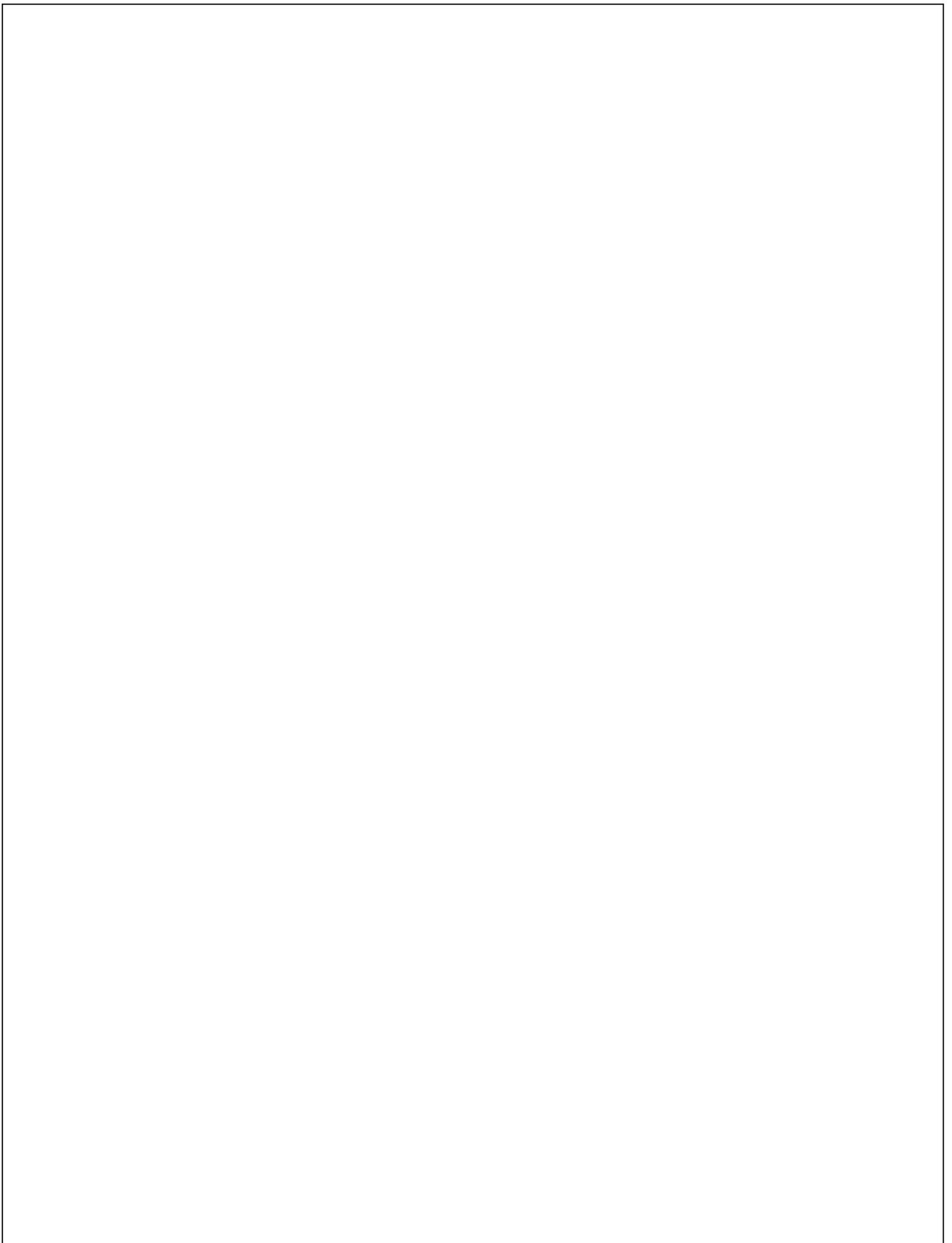


2014-2015

# Biostatistics PhD Program





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## 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 PhD program in biostatistics combines the strength in statistical theory and modeling biostatistical methods research, health sciences applications, and public health. 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 financial support is typically awarded to full-time students for up to 5 years provided that satisfactory progress and good standing is maintained. Additional information regarding specific policies of the Indiana University Graduate School can be found in the [IUPUI 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+ (or 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 16500, 16600 and 26100 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
- PBHL-B 515 Biostatistics Practicum
- STAT 51900 Introduction to Probability \*
- STAT 52500 Generalized Linear Model \*
- PBHL-B 527 Introduction to Clinical Trials
- STAT 52800 Mathematical Statistics I \*
- STAT 53600 Introduction to Survival Analysis \*
- PBHL-B 546 Applied Longitudinal Data Analysis \*

Any three of the following:

- STAT 61900 Probability Theory
- PBHL-B 621 Advanced Statistical Computing
- STAT 62800 Advanced Statistical Inference
- PBHL-B 636 Advanced Survival Analysis
- PBHL-B 646 Advanced Generalized Linear Models

(\* indicates the Program's Core Courses)

Required coursework continued on next page....

Every student in the program is also required to complete a fundamental epidemiology course and introductory courses in public health for a total of 6 credits:

- PBHL-E517 Fundamental of Epidemiology
- Introduction to Public Health
  - PBHL-A670 Environmental Science
  - PBHL-H670 Healthy Policy and Management
  - PBHL-S670 Social and Behavioral Health Sciences

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 39 credit hours will be taken as additional coursework in a minor area (12 credits), further elective courses, independent studies, and directed dissertation research (21-24 credits).

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, health policy, translational science and health economics, among many others.

### *Qualifying Examination and Preliminary Examination*

All students must successfully complete the Qualifying Examination and the Preliminary Examination prior to being admitted to Candidacy.

#### *I) Qualifying Examination - Written (required):*

Students must pass an initial written Qualifying Examination on the five core courses: **STAT 51900, 52500, 52800, 53600 and PBHL-B 546**. The written qualifying examination is 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 Program Graduate Examination Committee. Students are expected to have completed and passed both sections of the written qualifying examination on or before their written qualifier deadline.

- **Deadline for full-time students:** The deadline for passing the written 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 written 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 written qualifier deadline, they will have their privilege to continue in the program terminated.

