of the chosen subject matter. The committee may ask the student questions which normally will be directed to the subject matter of the research but may, by natural extension, also cover any other relevant topic.

Admission to Candidacy

Following the passing of the preliminary examination and the completion of all required coursework, the student's advisory committee will nominate the student to candidacy. Upon approval of the dean of the IU Graduate School, the student will be admitted to candidacy.

Dissertation

A Ph.D. dissertation is a document authored by an individual, describing results of original research undertaken by that individual, and asserting a position which that individual is willing to defend. A dissertation must be submitted in final form presenting new results of sufficient importance to merit publication.

After consultation with and approval by the student's advisor and research committee, the student will submit to the University Graduate School (at the IUPUI Graduate Office, UN 207) a one- or two-page prospectus of the dissertation research. If the proposed research involves human subjects, animals, biohazards, or radiation, approval from the appropriate university committee must also be obtained. The dissertation prospectus must be approved by the University Graduate School at least six months before the defense of the dissertation.

The dissertation must meet departmental and University format requirements. Consult the Guide to the Preparation of Theses and Dissertations ("The Format Guide") - for use by students admitted to IU Graduate School Programs located at IUPUI. The Format Guide is available at the IUPUI Graduate Office website.

Final Examination (Defense)

When the dissertation has been completed, the student should submit an unbound copy to each member of the research committee as the initial step in scheduling the defense of the dissertation. All members of the research committee should read the dissertation in its entirety before attending the defense. At this stage both the student and the faculty members must extend certain courtesies to each other. It is the responsibility of the student to give faculty members sufficient time to read the dissertation without making unreasonable requests of them based upon University Graduate School time limitations, immediate job possibilities, contract renewal, or some other reason. Similarly, a faculty member should not keep a student's work for inordinate periods of time because of the press of other duties. Once a faculty member assumes membership on a research committee, it becomes another part of his or her teaching assignment, comparable to conducting regularly scheduled classes.

After the committee members have read the dissertation, there should be direct communication (either in writing or orally) between the research committee chairperson and the other committee members about its readiness for defense. Readiness for defense, however, is not tantamount to acceptance of the dissertation; it means that the committee is ready to make a decision. The decision to hold a doctoral defense, moreover, is not entirely up to the research committee. If a student insists upon the right to a defense before the committee believes the dissertation is ready, that student does have the right to due process (i.e., to an oral defense) but exercises it at some risk.

If the decision to proceed with the defense of the dissertation is made against the judgment of one or more members of the committee, or if one or more members of the committee disapprove of parts of or the entire dissertation, the committee member(s) should not resign from the committee in order to avoid frustration or collegial confrontation. The University Graduate School urges that such committee members, after ample communication with both the student and the chairperson, remain on the committee and thus prevent the nomination of a committee that might eventually accept what could be unsatisfactory work. Such a committee member could agree that a dissertation is ready for defense but should not be passed (or should not be passed without substantial modification). There will, of course, be situations in which the membership of research committees should or must be changed (e.g., turnover of faculty), but changes because of modifications in the dissertation topic or some equally plausible reason should be made early in the writing of the dissertation.

Thirty days prior to the scheduled defense of the dissertation, the candidate must submit to the University Graduate School a one-page announcement of the final examination. This announcement must follow a format available in the Guide to the Preparation of Theses and Dissertations (“The Format Guide”) - for use by students admitted to IU Graduate School Programs located at IUPUI. The Format Guide is available at the IUPUI Graduate Office website. The announcement contains, among other things, a summary of the dissertation (not less than 150 words) which is informative and contains a brief statement of the principal results and conclusions.

Once the final examination has been scheduled, the announced time and place of the defense must not be changed without the approval of the dean. Any member of the graduate faculty who wishes to attend the final examination is encouraged to do so; it is requested, however, that the

faculty member notify the chairperson of the research committee in advance so that space can be arranged. With the approval of the research committee and the consent of the candidate, other graduate students may attend the defense of the dissertation; normally such students will act as observers, not as participants.

At the end of the oral examination, the research committee must vote on the outcome of the examination. Four options are available to the committee: (1) pass, (2) conditional pass, (3) deferred decision, and (4) failure. If the decision to pass is unanimous, the dissertation is approved once it is received by the University Graduate School along with an acceptance page signed by the members of the research committee. If the decision is not unanimous, majority and minority reports should be submitted to the dean who, within 10 working days, will investigate and consult with the research committee. Upon completion of the dean's investigation and consultation, another meeting of the research committee will be held, and if a majority votes to pass, the dissertation is approved when it is received by the University Graduate School with an acceptance page signed by a majority of the members of the research committee.

