Harvard University PhD Program in Health Policy
Evaluative Science and Statistics Concentration
2009-2010

General description of the evaluative science concentration:

Training in this concentration will enable students to study the effects of a wide range of policies and health services (e.g., health insurance, health-care quality improvement, clinical decision-making, drug policy, cost-containment, and socioeconomic factors) on behaviors, access, processes and quality of health care, health outcomes, or costs. Students in this concentration will develop proficiency in experimental and quasi-experimental research design, statistics, relevant social sciences, and other methodological approaches (e.g., epidemiology, program evaluation, qualitative methods, and survey design). Previous students in this track have used innovative methodological and statistical approaches to study, for example:

POLICY EVALUATION
- Impact of acquiring Medicare coverage on the health of previously uninsured adults
- Effects on health behavior of insurance restrictions on maternity lengths of stay
- Effects of drug coverage on access to essential medications in Medicare
- Effects of regulatory changes in legal drinking ages on health and mortality

QUALITY OF CARE AND CLINICAL DECISION-MAKING
- Effects of physician experiences with adverse medical events on under-prescribing of essential medicines
- A controlled natural experiment on the effectiveness of direct to consumer drug advertising

DISPARITIES
- Effects of near-universal Medicare coverage on disparities in cardiovascular disease and diabetes control
- Methods to estimate racial/ethnic health care disparities and their effects on health

COMPARATIVE HEALTH POLICY
- International differences in health outcomes following medical care for acute myocardial infarction

POPULATION HEALTH
- Effects of unemployment on mortality

Click to view descriptions of dissertation research for all graduates of the Evaluative Science and Statistics track.

Courses for students in the evaluative science concentration:
The course requirements for the evaluative science and statistics concentration were selected to provide students with important skills needed for conducting original health policy research; at the completion of coursework, students should be able to propose feasible study designs to answer health policy questions, using both experimental and quasi-experimental designs, as well as identify the strengths and limitations of the various designs in their proposed work and in other published studies. They also will develop strong analytical skills, including the technical expertise required to analyze data as well as interpret results, identify the strengths and limitations of analyses, and the broader implications of results for future health policy.

The following course requirements encompass both statistics and research design. Students are required to take at least 5 credits of statistics; students should be proficient in linear, logistic and survival regression analyses upon completion of statistics-related coursework. Students are also strongly recommended to develop skills in hierarchical modeling and analysis of survey data, either through coursework or outside study. Incoming students should also be aware that many of the intermediate and advanced courses have prerequisites, some courses are only offered in alternative academic years, and that scheduling conflicts do occur. Due to these issues, incoming students are recommended to plan a tentative 2-year course program early in the first year, and to consult with more senior students about their tentative program for

additional feedback and suggestions. In planning such a program, students are encouraged to follow a basic sequence of courses *within a particular school or department* (i.e., Biostatistics, Statistics, Economics, or KSG) as opposed to selecting from multiple schools/departments (See pg. 4 for suggested sequences). This is recommended in order to facilitate a more coherent presentation of the fundamentals. Subsequently, students are encouraged to choose courses based on interests and career objectives from among all schools/departments. Evaluative science and statistics course requirements are in addition to, but may overlap with the core requirements required of all students.

Required Courses (*Note: 1 credit = 1 semester*):

❖ **Social Sciences/Related Fields (2 credits)**
- Economics (program requirement)
- Law
- Political Science
- Psychology
- Sociology/Organizational Behavior

❖ **Statistics (5 credits)**
- Probability Theory (1 credit)
- Statistical Inference (1 credit)
- Regression (1 credit)
- Other Data Analyses (2 credits)

❖ **Evaluative Sciences (3.5 credits)**
- Research Design and Methods (1 credit)
- Specific Methodological Approaches (2.5 credits)
  - Decision Sciences (program requirement)
  - Epidemiology (program requirement)
  - Program Evaluation
  - Qualitative Research
  - Survey Research Methods
  - Other