A student will have at most two attempts to pass the written examinations. The first attempt must include the entire written 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:

- a. **Pass Both Written 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.
- b. **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.
- c. **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 written examination session.

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

- a. **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.
- b. **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.

Students who failed any part of the written qualifying examinations will be availed within one month of the announced results, the opportunity to review their graded examinations and appeal their grades if they choose so to do. The program Directors will not accept for consideration any appeal beyond this one month period.

## ***II) Preliminary Examination - Oral (required):***

A student becomes eligible to take the oral Preliminary Examination after successfully passing the written Qualifying Examination. This examination consists of an oral presentation on an advanced research topic suggested by the student to the student's advisory committee, which administers this examination. In preparation for this examination, the student must provide the committee with a paper (10 – 15 pages) outlining the advanced 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 including the minor subject.

The oral Preliminary Examination will normally be completed at the end of course work, before the student embarks on the dissertation. The student must pass this examination (as well as any remaining minor area requirements) before passing on to Candidacy.

### ***ADVISING***

**Academic Advisor:** Students admitted to the program will be assigned an **initial academic advisor** who may be consulted for advice on all the academic issues and the program. The Program Director is also available for general consultation. The student may change advisor upon the consent of the new faculty member and the approval of the Program Director who will also inform the original advisor of this switch. This academic advisor is the chair of the student's advisory committee.

**Advisory Committee:** Within one year of admission to the program, each student shall be assigned, in consultation with the Director of the Program, an academic advisory committee. This committee will consist of at least two members of the program's graduate training faculty (the student's major area), the student's academic advisor who will serve as its chair and at least one member from another area. This committee will guide the student's doctoral program, will approve the student's program of study and will oversee and conduct the oral qualifying exam in the student's research area, and the designation of a suitable **research committee** (and the advisory committee henceforth is abolished).