Dissertation Submission

After passing the defense and prior to final submission, all students will meet with the IUPUI Graduate Office for a format review. Following acceptance by the research committee, the dissertation is submitted to the University Graduate School (at the IUPUI Graduate Office, UN 207). Please carefully follow the “Format Guide” - available at the IUPUI Graduate Office website.

General Requirements and Procedures

Transfer Coursework

Candidates for the Ph.D. degree may petition for up to 30 hours of graduate credit from other institutions. Students submit the *Petition for Approval of Transfer Course* form in order to initiate an appeal process and receive approval to apply a course completed at a different institution towards their degree. Students must provide, at minimum, the syllabus for the course under evaluation. Other documentation may be requested, as needed.

Expired Coursework

Normally, a course may not apply towards degree requirements if was completed more than seven years prior to the passing of the preliminary examination. Students submit the *Petition for Course Revalidation* form in order to initiate an appeal process and receive approval to apply an expired course towards their degree. Students must provide, at minimum, the syllabus for the course under evaluation. Other documentation may be requested, as needed.

Elective Coursework

Students submit the *Petition for Approval of Elective Course* form in order to initiate an appeal process and receive approval to apply a course completed in a different department towards their degree. Students must provide, at minimum, the syllabus for the course under evaluation. Other documentation may be requested, as needed.

Time Limits for Completion

The student must receive acceptance of his or her dissertation and must submit a copy to the University Graduate School within seven years after passing the qualifying examination, and complete the degree in entirety within ten years from time of admission into the program. Failure to meet this requirement will result in the termination of candidacy and of the student's enrollment in the degree program. Any student whose candidacy lapses will be required to apply to the University Graduate School for reinstatement before further work toward the degree may be done formally. To be reinstated to candidacy in the University Graduate School, the student must: (1) obtain the permission of the departmental chairperson; (2) fulfill the departmental requirements in effect at the time of the application for reinstatement; (3) pass the current Ph.D. qualifying examination or its equivalent (defined in advance); and (4) request reinstatement to candidacy from the dean. Such reinstatement, if granted, will be valid for a period of three years, during which time the candidate must enroll each semester for a minimum of one credit.

Normal Progress and Termination

Once students begin research, they must maintain normal progress toward their degree objective to ensure continued financial support and/or active status. If, in the opinion of the research committee, satisfactory research progress is not being made or if the GPA continues to be below 3.0, a meeting of the student's research committee may be convened. This meeting will include a brief presentation by the student on the work accomplished up to that point, and/or a discussion concerning the problems which have hampered progress. If the consensus of the committee is that the student needs to show improvement, he/she will have 60 days to demonstrate a change in performance. At the end of this time, financial support may be discontinued, if applicable.

If a student finds it necessary to withdraw from the graduate program, then he/she should provide as much notice as possible. In the case of teaching or research assistants, students are expected to complete the semester once it has begun. Similarly, the program will provide a student with as much advance notice as possible if the student is dropped from the program for reasons of poor performance. In addition, the student must maintain continual enrollment (at least 1.0 credit hour per fall and spring semesters) in the program after passing the qualifying examination, not including summer sessions. The student must also be registered during the semester of graduation.

Resources

List of Required Forms

Throughout the period of enrollment in the Ph.D. program, specific forms must be filled out at

certain points in the program. It is the student's responsibility to complete the forms, as required. Below is a list of all required forms with an explanation. All forms are available at the IUPUI Graduate Office website and must be filed with the Graduate Programs Coordinator in the Math Department.

- **Appointment of Advisory Committee Form**
  Within one year of passing the qualifying exams, each student must select an advisory committee, consisting of at least two members of the program's graduate training faculty, and at least one member from outside the program, preferably from the student's minor area. The student should select at least one member to be the primary advisor.

- **Nomination of Candidacy Form**
  Following the passing of the preliminary examination and the completion of all required coursework, the student's advisory committee will nominate the student to candidacy. Upon approval of the dean of the IU Graduate School, the student will be admitted to candidacy.

- **Nomination of Research Committee Form**
  The research committee is selected when the student begins to prepare for the preliminary examination and consists of at least four faculty members, including the student's advisor and at least one member from the student's minor area. The committee may consist of the same members as the student's original advisory committee, but is not required to. The nomination form is filed after successful completion of the preliminary exam, and includes a one- to two-page summary of the proposed dissertation. The signatures of the faculty members on this form indicate that they agree to supervise the research.