Minimum Course Requirements: Statistics

	Semester	Time
Probability Theory (1 credit)		
Statistics 110: Introduction to Probability	Fall	*M, W, F, 12*
Economics 2110[1]: Introductory Probability and Statistics for Economists	Fall	*M, W, 10–11:30*
Biostatistics 222[1]: Basics of Statistical Inference	Fall	*Tu, Th, 8:30–10:20*
Statistics 210: Probability Theory	Fall	*M, W, 2:30–4:-00*
Biostatistics 230: Probability Theory and Applications I	Fall	*M, W, 8:30–10:20*
Statistical Inference (1 credit)		
Statistics 111: Introduction to Theoretical Statistics	Spring	*Tu, Th, 1–2:30*
Economics 2110[1]: Introductory Probability and Statistics for Economists	Fall	*M, W, 10–11:30*
Biostatistics 222[1]: Basics of Statistical Inference	Fall	*Tu, Th, 8:30–10:20*
Statistics 211: Statistical Inference	Spring	*M, W, 2:30–4:-00*
Economics 1127: Statistical Methods for Evaluating Causal Effects	Spring	*Tu, Th, 2:30–4*
Statistics 220: Bayesian Data Analysis	Fall	*Tu, Th, 2:30–4*
Biostatistics 231: Statistical Inference I	Spring	*M, W, 10:30–12:20*
API-209: Advanced Quantitative Methods I: Statistics	Fall	*Tu, Th, 1:10–2:30*
Regression (1 credit)		
Statistics 139: Statistical Sleuthing Through Linear Models	Fall	*Tu, Th, 10–11:30*
Biostatistics 211: Regression and Analysis of Variance in Exper Research	Fall	*Tu, Th, 3:30–5:20*
Biostatistics 213: Applied Regression for Clinical Research	Fall	*M, W, 8:30–10:20*
EDU S-030 A,B: Intermediate Statistics: Applied Regression and Data Analysis	Spring	*(A) Tu, Th, 10–11:30; (B) Tu, Th, 1 –2:30*
GHP 525: Econometrics for Health Policy	Spring	*T, Th, 8:30–10:20*
Economics 1123: Introduction to Econometrics	Fall/Spring	*(F) Tu, Th, 11:30–1; (S) Tu, Th, 1–2:30*
Biostatistics 235[2]: Regression and Analysis of Variance	Fall	*M, W, 10:30–12:20*
Economics 2120: Introduction to Applied Econometrics	Spring	*Tu, Th, 2:30–4*
API-210: Advanced Quantitative Methods II: Econometric Methods	Spring	*Tu, Th, 10:10–11:30*
Other Data Analyses (2 credits)		
Biostatistics 210: Analysis of Rates and Proportions	Fall/ Spring	*(F) M, W, 8:30–10:20;* *(S)Tu, Th, 8:30 –10:20*
Biostatistics 233: Methods II	Spring	*M, W, 8:30–10:20*
EDU S-052: Applied Data Analysis	Fall	*Tu, Th, 11:30–1:00*
Biostatistics 232: Methods I	Fall	*M, W, 10:30–12:20*
Biostatistics 223: Applied Survival Analysis and Discrete Data Analysis	Spring	*Tu, Th, 10:30–12:20*
Biostatistics 226: Applied Longitudinal Analysis	Spring	*Tu, Th, 1:30–3:20*
EDU S-077: Applied Longitudinal Data Analysis	Spring	*Th, 1–4*
Statistics 131: Time Series Analysis and Forecasting	Fall	*M., W., 1-2:30*
Economics 2130: Applied Econometrics	Spring	(Not offered 2009-10)
Economics 2140: Econometric Methods	Fall	*Tu, Th, 11:30–1*
Statistics 149: Statistical Sleuthing Through Generalized Linear Models	Spring	*M, W, 2:30–4*
Government 2001: Advanced Quantitative Research Methodology	Spring	*M, 2–4*
Statistics 160: Design and Analysis of Sample Surveys	Fall	*M, W, 2:30–4*
Calculus/Linear Algebra (Not required)		
Math 1b: Calculus, Series, and Differential Equations	Fall/Spring	*M, W, F, 9 or 10 or 11 or 12* *or Tu, Th, 10–11:30 or 11:30–1*
Mathematics 20. Algebra and Multivariable Mathematics for Social Sciences	Fall/Spring	*M, W, F, 9 (fall) 10 (spring)*

For statistics course descriptions, refer to pages 10-17.

[1] Satisfies both probability theory and statistical inference course requirements

[2] Very theoretical and requires previous applied regression course

Minimum Course Requirements: Evaluative Sciences

	Semester	Time
Research Design and Methods ***(Must take one of the following 1.0 credit courses)***		
SHH245: Social and Behavioral Research Methods	Fall	*Tu, Th, 8:30–10:20*
Psychology 2100: Research Methodology	Spring	*Tu, Th, 8:30–10:00*
Specific Methodological Approaches ***(Take 2.5 credits from courses in any of the six categories below.)***		
Decision Sciences		
API-302: Analytic Frameworks for Policy	Fall	*Tu, Th, 10:10–11:30*
RDS280: Decision Analysis for Health and Medical Practices	Fall 2	*Tu, Th, 1:30–3:20*
RDS282: Cost-Effectiveness and Cost-Benefit Analysis for Program Evaluation	Spring 2	*M, W, 1:30–3:20*
Epidemiology[3]		
EPI200: Principles of Epidemiology (program requirement)	Fall 1	*Tu, Th, 8:30–9:20*
EPI202: Elements of Epidemiologic Research	Fall 2	*Tu, Th, 10:30–12:20*
EPI207: Advanced Epidemiologic Methods	Fall 1	*M, W, 3:30–5:20; Th, 8:30–10:20*
EPI241: Measuring Health Status	Fall 2	(Not offered 2009-10)
Program Evaluation		
EDU S-013: Empirical Analysis and Program Evaluation in Education	Fall	(Not offered 2009-10)
API-208: Program Evaluation: Estimating Program Effectiveness with Empirical Analysis	Spring	(Not offered 2009-10)
Qualitative Research		
Sociology 209: Qualitative Social Analysis: Seminar	Spring	*T, 10–12*
EDU S-504: Introduction to Qualitative Research	Fall	*F, 9-12*
EDU S-520: The Logics of Qualitative Research Methods	Spring	(Not offered 2009-10)
SHH235: Qualitative Research Methods for Public Health	Spring 2	(Not offered 2009-10)
Survey Research Methods and Sampling (*highly recommended*[4])		
Biostatistics 212: Survey Research Methods in Community Health	Spring	*W, 3:30–5:20*
Statistics 160: Design and Analysis of Sample Surveys	Fall	*M, W, 2:30–4:00*
Other		
EPI203: Study Design in Epidemiologic Research	Spring 2	*Tu, Th, 3:30–5:20*
EPI204: Analysis of Case-Control and Cohort Studies	Spring 2	*Tu, Th, 10:30–12:20*
SHH263: Multilevel Statistical Methods: Concept and Application	Spring	*M, W, 10:30–12:20*
HBS 4070: Design of Field Research Methods	Spring	*Tu 12-3*
Statistics 140: Design of Experiments	Spring	*Tu, Th, 11:30–1*
GOV 2010: Strategies of Political Inquiry	Fall	*W, 2–4*
Statistics 240: Matched Sampling and Study Design	Fall	*W 10-12*

For evaluative science course descriptions, refer to pages 16-21.

[3] Program Requirement

[4] Because survey data are frequently used in health policy research, students are strongly recommended to take at least one of the survey research methods and sampling courses

Suggested sequences of statistics courses

	Fall 1st year	**Spring 1st year**	**Fall 2nd year**	**Spring 2nd year**
Biostatistics (Level 1)	BIO232 BIO222	BIO233 or BIO210; BIO211	BIO226	BIO223
Biostatistics (Level 2)	BIO230 BIO232	BIO231 BIO233	BIO226	BIO223 BIO235
Statistics (Level 2)	STAT 110	STAT 111	STAT 139	STAT 149 GOV 2001
Statistics (Level 3)	STAT 210	STAT 211	STAT 220	STAT 214
Econometrics (Level 1)	API-209	API-210	ECON 2120	
Econometrics (Level 2)	ECON 2110	ECON 2120		STAT 214

List of current students who have taken each course.