**Ph.D. Advisor and Research Committee:** Upon the successful passing of the oral qualifying examination, the student should identify, in consultation with the advisory committee, a professor from the program's graduate faculty who will serve as the student's primary research advisor and will direct the student's dissertation and will chair this committee. This advisor along with least two appointed members of the program's graduate training faculty, and at least one graduate faculty from outside of the program—will constitute the student research committee. The committee may consist of the same members as the student's original advisory committee, but is not required to be the same. This committee has the responsibility of supervising the research, reading the dissertation, and conducting the Ph.D. defense final examination.

### ***MINOR AREA***

In addition to the 45 credits of formal statistics/biostatistics coursework, the student must complete 12 credits of coursework as minor in an area related to any life and health sciences disciplines. The minor may be obtained in areas such as pharmacology and toxicology, epidemiology, genetics, biology, physiology, bioinformatics, health policy, translational science and health economics, among many others, and it must be approved by the student's advisory committee. Minors are structured by the minor department and requirements differ and some may include a Minor Area examination. Most minors have a requirement of 12 credits. Examples of Plans of Study for a minor area can be found in Appendix A.

### ***ADMISSION TO CANDIDACY***

Following the passing of the oral qualifying examination (and minor area examination, if applicable) and the completion of all required coursework, the student's advisory committee will nominate the student to candidacy. Upon approval by the dean of the IU Graduate School, the student will be admitted to candidacy.

## ***DISSERTATION***

The remaining credit hours, 27-33, to total 90 will be guided research dissertation hours. After passing the oral part of the qualifying examination (and the minor area examination, if applicable), and the formation of the Research Committee, the student's work on the dissertation may officially begin. The dissertation authored by the student, must contain original and publishable statistical/biostatistical research originating from and with application to well-defined life and health related problems. 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) 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 student must submit the completed written dissertation to the research committee for reading and evaluation and subsequently will have to present and defend it orally in a public forum before the committee. 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](#).

Dissertation of Three Publishable Papers: In lieu of the traditional dissertation, students may elect to write a dissertation that consists of an introduction, three papers of publishable quality and a conclusion. The Dissertation Committee must approve the selection of the three-paper option at the time of the proposal defense. Upon successful final oral defense, the papers are to be submitted to referenced journals. Evidence of manuscript submission, as determined at the defense, is required prior to final dissertation signatures. Guidelines for the Dissertation of Three Publishable Papers can be found [here](#).

## ***FINAL EXAMINATION (DEFENSE)***

Once the dissertation has been completed, the student must present and defend the contents of the dissertation or thesis before the Research Committee in an open colloquium or seminar. As an initial step in scheduling the defense, the student should submit an unbound copy of the dissertation to each member of the research committee. All members of the research committee should read the dissertation in its entirety before attending the defense. 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 should contain, 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 (defense) has been scheduled, the announced time and place of the defense must not be changed without the approval of the dean.

At the conclusion of the public presentation of the defense, the Research Committee may convene to an executive session with and without the student to further discuss the dissertation and its defense by the student. The Research Committee will conclude its deliberation with a vote on the outcome of the defense and examination (pass, conditional pass, deferred decision, or fail). The dissertation is finally 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). Please carefully follow the “Format Guide” available at the [IUPUI Graduate Office website](#).