- **PhD Minor Form**
  This form is filed as soon as a minor area has been agreed upon, and must be signed by the student's major advisor and the faculty member selected to be the student's minor advisor. Should the coursework selected for the minor change, a new form must be filed.

- **Change of Research Committee Member Form**
  The membership of the research committee may be changed. However, the final version of the research committee must be fixed no later than six months prior to the defense.

- **Announcement of Dissertation Defense**
  Thirty days prior to the scheduled defense of the dissertation, the candidate must submit to the University Graduate School (at the IUPUI Graduate Office, UN 207) a one-page announcement of the final examination. This announcement must follow Guide to the Preparation of Theses and Dissertations ("The Format Guide") - for use by students admitted to IU Graduate School Programs located at IUPUI. The Format Guide is available at the IUPUI Graduate Office website. The announcement contains, among other things, a summary of the dissertation (not less than 150 words) which is informative and contains a brief statement of the principal results and conclusions. Once the final examination has been scheduled, the announced time and place of the defense must not be changed without the approval of the dean.

Appendix A

A1: Example of Doctoral Minor in Epidemiology

The Department of Public Health offers a rigorous, highly focused 12-credit hour minor in Epidemiology. The field of epidemiology is growing in national and international importance, is integral to many areas of pursuit, enhances analytic and data-based management skills that are desirable for many doctoral level research projects, offers population-based research perspectives, offers skills that are of interest to the private and public sectors, and formally acknowledges the course work that doctoral students are currently taking as electives through the Department of Public Health.

The minor in Epidemiology will provide students with concepts and principles of the research, field, theory and practice of epidemiology so that they will be able to:

- Use epidemiologic methods to collect data, study, analyze, and report the patterns of disease in human populations for diverse audiences.
- Use biostatistics to analyze and report public health data.
- Understand and apply descriptive epidemiology to assess health status and the burden of disease in populations.

- Understand, apply and interpret epidemiologic research methods and findings to the practice of public health.
- Demonstrate the ability to identify and use existing sources of epidemiologic data at the local, state, national and international level.
- Understand the key components of public health surveillance and public health screening programs.
- Develop written and oral presentation based on epidemiologic analysis for both public health professionals and lay audiences.
- Demonstrate a basic level of SAS programming for data set creation, data management and data analysis.

The minor in Epidemiology offers the opportunity to draw together students from health related doctoral programs from many schools, including the Schools of Nursing, Dentistry, Medicine, Health, Physical Education and Recreation, Health and Rehabilitative Sciences, Public and Environmental Affairs, and others. Epidemiology faculty in the Department of Public Health will serve as advisors for the minor.

Curriculum:
The curriculum for the 12 credit hour minor in Epidemiology is comprised of the following 3 required courses: P517, P600, P601 and one course from the following: P609, P610 or P612. This focused minor provides students with a rigorous grounding in the background and application of epidemiology.

Satisfactory completion of the requirements for the minor in Epidemiology will be monitored by the student's minor advisor on their program/dissertation committee. Doctoral students must notify the IU School of Medicine Department of Public Health before beginning their course of study for the minor. All courses must be taken in the Department of Public Health. No transfer credit is allowed. No credit will be awarded toward a minor in Public Health or Epidemiology if students earn a Master of Public Health degree or Graduate Certificate in Public Health.

Required Courses for the 12-hour Minor in Epidemiology:

P517: Fundamentals of Epidemiology 3.0 cr. Fall Semester
P600: Epidemiological Research Methods 3.0 cr. Fall Semester
P601: Advanced Epidemiology 3.0 cr. Spring Semester

Plus one course from the following:

P609: Infectious Disease Epidemiology 3.0 cr. Spring Semester
P610: Chronic Disease Epidemiology 3.0 cr. Fall Semester
P612: Health Outcomes Research 3.0 cr. Spring Semester

Course Descriptions:

PBHL P517: Fundamentals of Epidemiology 3.0 cr. Fall Semester
This course introduces basic epidemiologic concepts including determinants of health and

patterns of disease in populations and implications of disease processes on prevention strategies and policy development. Among the topics to be covered are measures of morbidity and mortality, sources of data, and design of research studies and clinical trials.

PBHL P600: Epidemiological Research Methods 3.0 cr. Fall Semester
This course provides an in-depth presentation of the major research designs, analytical methods and practical issues specifically related to conducting research in the field of Epidemiology. Descriptive, observational and experimental designs are included. In addition, issues of ethics, protocol, data quality, instrument design and analysis are covered. Prerequisite: Biostatistics or Statistics.