	Chace	Graves	Faden	Pande	Reiss	Shei
Probability Theory (1 credit)						
Statistics 110: Introduction to Probability						
Economics 2110: Introductory Probability & Stats for Economists		2006				2006
Biostatistics 222: Basics of Statistical Inference	2007		2008	2007	2005	
Statistics 210: Probability Theory						
Biostatistics 230: Probability Theory & Applications I						
Statistical Inference (1 credit)						
Statistics 111: Intro to Theoretical Statistics						
Economics 2110: Introductory Probability & Stats for Economists		2006				2006
Biostatistics 222: Basics of Statistical Inference	2007		2008	2007	2005	
Statistics 211: Statistical Inference						
Economics 1127 / Statistics 186: Statistical Methods for Evaluating Causal Effects		2008				
Statistics 220: Bayesian Data Analysis						
Biostatistics 231: Statistical Inference I						
Regression (1 credit)						
Statistics 139: Statistical Sleuthing Through Linear Models						
Biostatistics 211: Regression & Analysis of Variance in Exper Res	2005					2005
Biostatistics 213: Applied Regression for Clinical Research			2008	2004	2004	
EDU S-030 A,B: Applied Regression & Data Analysis						
PIH525: Econometrics for Health Policy				2005		2006
Economics 1123: Intro to Econometrics						
Biostatistics 235: Regression & Analysis of Variance						
Economics 2120: Intro to Applied Econometrics		2007				2007
Other Data Analyses (2 credits)						
Biostatistics 210: Analysis of Rates & Proportions	2005			2003		
Biostatistics 233: Methods II						
EDU S-052: Applied Data Analysis	2008					
Biostatistics 232: Methods I						
Biostatistics 223: Applied Survival Analysis	2009	2008	2009	2009	2006	2007
Biostatistics 226: Applied Longitudinal Data Analysis	2009		2009	2009	2006	
EDU S-077: Applied Longitudinal Data Analysis						
Statistics 131: Time Series Analysis and Forecasting						
Economics 2130: Applied Econometrics						
Economics 2140: Applied Econometrics						

	Chace	Graves	Faden	Pande	Reiss	Shei
Statistics 149: Statistical Sleuthing Through Generalized Linear Models						
Govt 2001: Advanced Quantitative Research Methodology		2008		2008	2007	
Statistics 160: Design and Analysis of Sample Surveys	2007	2007				2007
Calculus/Linear Algebra (Not required)						
Math 1b: Calculus, Series, & Differential Equations						
Math 20: Intro to Linear Algebra & Multivariable Calculus						
Evaluative Sciences						
GOV 2010: Designing Political Inquiry						
SHH245: Social and Behavioral Research Methods, Part I				2007	2006	
Psychology 2100: Research Methodology	2008	2008				2008
Decision Sciences						
API-302: Analytic Frameworks for Policy						2005
RDS280: Decision Analysis for Health & Medical Practices	2004	2006	2008	2007	2004	2004
RDS282: Cost-Effectiveness & Cost-Benefit Analyses				2009	2005	2006
Epidemiology						
EPI200: Intro to Epidemiology (program requirement)		2007			2003	
EPI202: Elements of Epidemiologic Research				2003	2003	
EPI207: Advanced Epidemiologic Methods						
EPI241: Measuring Health Status (0.5 credit)						
Program Evaluation						
HPM212: Program Evaluation in Health Policy						
EDU S-013: Evaluation of Programs and Policies						
API-208: Program Evaluation	2008	2007		2008	2006	2008
Qualitative Research						
Sociology 209: Qualitative Social Analysis						
EDU S-520: The Logic of Qualitative Research Methods						
SHH235: Qualitative Research Methods				2008		
Survey Research Methods and Sampling (*highly recommended*)						
BIO212: Survey Research Methods in Community Health						
Statistics 160. Survey Methods						
Other						
EPI203: Design of Case Control and Cohort Studies						
EPI204: Analysis of Case Control and Cohort Studies						
SHH263: Multilevel Methods for Health and Social Behavioral Research				2005		

	Chace	Graves	Faden	Pande	Reiss	Shei
HBS 4070: Design of Field Research Methods						
Statistics 140: Design of Experiments						

Faculty Associated with the Evaluative Science and Statistics Concentration

Stephen Soumerai
Co-chair, Professor of Ambulatory Care and Prevention, Harvard Medical School
Alan Zaslavsky
Co-chair, Professor of Health Care Policy (Statistics), Harvard Medical School
Alberto Abadie
Professor of Public Policy, Harvard Kennedy School
Alyce S. Adams
Research Scientist, Kaiser Permanente
John Z. Ayanian
Professor of Health Care Policy and Medicine, Harvard Medical School
Professor in the Department of Health Policy and Management, Harvard School of Public Health
Niteesh K. Choudhry
Assistant Professor of Medicine, Harvard Medical School
Arnold M. Epstein
John H. Foster Professor of Health Policy and Management, Harvard School of Public Health
Professor of Medicine and Health Care Policy, Harvard Medical School
Majid Ezzati
Associate Professor of International Health, Harvard School of Public Health
Guido Imbens
Professor of Economics, Faculty of Arts and Sciences
Gary King
Albert J. Weatherhead III University Professor, Faculty of Arts and Sciences
Mary Beth Landrum
Associate Professor of Health Policy (Biostatistics), Harvard Medical School
Dan Levy
Lecturer in Public Policy and Faculty Chair, MPA Programs, Harvard Kennedy School
Richard J. Light
Walter H. Gale Professor of Education, Harvard Graduate School of Education and Harvard Kennedy School
Barbara J. McNeil
Ridley Watts Professor of Health Care Policy, Harvard Medical School
Professor of Radiology, Harvard Medical School
J. Michael McWilliams
Assistant Professor of Health Care Policy and Medicine, Harvard Medical School
Carl N. Morris
Professor of Statistics, Faculty of Arts and Sciences
Sharon-Lise Normand
Professor of Health Care Policy (Biostatistics), Harvard Medical School
Professor in the Department of Biostatistics, Harvard School of Public Health
Dennis Ross-Degnan
Associate Professor of Ambulatory Care and Prevention, Harvard Medical School
Donald B. Rubin
John L. Loeb Professor of Statistics, Faculty of Arts and Sciences
Katherine Swartz
Professor of Health Economics and Policy, Harvard School of Public Health

Evaluative Science and Statistics Concentration Course Descriptions

Please Note: The following list is meant to give students the "official" course descriptions. It may not contain fully up to date semester and week times or faculty members. Courses not being offered for this academic year are labeled accordingly. Please refer to the online course catalogs to confirm faculty members and course times.