## **General Requirements and Procedures**

### ***SATISFACTORY PROGRESS AND TERMINATION***

Students must maintain satisfactory progress towards their degree objective to ensure their continued good standing in the program and financial support. The minimum criteria for satisfactory progress are a GPA of 3.00 or above, satisfactory research progress, and completion of other degree requirements (written and oral qualifying examinations, minor area requirements, candidacy requirements). If at any time the GPA drops below 3.0, the student will be placed on academic probation. Financial support may be rescinded if the GPA is not increased to 3.0 in a reasonable time period. Further, if the student’s GPA in two consecutive semesters is below 3.0 the student’s standing in the Biostatistics PhD program will be terminated. In addition, credit towards the doctoral degree will not be given for any course in which the student obtains a grade of “B-” or below. This includes students’ work on their research. If, in the opinion of the research committee, satisfactory research progress is not being made, 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 research 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—especially if supported financially by the program. 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.

### ***ANNUAL REVIEWS***

All students in the program are required to file by June 1<sup>st</sup> of each year an annual report with their advisor and advisory or research committee. The annual report will cover all of the student’s academic activities in the previous year and will typically include summaries of all course work, teaching or service activities and research progress. This annual report will be an integral part of the annual review of the student’s progress conducted by the Advisor and Director which will provide written feedback to the student, including any recommendations or required actions. The feedback will be signed by the student’s committee chair as well as by the Director of the Program.

### ***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 toward 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 oral 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.

### ***FINANCIAL ASSISTANCE***

The Program offers financial support to qualified students in the form of Teaching or Research Assistantships or in the form of University Fellowships. In addition, supported students receive a fee scholarship, which remits most of the tuition costs and payment of the mandatory student health insurance premium. Student's financial support may be renewed for up to ten semesters, provided that the recipient is making satisfactory progress toward the degree and is discharging the teaching or research assignment in a quality and professional manner. Because the objective of the financial support of the stipend and fee scholarship is to provide the student with the opportunity to devote a full-time effort to their studies and research responsibilities ***it is expected that recipients will not hold any outside employment.***

### **Teaching Assistantships**

To qualify for a Teaching Assistantship, foreign students must take the SPEAK (oral English proficiency) exam administered by the IUPUI ESL program. Students who do not pass the exam would want to enroll in G020, *Communication Skills for TAs*, before retaking this exam.

Each semester the responsibilities of a teaching assistant will involve teaching related assignments (instruction, recitation, tutoring and or grading) of up to 20 hours per week during the Fall and Spring Semesters plus one of the six-week summer sessions. Vacation time to those receiving such assignments, is dictated by the academic calendar and it is not to exceed 4 weeks per academic year.

Students whose teaching performance is unsatisfactory will be notified; if, at the end of the following semester, sufficient improvement has not been made, support will be terminated.

### **Research Assistantships**

Some faculty of the program may have research grants that include 12-month stipend, tuition remission, and fees for graduate students assigned to work on the funded research project. The availability of research assistantships will vary each year among the investigators and the funded research projects in the departments. The awards are usually not made by the Department but rather are arranged with the major professor serving as a PI or the leading investigator of the funded research project.

Students supported in this manner are expected to devote up to 20 hours per week to their assigned responsibilities in the funded research project(s) during the year. Vacation time to those receiving such assignments, must be pre-arranged with the RA supervisor and it is not to exceed 4 weeks per year.

Students whose performance as RA on the assigned funded research project(s) is insufficient will be notified and given one semester to correct the deficiency, or support will be terminated.

### **University Fellowships**

Ph.D. students with outstanding credentials may receive competitive, first year IUPUI Fellowships. Stipends may vary from the usual Program's support levels but students are guaranteed these levels of stipend as a minimum, after the first year, contingent on their satisfactory performance. All first year Fellowships come with fee remission and graduate student health insurance.

