Department of Biostatistics and Bioinformatics Courses (PHBI/PHDA/PHST)

PHBI 750 Statistics for Bioinformatics
Development of high throughput technologies has changed the face of biological sciences. The high dimensional complicated data generated from DNA sequences, amino acid sequences, genetic maps and polymorphic marker data etc. help to unravel the mysteries of many biological processes. However, sophisticated statistical methods and computational tools are needed to analyze these data. This course will introduce basics of genetics and introduction of such data, knowledge of statistical inference and probability, Introduction to stochastic processes, Analysis of DNA and protein sequences, Hidden Markov models, Evolutionary models etc. This course is developed for individuals interested in pursuing research in computational biology, genomics and bioinformatics. Students are expected to be familiar with some elementary statistics and probability concepts.

PHBI 751 High throughput data analysis
High-throughput technology has changed the dimension of biotechnology. The array of high-speed, highly automated biotechnical equipment DNA sequencers, microarray (DNA, Protein), proteomic analyzers (mass spectrometers) and cell sorters are all designed to capture and process vast amounts of biological data at high speeds. We will briefly discuss some of these technologies. Secondly, this course will concentrate with the process of microarray data mining (analysis) from beginning to end. In particular, this course will provide the researchers and practitioners guidelines to use appropriate statistical methodology for experimental design, image processing, normalization, identifying differentially expressed genes, clustering and classification techniques etc. Introduction to S-PLUS/R library for the data analysis will also be attempted

PHDA 601 Introduction to Medical Decision Analysis
Introduction to decision analysis in health care. Students will learn the principles and application of decision analysis and to use decision analysis software. Topics: identification of problems suitable for decision analysis, utility theory and measurement, importance and estimation of probability, creation/analysis of decision trees including sensitivity analysis, advanced methods of decision modeling, and illustration and presentation of results.

PHDA 603 Biostatistics-Decision Science Public Health Practicum I
A student is assigned to a health care agency and works with the staff of that agency on a policy issue facing that agency.

PHDA 604 Biostatistics-Decision Science Public Health Practicum II
A study is assigned to a health care agency and works with the staff of that agency on a policy issue facing that agency.

PHDA 605 Ethics and Bioethical Decision Making
A study of ethical issues in contemporary bioethics. Ethical dilemmas in medical science will be analyzed for the philosophical assumptions, interplay of facts and values, the role

of rules and principles, and the contextual factors involved. Such topics as abortion, elective death, genetic engineering, organ transplants, and health care reform will be explored.

PHDA 606 Health, Law & Policy
Introduce students to the broad legal and policy context of health care, with diverse topical areas that are useful for demonstrating the broad range of legal and policy responses.

PHDA 663 Decision Analysis
This course teaches methods for making decisions in complex situations especially those involving conflicting values, uncertainty, or risk. Thinking from the early foundations in economics through current methods is covered. Included are methods of value or utility elicitation and probability assessment. Analysis methods covered include decision trees, conjoint measurement, and multiattribute utility theory. Also covered are findings from psychology on cognitive errors, which are common in decision making.

PHDA 666 Master's Thesis Research
Mentored research; Thesis Preparation.

PHDA 673 Biostatistics-Decision Science Research
A doctoral student rotates through at least two research projects of the Biostatics-Decision Science Program faculty, conducting research and learning the details of the design, implementation, and analysis of the project. PHDA 673 must be taken initially during the first year of residence in the doctoral program. PHDA 673 may be repeated once, focusing on one research project of the Program Faculty, with the consent of the Graduate Studies Director or the student's major professor.

PHDA 690 Utility Theory and Assessment
A seminar course to study the theory, assessment, and use of utility in health care measurement and research.

PHDA 701 Advanced Medical Decision Making
A course to study advanced features of Medical Decision Making including theory, applications, model building, and analysis in health care research.

PHDA 777 Dissertation Research
The Ph.D. student may take a total of up to 24 hours credit for the planning, data collection, analysis, and writing of the research project that results in the doctoral dissertation. PHDA 777 must be taken under the direction of the student's major professor. Dissertation research hours are seen as a major component of the doctoral program.

PHST 600 Introduction to Biostatistics for Public Health
An introduction to descriptive and inferential statistics including descriptive methods and graphing, binomial and Gaussian probability theory, estimation, confidence intervals,

hypothesis testing, correlation, and regression. One-, two- and multi-group parametric and nonparametric methods will be introduced. Sampling distributions covered include the Z, t, F, and Chi-squared distributions. Multivariate methods will be introduced.