Course Descriptions: Statistics

Probability Theory (1 credit)

- **Statistics 110. Introduction to Probability**
  Catalog Number: 0147
  Joseph K. Blitzstein
  Half course (fall term). M., W., F., at 12, and a section to be arranged. EXAM GROUP: 5

A comprehensive introduction to probability. Basics: sample space, conditional probability, Bayes Theorem. Univariate distributions: mass functions and density, expectation and variance, binomial, Poisson, normal, and gamma distributions. Multivariate distributions: joint and conditional distribution, independence, transformation, multivariate normal and related distributions. Limit laws: probability inequalities, law of large numbers, central limit theorem. Markov chains: transition probability, stationary distribution and convergence.
Note: When taken for a letter grade, this course meets the Core area requirement for Quantitative Reasoning. *Prerequisite:* Mathematics 19a or equivalent or above required (may be taken concurrently), Mathematics 19b or equivalent or above recommended.

Economics 2110. Introductory Probability and Statistics for Economists
Catalog Number: 7213
Rustam Ibragimov
Half course (fall term). M., W., 10–11:30. EXAM GROUP: 3, 4
Introduction to probability and statistics. Emphasis on general methods applicable to both econometrics and economic theory. Topics include probability spaces, random variables, limit laws, estimation, hypothesis testing, and Bayesian methods.
Prerequisite: Statistics (Stat 100), Linear Algebra and Calculus (Math 21a and 21b), and Real Analysis (Math 112).

- **BIO222 Basics of Statistical Inference**
  Fall
  Dr. P. Williams
  5 credits
  Lectures, laboratories. Two 1.5 hour-sessions each week. One 2-hour lab each week.

This course will provide a basic, yet thorough introduction to the probability theory and mathematical statistics that underlie many of the commonly used techniques in public health research. Topics to be covered include probability distributions (normal, binomial, Poisson), means, variances and expected values, finite sampling distributions, parameter estimation (method of moments, maximum likelihood), confidence intervals, hypothesis testing (likelihood ratio, Wald and score tests). All theoretical material will be motivated with problems from epidemiology, biostatistics, environmental health and other public health areas. This course is aimed towards second year doctoral students in fields other than Biostatistics. Background in algebra and calculus required.

Course Note: One intermediate level biostatistics course such as BIO 210, or BIO 211, or signature of the instructor required; lab or section times to be announced at first meeting. (5.06)

- **Statistics 210. Probability Theory**
  Catalog Number: 2487
  Carl N. Morris and Joseph K. Blitzstein

Half course (fall term). M., W., 2:30–4. EXAM GROUP: 7, 8
Random variables, measure, representations. Families of distributions: Multivariate Normal, conjugate, marginals, mixtures. Conditional distributions and expectation. Convergence, laws of large numbers, and central limit theorems. Markov chains and martingales.
Prerequisite: Statistics 110 or equivalent required; Statistics 111 or equivalent recommended.

❖ **BIO230 Probability Theory and Applications I**
Dr. A. Schwartzman
5 credits
Lectures, laboratories. Two 2-hour sessions each week. One 2-hour lab each week.

Axiomatic foundations of probability, independence, conditional probability, joint distributions, transformations, moment generating functions, characteristic functions, moment inequalities, sampling distributions, modes of convergence and their interrelationships, laws of large numbers, central limit theorem, and stochastic processes.
Course Note: Enrollment in the Biostatistics department, or BIO 222, or signature of instructor required; lab or section times to be announced at first meeting; cross-listed: HSPH student must register for HSPH course.

Statistical Inference (1 credit)

Statistics 111. Introduction to Theoretical Statistics
Catalog Number: 1946
Carl N. Morris
Half course (spring term). M., W., 2:30–4. EXAM GROUP: 7, 8
Inference: frequency, Bayes, decision analysis, foundations. Likelihood, sufficiency, and information measures. Models: Normal, exponential families, multilevel, and non-parametric. Point, interval and set estimation; hypothesis tests. Computational strategies, large and moderate sample approximations.
Prerequisite: Statistics 111 and 210 or equivalent.

❖ **Economics 2110: Introductory Probability and Statistics for Economists**
(Course information on page 10)

❖ **BIO222: Basics of Statistical Inference**
(Course information on page 10)

❖ **Statistics 211. Statistical Inference**
Catalog Number: 1836
S.C. Samuel Kou
Half course (spring term). Tu., Th., 1–2:30, and a weekly section to be arranged. EXAM GROUP: 15, 16
Basic concepts of statistical inference from frequentist and Bayesian perspectives. Topics include maximum likelihood methods, confidence and Bayesian interval estimation, hypothesis testing, least squares methods and categorical data analysis.
Prerequisite: Mathematics 19a and 19b or equivalent and Statistics 110.

❖ **Economics 1127 / Statistics 186. Statistical Methods for Evaluating Causal Effects**
Catalog Number: 9967
Donald B. Rubin
Half course (spring term). Tu., Th., 2:30–4. EXAM GROUP: 16, 17
Statistical methods discussed for inferring causal effects from data from randomized experiments or observational studies. Students will develop expertise to assess the credibility of causal claims and the ability to apply the relevant statistical methods for causal analyses. Examples will come from many disciplines: economics, education, other social sciences, epidemiology, and biomedical science. Evaluations of job training programs, educational voucher schemes, changes in laws such as minimum wage laws, medical treatments, smoking, military service.
Prerequisite: Statistics 100 or preferably Statistics 111; Mathematics 20.