## 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.

- **Appointment of Advisory Committee Form**

Within one year of admission, 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 (if already identified). The student should select at least one member to be the primary academic advisor.
- **Nomination of Candidacy Form**

Following the passing of the oral qualifying 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 successfully concluded the oral qualifying examination and consists of at least four faculty members, including the student's advisor and at least one member from outside the program faculty. 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 oral 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) 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 - PHD MINORS***

Examples of potential PhD minors can be found by visiting the following links:

Doctoral Minor in Epidemiology:

[http://pbhealth.iupui.edu/files/2013/9394/9489/EPI\\_PhD\\_Minor\\_2013.pdf](http://pbhealth.iupui.edu/files/2013/9394/9489/EPI_PhD_Minor_2013.pdf)

Doctoral Minor in Health Policy and Management:

[http://pbhealth.iupui.edu/files/1913/9394/9469/HPM\\_PhD\\_Minor\\_2013.pdf](http://pbhealth.iupui.edu/files/1913/9394/9469/HPM_PhD_Minor_2013.pdf)

## ***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, multi-classification, factorial, nested factorial, incomplete blocks, fractional replications, confounding, general mixed factorial, split-plot and optimum design. Use of existing statistical computing packages.

**PBHL–B 515 Biostatistical Practicum (1–3 cr.)** P: STAT 52100; PBHL B527, B546; 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.

**PBHL-B 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.

**PBHL–B 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 R and SAS.

**PBHL–B 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.

**PBHL–B 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**

**PBHL-B 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

**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-Nikodym 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.

**PBHL-B 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.

**PBHL-B 627 Statistics in Pharmaceutical Research (3 cr.)** P: STAT 51200; PBHL B527, B546. 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.

**PBHL-B 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.

**PBHL-B 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.

**PBHL–B 646 Advanced Generalized Linear Models (3 cr.)** P: PBHL B546. 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.

**PBHL-B 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.

**PBHL–B 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.

**PBHL-B 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***

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. **Jaroslav Harezlak**, Associate 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, 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. **Shanshan Li**, Assistant Professor of Biostatistics; PhD, Biostatistics, 2013, Johns Hopkins University. *Time dependent ROC analysis, functional data analysis, analysis of recurrent events*

10. **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*
11. **Hai Liu**, Assistant Professor of Biostatistics; Ph.D., Statistics, 2009, University of Iowa; *generalized additive models, semiparametric regression, mixed effects models, threshold models*
12. **Ziyue Liu**, Assistant Professor of Biostatistics; Ph.D., Biostatistics, 2010, University of Pennsylvania; *longitudinal data analysis, functional data analysis, time series analysis, clinical trials*
13. **Patrick O. Monahan**, Associate Professor of Biostatistics; Ph.D., Measurement and Statistics, 2002, University of Iowa; *psychometric methodologies applied to behavioral research*
14. **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*
15. **Susan M. Perkins**, Associate Professor of Biostatistics; Ph.D., Biostatistics, 1997, University of Michigan; *categorical data analysis, clinical trials design and analysis, behavioral research*
16. **Chandan K. Saha**, Associate Professor of Biostatistics; Ph.D., Biostatistics, 2001, University of Iowa; *statistical methods for longitudinal studies and clinical trials*
17. **Jyotirmoy Sarkar**, Chair and Professor of Statistics; Ph.D., Statistics, 1990, University of Michigan; *statistics, probability, economics*
18. **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*
19. **Fei Tan**, Assistant Professor of Statistics; Ph.D. Biostatistics 2009, Florida State University; *survival analysis, modeling of correlated binary data, mixed effects model*
20. **Wanzhu Tu**, Professor of Biostatistics; Ph.D., Statistics, 1997, University of South Carolina; *longitudinal data analysis, semiparametric regression.*
21. **Huiping Xu**, Assistant Professor of Biostatistics; Ph.D. Statistics, 2007, Purdue University; *latent variable analysis, longitudinal analysis, health services research.*
22. **Constantin Yiannoutsos**, Professor of Biostatistics; Ph.D., Statistics, 1991, University of Connecticut; *diagnostic test validation, longitudinal data analysis, clinical trials, HIV epidemiology*
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. **Ying Zhang**, Program Co-Director and Professor of Biostatistics; Ph.D. Statistics, 1998, University of Washington; *non-/semi-parametric inference, statistical methods for panel count and interval-censored data, joint modelling analysis of survival and longitudinal data, design of clinical trials, statistical computing and data mining*
25. **Wei Zheng**, Assistant Professor of Statistics; Ph.D., Statistics, 2011, University of Illinois, Chicago; *experimental Designs, time Series Analysis*

## **Campus and Department Resources**

### **ACADEMIC CALENDARS**

The Office of the Registrar maintains all academic calendars. The academic calendar can be access [here](#). To view the long term academic campus calendar, click [here](#).