PBHL P601: Advanced Epidemiology 3.0 cr. Spring Semester
This course provides students with an in-depth understanding of advanced epidemiologic concepts and an
understanding of epidemiologic techniques not covered in other classes. Topics included will represent cutting edge techniques, philosophical issues and insights to appropriately conduct and interpret the findings of epidemiological studies. Prerequisite: PBHL P600 or equivalent.

PBHL P609: Infectious Disease Epidemiology 3.0 cr.
This course is designed to provide a basic overview of the infectious disease process, including disease agents, transmission routes, immunity and public health significance. The course introduces principles of infectious disease epidemiology, including outbreak investigation and surveillance, using case studies as examples. Concepts on globalization of disease, microbial ecology, and disease eradication are discussed. Prerequisite: PBHL H517 or equivalent.

PBHL P610: Chronic Disease Epidemiology 3.0 cr.
This course examines chronic health conditions from epidemiological perspectives. Concepts include distribution, determinants, diagnosis, measures of severity, treatment modalities, surveillance measures, survival and prognosis, and quality of care measures. Research methods, prevention strategies and screening tests are presented. Clinical experts present diagnosis and treatment methods. Prerequisite: PBHL H517 or equivalent.

PBHL P612: Health Outcomes Research 3.0 cr.
This web-based course is evidence-based and focused on health outcomes research in contemporary health care. The different types of health outcomes assessment tools and their application in determining patient health status, changes in health status, and the effectiveness of health care interventions will be addressed. The course will focus on generic and specific health related outcomes assessment tools, looking at such issues as disease specific outcomes and patient satisfaction.

A2: Example of Doctoral Minor in Public Health

The Department of Public Health offers a rigorous, highly focused 12-credit hour Minor in Public Health. The field of public health is growing in national and international importance, is integral to many areas of pursuit, enhances analytic and data-based management skills that are desirable for many doctoral level research projects, offers population-based research perspectives, offers skills

that are of interest to the private and public sectors, and formally acknowledges the course work that doctoral students are currently taking as electives through the Department of Public Health.

The minor in Public Health will provide students with concepts and principles of the research, field, theory and practice of public health so that they will be able to:

- Use biostatistical methods to analyze and report public health data.
- Specify approaches to assess, prevent and control environmental and occupational hazards to human health and safety.
- Use epidemiologic methods to collect, study, analyze and report the patterns of disease in human populations for diverse audiences.
- Identify and analyze the components and issues of leadership, including financing and delivery of public health services and systems.
- Apply policy process, development and analysis methods to address current national, state and local public health issues.
- Identify social and behavioral science factors, theories and models and develop, implement and evaluate interventions designed to positively affect health behaviors in populations.
- Collect and disseminate public health data through the use of technology and media.
- Explain how human biology influences health and public health practice.
- Exhibit high standards of personal and organizational integrity, compassion, honesty and respect for all people.
- Use systems methods to analyze the effects of political, social and economic influences on public health systems at the individual, community, state, national and international levels.
- Demonstrate the impact of diversity and culture on public health across discipline areas.
- Demonstrate an understanding of the basic ethical and legal principles pertaining to the collection, maintenance, use and dissemination of public health data.

The minor in Public Health offers the opportunity to draw together students from all health related graduate programs, including doctoral students in the Schools of Nursing, Dentistry, Medicine, Health, Physical Education and Recreation, Health and Rehabilitative Sciences, and Public and Environmental Affairs.

Faculty in the Department of Public Health will serve as advisors for the Minor in Public Health. The curriculum for the 12 credit hour minor in Public Health is comprised of the following 4 required courses: P500, P504, P517 and P519. This minor provides students with a foundation in public health. Satisfactory completion of the requirements for the minor in Public Health will be monitored by the student's minor advisor on their program and dissertation

Doctoral students must notify the IU School of Medicine Department of Public Health before beginning their course of study for the Public Health Minor. All courses must be taken in the Department of Public Health. No transfer credit is allowed. No credit will be awarded toward a Minor in Public Health if students have earned or are working toward a Master of Public Health degree or Graduate Certificate in Public Health.