❖ **Statistics 220. Bayesian Data Analysis**
Catalog Number: 6270
Donald B. Rubin and S.C. Samuel Kou
Half course (fall term). Tu., Th., 2:30–4. EXAM GROUP: 16, 17
Basic Bayesian models, followed by more complicated hierarchical and mixture models with nonstandard solutions. Includes methods for monitoring adequacy of models and examining sensitivity of models.
Note: Emphasis throughout term on drawing inferences via computer simulation rather than mathematical analysis.
Prerequisite: Statistics 110 and 111.

❖ **BIO231 Statistical Inference I**

Dr.Y. Li

5 credits

Lectures, laboratories. Two 2-hour sessions each week. One 1.5-hour lab each week.

A fundamental course in statistical inference. Discusses general principles of data reduction: exponential families, sufficiency, ancillarity and completeness. Describes general methods of point and interval parameter estimation and the small and large sample properties of estimators: method of moments, maximum likelihood, unbiased estimation, Rao-Blackwell and Lehmann-Scheffe theorems, information inequality, asymptotic relative efficiency of estimators. Describes general methods of hypothesis testing and optimality properties of tests: Neyman-Pearson theory, likelihood ratio tests, score and Wald tests, uniformly and locally most powerful tests, asymptotic relative efficiency of tests.

Course Note: BIO 230 or signature of instructor required; lab or section time to be announced at first meeting; cross-listed: HSPH student must register for HSPH course.

❖ **API-209: Advanced Quantitative Methods I: Statistics**

Dan Levy

Fall: Tu, Th, F, 1:10–2:30

The goal of this course is to prepare students to analyze public policy issues using statistics. It covers topics in the areas of probability theory, sampling, estimation, hypothesis testing, and regression analysis. While many students taking this class will have already taken courses in statistics and regression analysis, this course will probably place a much stronger emphasis than typical courses on conceptually understanding the statistical methods. Since the course is targeted to first-year students in the MPA/ID program, we will not shy away from using the mathematical tools needed to develop the conceptual understanding. But the emphasis of the course will be on the conceptual understanding and application of the tools rather than on the math or the mechanics behind the tools.

Prerequisites: Multivariate calculus or linear algebra.

Note: This course is open to non-MPA/ID students only by permission of the instructor. May not be taken for credit with API-201.

Regression (1 credit)

❖ **Statistics 139. Statistical Sleuthing Through Linear Models**

Catalog Number: 1450

Members of the Department

Half course (fall term). Tu., Th., 10-11:30, and a weekly section to be arranged. EXAM GROUP: 12, 13

A serious introduction to statistical inference where linear models and related methods are used. Topics include the pros and cons of t-tools and their alternatives, multiple-group comparisons, linear regressions, model checking and refinement. Emphasis on statistical thinking and tools for real-life problems, application to current events whenever relevant.

Prerequisite: Statistics 100 or equivalent and Mathematics 19a and 19b or equivalent.

❖ **Statistics 149. Statistical Sleuthing Through Generalized Linear Models**

Catalog Number: 6617

Members of the Department

Half course (spring term). M., W., 2:30–4. EXAM GROUP: 7, 8

A sequel to Statistics 139, emphasizing common methods for analyzing categorical data. Topics include mixed effects model, contingency tables, log-linear models, logistic, Probit and Poisson regression, model selection, and model checking. Examples will be drawn from several fields, particularly from biology and social sciences.

Prerequisite: Statistics 139 or permission of instructor.

❖ **BIO211 Regression and Analysis of Variance in Experimental Research**

Fall

Dr. C. Hu

5 credits

Lectures, laboratories. Two 1.5-hour sessions each week; one 1-hour lab each week.

Covers analysis of variance and regression, including details of data-analytic techniques and implications for study design. Also included are probability models and computing. Students learn to formulate a scientific question in terms of a statistical model, leading to objective and quantitative answers.

Course Note: BIO 200, or BIO 201, or BIO 202 and BIO 203, or BIO 206 and one of BIO 207, BIO 208, or BIO 209, or

signature of instructor required; lab or section times to be announced at first meeting. (5.06)

- **BIO213 Applied Regression for Clinical Research**

  Fall
  Dr. E. J. Orav
  5 credits
  Lectures. Two 2-hour sessions each week. One 1.5-hour lab each week.

This course will introduce students involved with clinical research to the practical application of multiple regression analysis. Linear regression, logistic regression and proportional hazards survival models will be covered, as well as general concepts in model selection, goodness-of-fit, and testing procedures. Each lecture will be accompanied by a data analysis using SAS and a classroom discussion of the results. The course will introduce, but will not attempt to develop the underlying likelihood theory. Background in SAS programming ability required.
Course Note: BIO 200, or BIO 201, or BIO 202 and BIO 203, or BIO 206 and one of BIO 207, BIO 208, or BIO 209, or signature of instructor required; lab or section times to be announced at first meeting. (5.06)

- **EDU S-030 A, B Intermediate Statistics: Applied Regression and Data Analysis**
  Stephanie Jones
  Half-course; Spring 2010
  Section A: Tuesday and Thursday, 10:00 a.m. - 11:30 a.m.
  Section B: Tuesday and Thursday, 1:00 p.m. - 2:30 p.m.

Are scores on high-stakes tests primarily a function of socioeconomic status? Do mandatory seat belt laws save lives? In this class, students will learn how to use a set of quantitative methods referred to as the general linear model--regression, correlation, analysis of variance, and analysis of covariance--to address these and other questions that arise in educational, psychological, and social research. Using dozens of real data sets as catalysts, we will discuss how to (1) formulate interesting research questions; (2) select appropriate statistical techniques; (3) conduct necessary calculations; (4) examine assumptions necessary for the technique to work appropriately; (5) interpret analytic results; (6) identify rival explanations of the results; and (7) summarize the findings in a cogent and convincing argument. Because quantitative skills are learned best through practice, computer-based statistical analyses will be an integral part of the course.
Prerequisite: An introductory statistics course at the level of S-012/S-010Y or permission of the instructor.