### **ADAPTIVE EDUCATIONAL SERVICES**

[The Office of Adaptive Educational Services](#) actively works to make campus life and learning accessible for students with disabilities. Sign language interpreters, note takers, readers, exam proctors, and classroom accommodations are services offered by Adaptive Educational Services. For more information, call 274-3241 or [e-mail](#).

### **BOOKSTORE**

After you register, visit the bookstore website to view a complete textbook listing. Books are typically listed two weeks prior to the beginning of the semester.

IUPUI Campus Center, 1<sup>st</sup> floor  
420 University Blvd.  
278-BOOK  
[sm631@bncollege.com](mailto:sm631@bncollege.com) <http://iupui.bncollege.com/>

Ordering Textbooks Online: To order your textbooks online, visit the [IUPUI Jag Bookstore website](#) and create a student account. You can search for your books using the customized textbook listing, add them to your cart, pay for your books, and have them shipped to your home.

### **CAMPUS MAP**

Click [here](#) for an interactive IUPUI Campus Map.

### **COMPUTER LABS**

The Department of Public Health has created a multipurpose student work area in room EF 220. This area houses many resources that are available for DPH student use only.

- Windows computer lab with printing capabilities.
- Computer lab hours vary by semester. A current lab schedule will be posted in the lab.

### **Campus Computer Labs:**

- Business/SPEA Building Rooms: 3000 & 3005
- Eskenazie Hall Room: 185
- Information Technology Building Rooms: 131, 131A, 131B, 131C, 131D, & 131G
- School of Education/Social Work Rooms: 2119, 2121, & 2124
- School of Nursing Room: 342
- School of Science Room: SL 070A
- University Library third and fourth floors

## **COUNSELING AND PSYCHOLOGICAL SERVICES (CAPS)**

[Counseling and Psychological Services \(CAPS\)](#) provides direct professional psychological services, including crisis response, counseling, assessment, and referral, that are accessible to, and provide for, the general well-being of all IUPUI students. Appointments are free (except a one-time application fee).

### **E-MAIL**

E-mail is considered an appropriate mechanism for official communication from Indiana University to IU students. The University reserves the right to send official communications to students by email with the full expectation that students will receive e-mail and read these messages in a timely fashion.

Official university e-mail accounts are available for all students once they have been admitted to the university. Official university communications will be sent to students' official university e-mail addresses. For IUPUI, this is the @iupui.edu, @imail.iu.edu, or @umail.iu.edu address.

Students are expected to check their e-mail on a frequent and consistent basis in order to keep abreast of university-related communications. In addition to their university e-mail account, students should also check for course-related e-mail within OnCourse/Canvas. The same user ID and password are used for OnCourse/Canvas and the university e-mail system. For more information about OnCourse/Canvas, visit <https://OnCourse.iu.edu>.

Students who choose to have their e-mail forwarded to a private (non-IUPUI) e-mail address outside the official university network address, do so at their own risk. The University is not responsible for any difficulties that may occur in the proper or timely transmission or access of e-mail forwarded to any unofficial e-mail address, and any such problems will not absolve students of their responsibility to know and comply with the content of official communications sent to students' official IU e-mail addresses. Instructions on forwarding e-mail may be found at: <https://itaccounts.iu.edu>.

### **Help Desk Information:**

If you are having problems with the Account Management Service or need assistance, please contact your campus support center or help desk at: 317-274-4357 (274-HELP). Phone support is available 24 hours a day, seven days a week. You can also e-mail the Help Desk at [support@iupui.edu](mailto:support@iupui.edu).