Required Courses for the 12-hour Minor in Public Health:

P500: Social and Behavioral Science in Public Health 3.0 cr. Fall/Spring
P504: US Health Care Systems and Health Policy 3.0 cr. Fall/ Spring
P517: Fundamentals of Epidemiology 3.0 cr. Fall/ Spring
P519: Environmental Science in Public Health 3.0 cr. Fall/ Spring

Course Descriptions:

PBHL P500: Social and Behavioral Science in Public Health (3 cr.)
Students will learn the principles of health education and behavioral science and strategies for their application to health problems in communities and among special populations.

PBHL P504: US Health Care Systems and Health Policy (3 cr.)
This course explores components of the health care system and associated managerial challenges. Ideological paradigms that predict utilization and health behavior, guidelines for ethical analysis, the policy process, interaction of federal, state and local politics in formation of policies, and theoretical assumptions associated with major policy models are included

PBHL P517: Fundamentals of Epidemiology (3 cr.)
This course introduces basic epidemiologic concepts including determinants of health and patterns of disease in populations and implications of disease processes on prevention strategies and policy development. Among the topics to be covered are measures of morbidity and mortality, sources of data, and design of research studies and clinical trials.

PBHL P519: Environmental Science in Public Health (3 cr.)
This course examines national and international environmental factors that influence health such as population, toxic substances, energy, food quality and air and water quality.
Students will discuss risk analysis as well as prevention strategies.

Appendix B

List of Courses

500 Level Courses

STAT 51200 Applied Regression (3 cr.) P: STAT 51100. Inference in simple and multiple linear regression, residual analysis, transformations, polynomial regression, model building with real

data, nonlinear regression. One-way and two-way analysis of variance. Use of existing statistical computing package.

STAT 51300 Statistical Quality Control (3 cr.) P: STAT 51100. Control charts and acceptance sampling, standard acceptance plans, continuous sampling plans, sequential analysis, statistics of combinations, and some nonparametric methods. Use of existing statistical computing packages.

STAT 51400 Design of Experiments (3 cr.) P: STAT 51200. Fundamentals, completely randomized design, randomized complete blocks. Latin squares, multiclassification, factorial, nested factorial, incomplete blocks, fractional replications, confounding, general mixed factorial, split-plot and optimum design. Use of existing statistical computing packages.

BIOS–S 515 Biostatistical Practicum (1–3 cr.) P: STAT 52100; BIOS S527, S546; or consent of instructor. Real world projects in biostatistics involving participation in consulting sessions, directed reading in the literature, research ethics, design of experiments, collection of data and applications of biostatistical methods. Detailed written and oral reports required.

STAT 51900 Introduction to Probability (3 cr.) P: MATH 26100. Algebra of sets, sample spaces, combinatorial problems, conditional probability, independence, random variables, distribution functions, characteristic functions, special discrete and continuous distributions, distributions of function of random variables, limit theorems.

STAT 52000 Time Series and Applications (3 cr.) P: STAT 51900. A first course in stationary time series with applications in engineering, economics, and physical sciences. Stationary, auto-covariance function and spectrum; integral representation of a stationary time series and interpretation; linear filtering; transfer function models; estimation of spectrum; multivariate time series; Kalman filtering, Burg's algorithm.

STAT 52100 Statistical Computing (3 cr.) P: STAT 51200. This course demonstrates how computing can be used to understand the performance of core statistical methods and introduces modern statistical methods that require computing in their application. Covers relevant programming fundamentals in at least two programming environments (e.g. SAS and R/Splus).

STAT 52200 Sampling and Survey Techniques (3 cr.) P: STAT 51200 or STAT 51100. Survey designs, simple random, stratified, cluster and systematic sampling; systems of sampling; methods of estimation, ratio and regression estimates, costs; non-response analysis; spatial sampling.

STAT 52300 Categorical Data Analysis Models (3 cr.) P: STAT 52800 or equivalent, or consent of instructor. Generating binary and categorical response data, two-way classification tables, measures of association and agreement, goodness-of-fit tests, testing independence, large sample properties. General linear models, logistic regression, probit and extreme value models. Log-linear models in two and higher dimensions; maximum likelihood estimation, testing Goodness-of-fit, partitioning Chisquare, models for ordinal data. Model-building, selection and

diagnostics. Other related topics as time permits. Computer applications using SAS.

STAT 52400 Applied Multivariate Analysis (3 cr.) P: STAT 52800 or equivalent, or consent of instructor. Extension of univariate tests in normal populations to the multivariate case, equality of covariance matrices, multivariate analysis of variance, discriminate analysis and misclassification errors, canonical correlation, principal components, factor analysis.