- **GHP 525 Econometrics for Health Policy**
  Spring
  Dr. G. Fink
  5 credits
  Lectures. Two 2-hour sessions each week and one optional lab each week.

This is a course in applied econometrics for doctoral and advanced master level students. The course has two primary objectives: (1) to develop skills in linking economic behavioral models and quantitative analysis, in a way that students can use in their own research; (2) to develop students' abilities to understand and evaluate critically other peoples' econometric studies.

The course focuses on developing the theoretical basis and practical application of the most common empirical models used in health policy research. In particular, it pays special attention to a class of models identifying causal effects in observational data, including instrumental variable estimation, simultaneous equations and two-stage-least-squares, quasi-experiments and difference-in-difference method, sample selection, treatment effect models and propensity score methods.

Lectures will be complemented with computer exercises building on public domain data sets commonly used in health research. The statistical package recommended for the exercises is Stata.
Course Note: Students are expected to be familiar with probability theory (density and distribution functions) as well as the concepts underlying basic ordinary least square (OLS) estimation.
Course Activities: Optional review and computer lab sessions will be held.

- **Economics 1123. Introduction to Econometrics**
  Catalog Number: 0813
  Raffaella Giacomini (UCLA and UCL) (fall term) and Keisuke Hirano (University of Arizona) (spring term)
  Half course (fall term; repeated spring term). Fall: Tu., Th., 11:30–1; Spring: Tu., Th., 1–2:30, and a weekly section to be arranged. EXAM GROUP: Fall: 13, 14; Spring: 15, 16

An introduction to multiple regression techniques with focus on economic applications. Discusses extensions to discrete response, panel data, and time series models, as well as issues such as omitted variables, missing data, sample selection,

randomized and quasi-experiments, and instrumental variables. Aims to provide students with an understanding of and ability to apply econometric and statistical methods using computer packages.
Note: Students may take either Economics 1123 or Statistics 139 for credit. Statistics 139 will not count as econometrics requirement. Also, Economics 1123 may not be taken for credit if taken after Economics 1126, but credit will be given for both courses if Economics 1123 is taken first. This course, when taken for a letter grade, meets the Core requirement for Quantitative Reasoning.
Prerequisite: Statistics 100.

❖ **BIO235 Regression and Analysis of Variance**

Fall
Dr. M. Zelen
5 credits
Lectures, laboratories. Two 2-hour sessions each week. One 2-hour lab each week.

This is an advanced course in data analysis for linear models - regression and analysis of variance. Estimation methods (maximum likelihood and least squares) and issues of inference (confidence intervals, hypothesis testing, analysis of residuals) are presented from a theoretical and data analysis perspective. Background in matrix algebra and linear regression required. *Course Note:* BIO230 and BIO232, or signature of instructor required; lab or section times to be announced at first meeting; cross-listed, HSPH student must register for HSPH course. *(5.06)*

❖ **Economics 2120. Introduction to Applied Econometrics**
Catalog Number: 2352
Dale W. Jorgenson
Half course (spring term). Tu., Th., 2:30–4. EXAM GROUP: 16, 17
Introduction to methods employed in applied econometrics, including linear regression, instrumental variables, panel data techniques, generalized method of moments, and maximum likelihood. Includes detailed discussion of papers in applied econometrics and computer exercises using standard econometric packages.
Note: Enrollment limited to PhD candidates in economics, business economics, health policy, public policy, and political economy and government (PEG).
Prerequisite: Economics 2110 or equivalent.

❖ **Economics 2130. Applied Econometrics (Not offered 2009-10)**
Half course (spring term). Hours to be arranged.
Advanced methods in applied econometrics, including nonlinear regression, discrete and limited dependent variables, models of selection, and stationary and non-stationary time series. Includes detailed discussion of empirical applications.
Note: Expected to be given in 2009–10. Students complete a short research project in applied econometrics.
Prerequisite: Economics 2120 or equivalent.

❖ **Economics 2140. Econometric Methods**
Catalog Number: 7210
Guido W. Imbens
Half course (fall term). Tu., Th., 11:30–1, and a one-hour weekly section to be arranged. EXAM GROUP: 13, 14
Econometric methods for cross-section and panel data. Topics include generalized method of moments, empirical likelihood, instrumental variables, bootstrapping, clustering, treatment effects, selection bias, difference-in-differences, qualitative choice, quantile regression, nonparametric methods, and semiparametric methods.
Prerequisite: Economics 2120 or equivalent.

❖ **API-209: Advanced Quantitative Methods II: Econometric Methods**
Alberto Abadie
Fall: Tu, Th, 10:10–11:30; F, 1:10–2:30 or 2:30–4:00,
Intended as a continuation of API-209, Advanced Quantitative Methods I, this course focuses on developing the theoretical basis and practical application of the most common tools of empirical analysis including non-linear models, instrumental variables, and panel data. Foundations of analysis will be coupled with hands-on examples and assignments involving the analysis of data sets.
Prerequisite: API-209 or permission of instructor.
Note: This course is open to non-MPA/ID students only by permission of the instructor. May not be taken for credit with API-202.

Other Data Analysis (2 credits)

- **BIO210 Analysis of Rates and Proportions**
  Fall
  Dr. M. Pagano
  5 credits
  Lectures, laboratories. Two 1.5-hour sessions each week. One 1.5-hour lab each week.

Emphasizes concepts and methods for analysis of data which are categorical, rate-of-occurrence (e.g., incidence rate), and time-to-event (survival duration). Stresses applications in epidemiology, clinical trials, and other public health research. Topics include measures of association, 2x2 tables, stratification, matched pairs, logistic regression, model building, analysis of rates, and survival data analysis using proportional hazards models.