PHST 602 Biostatistics-Decision Science Seminar
Students are given an evaluation protocol for each semester and must turn in a written evaluation of the presentation. The protocols will vary according to the presentation topic, but each will focus on a critical component of research design or analysis.

PHST 610 Statistical Computing and Data Management for Public Health
This course addresses data processing, data management and statistical computing tools utilized most often in the field of public health. Additionally, this course will allow the public health student to master skills in preparing and analyzing public health research data through the use of software packages such as Excel, EPI DATA and SPSS. Emphasis will be on storing and manipulating research data, along with elementary and moderate level data analyses.

PHST 620 Introduction to Statistical Computing
This course addresses fundamentals of statistical computing with special emphasis on software tools employed most often in biostatistics. This course will develop essential skills associated with the preparation and statistical analysis of research data through the use of statistical software packages, such as SAS, SPSS and other software. Emphasis will be on research data management, implementation and interpretation of basic statistical procedures, and documentation of coding and other work.

PHST 630 Applied Statistical Methods
Topics will include linear and multiple regression, analysis of variance, analysis of covariance, logistic regression, survival analysis using Cox regression, and repeated measures. These will be addressed from an applications standpoint, without derivations or other theoretical development. Emphasis will be placed on appropriate use of the different models and interpretation of parameter estimates, etc. Students completing this course will develop the ability to apply statistical methods as implemented in commonly used statistical software and facilitate communication between health sciences researchers and statisticians with regard to interpretation of data analyses and research findings.

PHST 640 Statistical Methods for Research Design in Human Studies
Statistical methods for clinical research and interpretation of the literature. Course includes basic features of design and analysis of clinical research studies looking at cause and effect relationships, surveys, case control studies, cohort studies, and randomized controlled trials. Topics include sampling, sample size calculations, matching, confounding, and methods for analysis of simple and complex studies.

PHST 650 Advanced Topics in Biostatistics
A treatment of one or more topics in advanced biostatistics not usually covered in a regularly offered course. May be repeated under different subtitles.

PHST 660 Mathematical Tools
This course focuses on the basic techniques of analytic geometry, differential and integral calculus, and matrix algebra; topics include limits, the chain rule, higher-order derivatives, partial derivatives, integration by parts, improper integrals, multiple integrals, sequences and series, vector and matrix arithmetic, and eigenvalues

PHST 661 Probability
This course in introductory probability theory; includes probability spaces, random variables, probability distributions, moments, moment generating functions, mathematical expectation, joint distribution, transformations of random variables, sampling distributions.

PHST 662 Mathematical Statistics
This course in introductory statistical theory; includes limiting distributions, central limit theorem, point estimation, maximum likelihood estimation, least squares, sufficiency and completeness, confidence intervals, Bayesian estimation, Neyman-Pearson theory of hypothesis testing, statistical power, uniformly most powerful tests, likelihood ratio tests, non-central distributions, advanced topics as time permits.

PHST 671 Special Topics in Biostatistics and Decision Science
A treatment of one or more topics in advanced Biostatistics and /or Decision Science not usually covered in a regularly offered course. May be repeated under different subtitles.

PHST 675 Independent Study in Biostatistics
Advanced study conducted under the direction of a faculty member. May be repeated under different subtitles.

PHST 680 Biostatistical Methods I
A mathematically sophisticated presentation of principles and methods of: exploratory data analysis; statistical graphics; point estimation; interval estimation; hypothesis testing of means, proportions and counts; chi square analysis; rate ratio; and Mantel- Haensel analysis. Matrix algebra is required. Data sets will be analyzed using statistical computer packages; examples will be drawn from the biomedical and public health literature. Emphasis will be placed on methods and models most useful in clinical research.

PHST 681 Biostatistical Methods II
A mathematically sophisticated introduction to: general linear models; regression; correlation; analysis of covariance; one and two-way analysis of variance; and multiple comparisons. Matrix algebra is required. Data sets will be analyzed using statistical computer packages; examples will be drawn from the biomedical and public health literature. Emphasis will be placed on methods and models most useful in clinical research.

PHST 682 Multivariate Statistical Analysis

Focuses on the multivariate statistical methods; topics include the multivariate normal distribution, inference for mean vectors; inference for covariance and correlation matrices, analysis of covariance structure, analysis of serial measurements, factor analysis, and discriminant analysis. Instruction will also be given in the proper use of software to carry out these analyses. Emphasis will be placed on methods and models most useful in clinical research.