STAT 52500 Generalized Linear Model (3 cr.) P: STAT 52800 or equivalent or consent of instructor. Generalized linear models, likelihood methods for data analysis, diagnostic methods for assessing model assumptions. Methods covered include multiple regression, analysis of variance for completely randomized designs, binary and categorical response models, and hierarchical log-linear models for contingency tables.

BIOS–S 527 Introduction to Clinical Trials (3 cr.) P: STAT 51200, exposure to survival analysis; or consent of instructor. Prepares biostatisticians for support of clinical trial projects. Topics: fundamental aspects of the appropriate design and conduct of medical experiments involving human subjects including ethics, design, sample size calculation, randomization, monitoring, data collection analysis and reporting of the results.

STAT 52800 Mathematical Statistics I (3 cr.) P: STAT 51900. Sufficiency and completeness, the exponential family of distributions, theory of point estimation, Cramer- Rao inequality, Rao-Blackwell Theorem with applications, maximum likelihood estimation, asymptotic distributions of ML estimators, hypothesis testing, Neyman-Pearson Lemma, UMP tests, generalized likelihood ratio test, asymptotic distribution of the GLR test, sequential probability ratio test.

STAT 52900 Bayesian Statistics and Applied Decision Theory (3 cr.) P: STAT 52800 or equivalent. Bayesian and decision theoretic formulation of problems; construction of utility functions and quantification of prior information; choice of prior; methods of Bayesian decision and inference,; Bayesian computations; MCMC methods; empirical Bayes; hierarchical models, Bayes factors; combination of evidence; game theory and minimax rules, Bayesian design and sequential analysis.

BIOS–S 530 Statistics Methods in Bioinformatics and Computational Biology (3 cr.) P: STAT 51200, 51900; or consent of instructor. Covers statistical methods used in many areas of bioinformatics research, including sequence alignment, genome sequencing and gene finding, gene expression microarray analysis, transcriptional regulation and sequence motif finding, comparative genomics, and proteomics. Pending final approval.

STAT 53200 Elements of Stochastic Processes (3 cr.) P: STAT 51900 or equivalent. A basic course in stochastic models including discrete and continuous time processes, Markov chains and Brownian motion. Introduction to topics such as Gaussian processes, queues and renewal processes and Poisson processes. Applications to economics, epidemic models, birth and death processes, point processes, and reliability problems.

STAT 53300 Nonparametric Statistics (3 cr.) P: STAT 51900 or equivalent. Binomial test for dichotomous data, confidence intervals for proportions, order statistics, one-sample signed

Wilcoxon rank test, two-sample Wilcoxon test, two-sample rank tests for dispersion, Kruskal-Wallis test for one-way layout. Runs test and Kendall test for independence, one and two sample Kolmogorov-Smirnov tests, nonparametric regression.

STAT 53600 Introduction to Survival Analysis (3 cr.) P: STAT 51700. Deals with the modern statistical methods for analyzing time-to-event data. Background theory is provided, but the emphasis is on the applications and the interpretations of results. Provides coverage of survivorship functions and censoring patterns; parametric models and likelihood methods, special lifetime distributions; nonparametric inference, life-tables, estimation of cumulative hazard functions, the Kaplan- Meier estimator; one and two-sample nonparametric tests for censored data; semiparametric proportional hazards regression (Cox Regression), parameters' estimation, stratification, model fitting strategies and model interpretations. Heavy use of statistical software such as Splus and SAS.

BIOS–S 546 Applied Longitudinal Data Analysis (3 cr.) P: STAT 51200, 52500; or permission of instructor. Covers modern methods for the analysis of repeated measures, correlated outcomes and longitudinal data. Topics: repeated measures ANOVA, random effects and growth curve models, generalized estimating equations (GEE) and generalized linear mixed models (GLMMs). Extensive use of statistical software, e.g. SAS, R.

BIOS–S 587 Nonlinear Mixed Models (3 cr.) P: Undergraduate statistics course and familiarity with statistical inference. This course will develop the student's ability to understand the pharmacokinetic/pharmacodynamic model, fit the nonlinear mixed model through the required software package, conduct the diagnosis of model fitting, perform the hypothesis tests, and provide the interpretation of the data.

600 Level Courses

BIOS-S 612 Modern Statistical Learning Methods (3 cr.) P: STAT 52500. This course covers the various topics pertaining to the modern methods of high-dimensional data analysis. Course is still subject to final approval by The University Graduate School.