Course Note: BIO 200, or BIO 201, or BIO 202 and BIO 203, or BIO 206 and one of BIO 207, BIO 208, or BIO 209, or signature of instructor required; lab or section times to be announced at first meeting. (5.06)

- **BIO233 Methods II**
  Spring
  Dr. B. Coull
  5 credits
  Lectures, laboratories (optional). Two 2-hour sessions each week. One 1.5-hour lab each week.

Intermediate course in the analysis of Gaussian, categorical, and survival data. The generalized linear model, Poisson regression, random effects and mixed models, comparing survival distributions, proportional hazards regression, splines and smoothing, the generalized additive model.

Course Note: BIO 232, or signature of instructor required; lab or section times to be announced at first meeting.

- **EDU S-052 Applied Data Analysis**
  John B. Willett
  Half-course; Fall 2009
  Tuesday and Thursday, 11:30 a.m. - 1:00 p.m.

S-052 is designed for those who want to extend their data-analytic skills beyond a basic knowledge of multiple regression analysis, and who want to communicate their findings clearly to audiences of researchers, scholars, and policymakers. The course contributes directly to the diverse data-analytic toolkit that the well-equipped empirical researcher must possess in order to perform sensible analyses of complex educational, psychological, and social data. Topics in the course include more extensive use of transformations in regression analysis, influence statistics, building and comparing taxonomies of regression models, general linear hypothesis testing, an introduction to multilevel modeling, nonlinear regression analysis, binomial and multinomial logistic regression analysis, principal components analysis, cluster analysis, introduction to discrete-time survival analysis, dealing with missing data, and others. S-052 is an applied course that offers conceptual explanations of statistical techniques, along with opportunities to examine, implement, and practice them in real data. Learning the computer skills necessary to conduct these kinds of analyses, and the communication skills to discuss them, is an integral part of the course. No more than 20 non-HGSE students will be permitted to enroll in the course.
Prerequisite: Successful completion of S-030, or permission of the instructor.

- **BIO232 Methods I**
  Fall
  Dr. V. DeGruttola
  5 credits
  Lectures. Two 2-hour sessions each week.

Introductory course in the analysis of Gaussian and categorical data. The general linear regression model, ANOVA, robust alternatives based on permutations, model building, resampling methods (bootstrap and jackknife), contingency tables, exact methods, logistic regression.
Course Note: Enrollment in the Department of Biostatistics, or signature of instructor required; lab or section times to be announced at first meeting; cross-listed: HSPH student must register for HSPH course.

❖ **BIO223 Applied Survival Analysis and Discrete Data Analysis**

Spring
Dr. Lee-Jen Wei
5 credits
Lectures. Two 2-hour sessions each week. One 1-hour optional lab each week.

This course will cover topics in both discrete data analysis (25% of class) and applied survival analysis (75% of class). The course will begin with a review of sampling plans and contingency table for discrete data. Further topics in discrete data analysis will include logistic regression, exact inference, and conditional logistic regression. This short survey of discrete data topics will provide a natural transition to analysis of survival data. Survival topics include: hazard, survivor, and cumulative hazard functions, Kaplan-Meier and actuarial estimation of the survival distribution, comparison of survival using log rank and other tests, regression models including the Cox proportional hazards model and accelerated failure time model, adjustment for time-varying covariates, and use of parametric distributions (exponential, Weibull) in survival analysis. Class material will include presentation of statistical methods for estimation and testing, along with current software (SAS, Stata, Splus) for implementing analyses of discrete data and survival data. Applications to real data will be emphasized.
Course Note: BIO 210 and BIO 213, or BIO 230 required, or signature of instructor.

❖ **BIO226 Applied Longitudinal Analysis**

Spring
Dr. M. Hughes
5 credits
Lectures, laboratories. Two 2-hour sessions each week.

This course covers modern methods for the analysis of repeated measures, correlated outcomes and longitudinal data, including the unbalanced and incomplete data sets characteristic of biomedical research. Topics include an introduction to the analysis of correlated data, repeated measures ANOVA, random effects and growth curve models, and generalized linear models for correlated data, including generalized estimating equations (GEE).
Course Activities: Homework assignments will focus on data analysis in SAS using PROC GLM, PROC MIXED, and PROC GENMOD.
Course Note: BIO 211, BIO 213, or BIO 232, or signature of instructor required; lab or section times will be announced at first meeting.

❖ **EDU S-077: Applied Longitudinal Data Analysis**

Spring
John B. Willett

Researchers in education and the social sciences often pose research questions about change and event occurrence over time. For instance, a researcher investigating the development of reading skills in young children might ask: How rapidly do children's reading skills develop as they age, and do the skills of boys and girls develop at different rates? Alternatively, her questions could be framed in terms of whether and when children achieve particular developmental milestones. Then, she would ask: When does a child make the transition from "learning to read" to "reading to learn," and do children exposed to innovative reading programs make the transition at different ages? Answering these kinds of questions requires longitudinal (panel) data and the application of innovative statistical methods. The goal of S-077 is to introduce two of these methods: individual growth modeling and survival analysis. The course is a seminar in which class members must take individual responsibility for reading new material, preparing written answers to discussion questions, and providing feedback to peers. Class members will also conduct an original research project of their own devising, using the new methods; make a public presentation of their findings; and submit a final paper of their original research. The nature of the research projects is negotiable, but must directly advance class members' professional and scholarly agenda. Enrollment is limited to advanced students who have completed the S-052 course, have arranged access to appropriate longitudinal data, and have proposed a suitable research project.

❖ **Statistics 131. Times Series Analysis and Forecasting**

Catalog Number: 8291
Tirthankar Dasgupta
Half course (fall term). M., W., 1–2:30. EXAM GROUP: 6, 7

An introduction to time series models and associated methods of data analysis and inference. Auto regressive (AR), moving average (MA), ARMA, and ARIMA processes, stationary and non-stationary processes, seasonal processes, auto-correlation and partial auto-correlation functions, identification of models, estimation of parameters, diagnostic checking of fitted models, forecasting, spectral analysis, and transfer function models.
Prerequisite: Statistics 111 and 139 or equivalent.