PHST 683 Survival Analysis
Focuses on statistical methods for analyzing survival data, including both parametric and nonparametric methods. Topics include life-table analysis, proportional hazard models, log-rank tests, parametric survival distributions, graphical methods, and goodness- of -fit tests. Emphasis will be placed on methods and models most useful in clinical research.

PHST 684 Categorical Data Analysis
Focuses on statistical methods for analyzing survival data, including both parametric and nonparametric methods. Topics include life-table analysis, proportional hazard models, log-rank tests, parametric survival distributions, graphical methods, and goodness- of -fit tests. Emphasis will be placed on methods and models most useful in clinical research.

PHST 691 Bayesian Inference and Decision
Focus on the use of Bayesian probability and statistics in both scientific inference and formal decision analysis. The frequency and subjective interpretations of probability are explored, as well as probability and decision making.

PHST 710 Advanced Statistical Computing I
This course will cover modern/classical statistical/biostatistical methods like smoothing techniques and data summaries, linear models, generalized linear models, modern nonlinear regression techniques, multivariate statistics using S-PLUS/R and SAS. Several real data examples will be analyzed following the 4th Edition of the book titled "*Modern Applied Statistics with S*" by Venables and Ripley.

PHST 711 Advanced Statistical Computing II
The course covers advanced topics in statistical computing, with an emphasis on biostatistical applications. Topics include matrix factorization methods, numerical optimization, the EM algorithm, random number generation, Monte Carlo techniques, simulation, randomization and resampling methods, bootstrapping, and recursive partitioning. Computer programming will be conducted using MATLAB, R, and SAS IML.

PHST 724 Advanced Clinical Trials
Advanced statistical methods for design and analysis of clinical trials. Content includes analysis of complex clinical trial designs, including post-stratification, cross-over, and phases I, II, and III clinical trials. Sample size calculations will be covered. Interim analysis methods and sample size re-estimation methods will be developed.

PHST 725 Design of Experiments

The course introduces experimental design principles and covers specific designs in detail. Topics include the completely randomized design, the randomized complete block design, cross-over designs, nested and hierarchical designs, factorial treatment arrangements, incomplete block designs, response surface methodology, and optimal designs. Concepts will be illustrated using examples from the health sciences.

PHST 726 Clinical Trials Statistics Laboratory
Statistical methods laboratory to accompany PHCI 624: Clinical Trials I, a.k.a. Design of Clinical Trials. Statistical methods described in Clinical Trials I will be demonstrated and taught with hands-on examples and homework problems. Methods covered include randomization methods, sample size calculations, post-stratification, Phase II early-stopping designs, repeated-measures analysis, survival analysis, and methods to avoid or reduce multiplicity.

PHST 762 Advanced Statistical Inference
This course is a mathematically sophisticated introduction to the theory and methods of statistical inference. Students will learn fundamental technical tools that are essential to carry out methodological research in the field of Biostatistics. Emphasis will be placed on how to correctly propose statistical methods in a general setting including concepts such as asymptotic unbiasedness, robust variance estimation and efficiency.

PHST 780 Advanced Nonparametrics
An introduction to the theory of linear models, with an emphasis on health sciences applications. Topic A mathematically advanced introduction to theory and methods of nonparametric statistical methods. Course will be useful to students planning to analyze data that do not follow a standard parametric distribution.

PHST 781 Advanced Linear Models
An introduction to the theory of linear models, with an emphasis on health sciences applications. Topic coverage includes projections, distributions of quadratic forms under normality, estimation procedures, general linear hypotheses, estimating and testing linear parametric functions, simultaneous inference, multifactor ANOVA models, hierarchical linear models, mixed effects models, and covariance parameter estimation methods. Examples will be illustrated using advanced statistical software.

PHST 782 Generalized Linear Models
Advanced statistical methods using inference based on the exponential family of distributions. Relationship to linear and non-linear regression. Theoretical development of link functions. Model-building and assessment of goodness-of-fit. Estimation and hypothesis testing. Correlated response methods using generalized estimating equations.

PHST 783 Advanced Survival Analysis
This course is a mathematically advanced introduction to the theory and methods of survival analysis. This course will be useful for students planning to analyze complex event time data including multivariate survival and multistate data. Also it will be useful

for students who are planning to carry out research in the general area of survival analysis.

PHST 785 Non-Linear Regression
Advanced statistical methods for non-linear models. Review of linear models and intrinsically linear models. Survey of generalized linear models. Development of nonlinear models, with emphasis on uses in Phase I clinical trials, relationship to differential equations. Estimation and goodness-of-fit. Sample size methods.