STAT 61900 Probability Theory (3 cr.) P: STAT 51900, 52800. Theory Measure theory based course in probability. Topics include Lebesgue measure, measurable functions and integration. Radon-Nikodyn Theorem, product measures and Fubini's Theorem, measures on infinite product spaces, basic concepts of probability theory, conditional probability and expectation, regular conditional probability, strong law of large numbers, martingale theory, martingale convergence theorems, uniform integrability, optional sampling theorems, Kolmogorov's Three series Theorem, weak convergence of distribution functions, method of characteristic functions, the fundamental weak compactness theorems, convergence to a normal distribution, Lindeberg's Theorem, infinitely divisible distributions and their subclasses.

BIOS–S 621 Advanced Statistical Computing (3 cr.) P: STAT 52100, experience with R/Splus programming. This course covers selected computational techniques useful in advanced statistical applications and statistical research, such as methods for solving linear equations, numerical optimization, numerical integration, Bayesian methods, bootstrap methods, and stochastic search algorithms.

BIOS–S 627 Statistics in Pharmaceutical Research (3 cr.) P: STAT 51200; BIOS S527, S546. An overview of the drug development process, including the various phases of development from pre-clinical to postmarketing. Topics: statistical issues in design, study monitoring, analysis and reporting. Additional topics may include regulatory and statistical aspects of population pharmacokinetics and real world applications.

STAT 62800 Advanced Statistical Inference (3 cr.) P: STAT 51900, 52800, C: STAT 61900. Real analysis for inference, statistics and subfields, conditional expectations and probability distributions, UMP tests with applications to normal distributions and confidence sets, invariance, asymptotic theory of estimation and likelihood based inference, U-statistics, Edgeworth expansions, saddle point method. Course is still subject to approval by The University Graduate School.

BIOS–S 634 Stochastic Modeling in Biomedical and Health Sciences (3 cr.) P: STAT 52800. The aim of this course is to develop those aspects of stochastic processes that are relevant for modeling important problems in health sciences. Among the topics to be covered are: Poisson processes, birth and death processes, Markov chains and processes, semi-Markov processes, modeling by stochastic diffusions. Applications will be made to models of prevalence and incidence of disease, therapeutic clinical trials, clinical trials for prevention of disease, length biased sampling, models for early detection of disease, cell kinetics and family history problems. Course is still subject to approval by The University Graduate School.

BIOS–S 636 Advanced Survival Analysis (3 cr.) P: STAT 53600, 62800. Addresses the counting process approach to the analysis of censored failure time data. Standard statistical methods in survival analysis will be examined, such as the Nelson-Aalen estimator of the cumulative hazard function, the Kaplan-Meier estimator of the survivor function, the weighted logrank statistics, the Cox proportional hazards regression model, and the accelerated failure time model.

BIOS–S 646 Advanced Generalized Linear Models (3 cr.) P: BIOS S546. The theory of classical and modern approaches to the analysis of clustered data, repeated measures, and longitudinal data: random effects and growth curve models, generalized estimating equations, statistical analysis of multivariate categorical outcomes, estimation with missing data. Discussion of computational issues: EM algorithm, quasi-likelihood methods, Bayesian methods for both traditional and new methodologies.

BIOS-S 688 Theory of Statistical Genetics (3 cr.) P: Graduate level statistics courses (such as B527, B546, and B536) and Q730: Methods in Human Genetics. This course is designed to provide solid training in statistical theory used in genetic analyses.

BIOS–S 698 Topics in Biostatistical Methods (1–3 cr.) P: Consent of instructor. Directed study and reports for students who wish to undertake individual reading and study on approved topics.

BIOS-S 699 Research-Ph.D. Thesis (1-15 cr.) P: Must have been admitted to candidacy. See advisor for more information. Research required by the graduate students for the sole purpose of writing a Ph.D. Dissertation.

Appendix C

Graduate Faculty and Their Research Interests (as of August 2011)

1. **Benzion Boukai**, Program Co-Director, Professor of Statistics; Ph.D., Statistics, 1988, SUNY Binghamton; *statistical inference, sequential analysis, Bayesian-frequentist interface*

2. **Joanne Daggy**, Assistant Research Professor of Biostatistics, Ph.D., Statistics, 2009, Purdue University; *multivariate modeling via copulas, longitudinal analysis, health services research*

3. **Sujuan Gao**, Professor of Biostatistics; Ph.D., Statistics, 1991, University of Southampton; *analysis of complex survey data, statistical methods for longitudinal data and missing data*