## **FINANCIAL AID**

The Office of Student Financial Aid Services administers federal, state, university, and private funds in the form of scholarships, grants, loans, and work-study part-time employment. The Office of the Bursar disburses all financial aid, except work-study. Work-study students receive paychecks biweekly.

The [Office of Student Financial Aid Services](#) is located in the IUPUI Student Center room 250A. Students can contact the office by phone 317-274-4162 or FAX to 317-274-5930. Students can also email a [Financial Aid Advisor](#) for more information and resources.

## **IUPUI EMERGENCY WITHDRAWAL POLICY**

The policy detailing emergency withdrawal procedures at IUPUI is available at

[http://www.iupui.edu/~fcouncil/committees/academic\\_affairs/emergency\\_withdrawal\\_finalforannreport.pdf](http://www.iupui.edu/~fcouncil/committees/academic_affairs/emergency_withdrawal_finalforannreport.pdf)

## **IUPUI GRADUATE OFFICE**

The Graduate School Office offers several resources for PhD students. The office posts grant and research opportunities, and publishes A Guide to the Preparation of Theses and Dissertations along with graduation deadlines for candidates. The IUPUI Graduate Office website address is:

<http://graduate.iupui.edu/index.shtml>. Click on "Current Students."

## **IU WARE**

IUware is a software distribution service for Indiana University students, faculty, and staff. IUware offers a wide variety of software packages at no charge, including site-licensed products from Adobe, Microsoft, Symantec, Thomson Reuters, and others. Software packages include programs for reading email and web browsing, as well as antivirus and office applications. The university pays for the relevant licenses through agreements with vendors, allowing students, faculty, and staff to use the programs available through IUware free of charge. The IUware server is regularly updated, and so patches and upgrades for IU-supported software are consistently available.

## **LIBRARIES**

University Library Main Desk: 274-8278, Reference Desk: 274-0469

Hours:

Monday-Thursday	7:30am - Midnight
Friday	7:30am - 9:00pm
Saturday	8:00am - 6:00pm
Sunday	10:00am - Midnight

Ruth Lilly Medical Library: 274-7182

Monday-Friday	7:00am - 9:00pm
Saturday	8:30am - 9:00pm
Sunday	12:00pm - 9:00pm

Dental School Library: 274-7204

Monday-Thursday	7:30am - 10:00pm
Friday	7:30am - 5:00pm
Saturday	9:00am - 4:30pm
Sunday	1:00pm - 5:00pm

School of Law Library: 274-4028

Monday-Friday	8:00am 10:00pm
Saturday	9:00 am - 5:00pm
Sunday	1:00 pm - 9:00pm

## **ONCOURSE AND CANVAS**

Oncourse and [Canvas](#) are web-based teaching and learning environments. Oncourse and Canvas provide course descriptions, course syllabi, information about the instructors, and many other resources. You can find Oncourse and Canvas using the [OneStart portal](#). You may search Oncourse or Canvas at any time to find out more about courses that are of interest to you. Canvas is available for teaching IU courses beginning in summer 2014. During the transition from Oncourse to Canvas, all IU courses will appear automatically in both systems. Oncourse will continue to be available for teaching through summer 2016.

## **ONESTART**

[OneStart](#) is Indiana University's Web-based application portal that provides a common front door to online services at all IU campuses. For example, you may view your current schedule, Bursar and Financial Aid information, and your transcript. You may also change your mailing address on this system.

## **PARKING AND TRANSPORTATION**

Parking passes are available on-line at [IUPUI Parking Services](#). Students may purchase parking permits in person at the Parking Services office on Vermont Street, 1004 W. Vermont Street, Indianapolis, IN 46202. Parking Services hours: M-F: 8:00a.m. - 5:00 p.m. Questions can be directed to 274-4232. **Permits are no longer available through the registration process.**

## **PUBLIC SAFETY ESCORT**

If you are on campus alone at night, the Safety Escort Service can provide someone to walk or drive you to your car or another campus destination. Call 317-274-SAFE (7233). This service only operates on University and IU Health-related campus property.