4. **Jaroslaw Harezlak**, Assistant Professor of Biostatistics; PhD, Biostatistics, 2005, Harvard University; *nonparametric longitudinal models, high dimensional data, functional and intensively collected data analysis, regularization methods in statistics*

5. **Siu L. Hui**, Professor of Biostatistics; Ph.D., Biostatistics, 1979, Yale University; *analysis of large clinical databases, health services research*

6. **Barry P. Katz,** Chair and Program Co-Director, Department of Biostatistics, Professor of Biostatistics; Ph.D., Biostatistics, 1984, University of Michigan; *modeling of infectious diseases, longitudinal data analysis, health services research*

7. **Fang Li,** Associate Professor of Statistics; Ph.D., Statistics, 2004, Michigan State University; *nonparametric models, kernel smoothing techniques, time series, stochastic process*

8. **Lang Li,** Professor of Medical and Molecular Genetics and Biostatistics; Ph.D., Biostatistics, 2001, University of Michigan; *pharmacokinetics, pharmacodynamics, pharmacogenetics, epigenetics, disease modeling*

9. **Xiaochun Li,** Associate Professor of Biostatistics; Ph.D., Statistics, 1996, University of British Columbia; *design and analysis of clinical trials, bioinformatics, medical informatics, nonparametric regression*

10. **Hai Liu**, Assistant Research Professor of Biostatistics; Ph.D., Statistics, 2009, University of Iowa; *generalized additive models, semiparametric regression, mixed effects models, threshold models*

11. **Ziyue Liu**, Assistant Professor of Biostatistics; Ph.D., Biostatistics, 2010, University of Pennsylvania; *longitudinal data analysis, functional data analysis, time series analysis, clinical trials*

12. **Patrick O. Monahan**, Associate Professor of Biostatistics; Ph.D., Measurement and Statistics, 2002, University of Iowa; *psychometric methodologies applied to behavioral research*

13. **Hanxiang Peng,** Associate Professor of Statistics; Ph.D., Mathematics, 2001, SUNY Binghamton; *asymptotic theory, robust regression and data mining, modeling of correlated binary data, survival analysis*

14. **Susan M. Perkins**, Associate Professor of Biostatistics; Ph.D., Biostatistics, 1997, University of Michigan; *categorical data analysis, clinical trials design and analysis, behavioral research*

15. **Chandan K. Saha**, Associate Professor of Biostatistics; Ph.D., Biostatistics, 2001, University of Iowa; *statistical methods for longitudinal studies and clinical trials*

16. **Jyotirmoy Sarkar,** Professor of Statistics; Ph.D., Statistics, 1990, University of Michigan; *statistics, probability, economics*

17. **Changyu Shen,** Associate Professor of Biostatistics; Ph.D., Biostatistics, 2004, University of Pittsburgh; *longitudinal data analysis, analysis of incomplete data, statistical methods in bioinformatics, empirical Bayesian models*

18. **Fei Tan,** Assistant Professor of Statistics; Ph.D. Biostatistics 2009, Florida State University; s*urvival analysis, modeling of correlated binary data, mixed effects model*

19. **Wanzhu Tu**, Professor of Biostatistics; Ph.D., Statistics, 1997, University of South Carolina; *longitudinal data analysis, semiparametric regression.*

20. **Huiping Xu**, Assistant Professor of Biostatistics; Ph.D. Statistics, 2007, Purdue University; *latent variable analysis, longitudinal analysis, health services research.*

21. **Constantin Yiannoutsos**, Professor of Biostatistics; Ph.D., Statistics, 1991, University of Connecticut; *diagnostic test validation, longitudinal data analysis, clinical trials, HIV epidemiology*

22. **Menggang Yu,** Associate Professor of Biostatistics; Ph.D., Biostatistics, 2003, University of Michigan; *clinical trials, survival analysis, semiparametric models, latent variable models*

23. **Zhangsheng Yu**, Assistant Professor of Biostatistics; Ph.D., Biostatistics, 2006, University of Michigan; *statistical methodology in survival analysis, longitudinal analysis, nonparametric regression, model selection, and statistical applications in pediatric pulmonary, nephrology and stroke*

24. **Wei Zheng**, Assistant Professor of Statistics; Ph.D., Statistics, 2011, University of Illinois, Chicago; e*xperimental Designs, time Series Analysis*

25. **Jian Zou**, Assistant Professor of Statistics; Ph.D., Statistics, 2009, University Connecticut, Storrs; *financial time series; spatial statistics, high dimensional statistical inference, Bayesian methodologies for risk analysis.*