## **REGISTRATION**

Students register for courses via [OneStart](#). Click [here](#) for the IUPUI Registration Guide.

### **Office of the Registrar**

IUPUI Campus Center Suite 250

420 University Boulevard

Indianapolis, IN 46202-5144

Telephone: (317) 274-1501

E-mail: [iupuireg@iupui.edu](mailto:iupuireg@iupui.edu)

Web address: <http://registrar.iupui.edu>

### *Hours of Operation:*

Monday – Thursday: 8:00 am – 6:00pm

Friday: 9:00 am – 5:00pm

Saturday: 9:00am – 12:00pm

## **STUDENT HEALTH SERVICES**

A student's health plays an important role in success in the academic environment. Our campus offers many resources and opportunities for students to find assistance with health concerns. All IUPUI students may receive care in the [IUPUI Health Service](#) office on a fee for service basis. All x-rays or referrals will be the responsibility of the student.

## **STUDENT INSURANCE PLANS**

The IU student health insurance plan is administered by Aetna Student Health. Information regarding rates, benefits, and provisions can be obtained by e-mailing: [studenthc@indiana.edu](mailto:studenthc@indiana.edu) or visiting: <http://health.iupui.edu/students/insurance.html>.

### **STUDENT ID CARDS**

The [IUPUI JagTag](#) is free to all enrolled students at IUPUI. The IUPUI JagTag can be used as campus identification, library card, print release validation card, physical education & recreation sports card, and Learning Center Cluster information card. The IUPUI JagTag may also be used by students, faculty and staff to purchase food and drinks from campus vending machines as well as from various dining locations across campus and around town.

### **UNIVERSITY ID NUMBER**

The university does not use social security numbers as a student's primary identification number. While in most cases, students will be able to complete their business with the university through [OneStart](#) by use of a user ID and password, there may be occasions when a student ID number may be required. Students may obtain their university ID numbers by viewing the “View My Personal Information” page in [OneStart](#) or by bringing photo identification to the Office of the Registrar.

### **UNIVERSITY WRITING CENTER**

[The University Writing Center \(UWC\)](#) supports faculty, staff and student writers by focusing on their individual needs in one-on-one conferences. Staff consists of faculty and carefully selected student tutors who strive to support and supplement classroom-writing instruction in all schools and disciplines on the IUPUI campus. The UWC does not fix papers for students. Its goal is to create better writers, rather than better papers, by guiding students toward strengthening their own writing skills. The UWC can also assist students needing help with resume writing and critiquing.

## **Student Involvement**

### **STUDENT LIFE**

[The Division of Student Life at IUPUI](#), as educators and advocates, provides student-centered services, consulting, facilities, learning experiences and programs for students, faculty, staff, alumni and the community.

### **STUDENT REPRESENTATION ON DEPARTMENT COMMITTEES**

#### ***PhD Program Committee***

This committee reviews proposals for new courses and dual degrees, recommends actions to the Faculty Committee, discusses issues related to the academic program, and reflects on short-term and long-term planning matters (public health competencies, course development, and curriculum content). The committee meets monthly during the fall and spring semesters. A PhD student representative is appointed by the PhD Student Association to sit on this committee.

#### ***PhD Student Association***

This association represents all students enrolled in FSPH PhD programs. Student leaders are actively involved in new student orientation, student gatherings, and philanthropic events. This committee meets monthly or as needed. Officers are elected annually by the PhD student body.

#### ***Graduate and Professional Student Organization (GPSG)***

The Graduate and Professional Student Organization is the graduate student government body on the campus of IUPUI. An FSPH PhD student is appointed to represent fellow PhD students at the IUPUI GPSG monthly meetings.

#### ***Ad Hoc Committees as needed***