❖ **Economics 2130: Applied Econometrics**
(Course information on page 14)

❖ **Economics 2140 Econometric Methods**
(Course information on page 14)

❖ **Government 2001. Advanced Quantitative Research Methodology**
Catalog Number: 8941
Gary King
Half course (spring term). M., 2–4. EXAM GROUP: 7, 8
Introduces theories of inference underlying most statistical methods and how new approaches are developed. Examples include discrete choice, event counts, durations, missing data, ecological inference, time-series cross sectional analysis, compositional data, causal inference, and others.
Prerequisite: Government 1000 or the equivalent.

❖ **Statistics 160: Design and Analysis of Sample Surveys**
Catalog Number: 2993
Alan M. Zaslavsky (Medical School)
Half course (fall term). M., W., 2:30–4. EXAM GROUP: 7, 8
Methods for design and analysis of sample surveys. The toolkit of sample design features and their use in optimal design strategies. Sampling weights and variance estimation methods, including resampling methods. Brief overview of nonstatistical aspects of survey methodology such as survey administration and questionnaire design and validation (quantitative and qualitative). Additional topics: calibration estimators, variance estimation for complex surveys and estimators, nonresponse, missing data, hierarchical models, and small-area estimation.
Prerequisite: Statistics 111 or 139 or permission of instructor.

Calculus

❖ **Mathematics 1b. Calculus, Series and Differential Equations**
Catalog Number: 1804 Enrollment: Normally limited to 30 students per section.
Matthew P. Leingang, John Duncan, and Rehana Patel (fall term); Matthew P. Leingang (spring term)
Half course (fall term; repeated spring term). Fall: Section I, M., W., F., at 9 (with sufficient enrollment); Section II, M., W., F., at 10; Section III, M., W., F., at 11; Section IV, M., W., F., at 12; Section V, Tu., Th., 10–11:30; Section Vl, Tu., Th., 11:30–1. Spring: Section I, M., W., F., at 10; Section II, Tu.Th. 10-11:30 (with sufficient enrollment) and a weekly problem section to be arranged. EXAM GROUP: 1
Speaking the language of modern mathematics requires fluency with the topics of this course: infinite series, integration, and differential equations. Model practical situations using integrals and differential equations. Learn how to represent interesting functions using series and find qualitative, numerical, and analytic ways of studying differential equations. Develop both conceptual understanding and the ability to apply it.
Note: Required first meeting in fall: Monday, September 18, 8:30 am, Science Center C. Required first meeting in spring: Wednesday, January 31, 8:30 am, Science Center A. This course, when taken for a letter grade, meets the Core area requirement for Quantitative Reasoning.
Prerequisite: Mathematics 1a, or Xa and Xb, or equivalent.

❖ **Mathematics 20. Algebra and Multivariable Mathematics for Social Sciences**
Catalog Number: 0906
Rehana Patel (fall term); Rehana Patel (spring term) Half course (fall term; repeated spring term).
M., W., F., at 10, and a weekly problem section to be arranged. EXAM GROUP: 3
Introduction to linear algebra, including vectors, matrices, and applications. Calculus of functions of several variables, including partial derivatives, constrained and unconstrained optimization, and applications. Covers the topics from Mathematics 21a,b which are most important in applications to economics, the social sciences, and some other fields. *Note:* Should not ordinarily be taken in addition to Mathematics 21a,b. Examples drawn primarily from economics and the social sciences though Mathematics 20 may be useful to students in certain natural sciences. This course, when taken for a letter
grade, meets the Core area requirement for Quantitative Reasoning.
Prerequisite: Mathematics 1b or equivalent, or an A or A- in Mathematics 1a, or a 5 on the AB or a 3 or higher on the BC Advanced Placement Examinations in Mathematics.

Course Descriptions: Evaluative Sciences

Research Design and Methodology

- **SHH245 Social and Behavioral Research Methods**
  Fall
  Dr. S. Gortmaker, Dr. L. Berkman
  5 credits
  Seminars. Two 2-hour sessions each week.

Provides a broad overview of social and behavioral research methodology, including experimental, quasi-experimental and non-experimental research design, measurement, sampling, data collection, and testing causal theories. By case studies, methodological readings, discussion, written assignments, and data analytic homeworks students learn to conduct social and behavioral research and more applied program evaluations. Homework includes analytic work with observational and experimental studies and development of new measures. Course Activities: Assigned readings, class participation, homeworks, reflections, two papers.
Course Note: BIO 210, BIO 211 or BIO 213 or equivalent required; enrollment limited to 20; a multivariate statistics course strongly recommended; course primarily for doctoral students.

- **Psychology 2100. Research Methodology**
  Catalog Number: 8552
  J. Richard Hackman
  Half course (spring term). Tu., Th., 8:30-10

How to conduct empirical research, primarily with human participants. Topics include formulating problems, design strategies, developing and validating concepts, designing and assessing measures and manipulations; issues in data collection, analysis, and interpretation; and publishing findings.
Note: Limited to doctoral students. Offered alternate years.

Decision Sciences

- **API-302 Analytic Frameworks for Policy**
  Richard Zeckhauser
  Fall - Tu, Th, 10:10-11:30; F, 1:10-2:30

Develops abilities in using analytic frameworks in the formulation and assessment of public policy. Considers a variety of analytic techniques, particularly those directed toward uncertainty and interactive decision problems. Emphasizes the application of techniques to policy analysis, not formal derivations. Students encounter case studies, methodological readings, the computer, a final exam, and challenging problem sets.
Prerequisites: An understanding of intermediate-level microeconomic theory and introductory techniques of optimization and decision analysis, API-101, API-102, or equivalent.

- **RDS280 Decision Analysis for Health and Medical Practices**
  Fall 2
  Dr. S. Goldie
  2.5 credits
  Lectures. Two 2-hour sessions each week.

This course is designed to introduce the student to the methods and growing range of applications of decision analysis and cost-effectiveness analysis in health care technology assessment, medical decision making, and health resource allocation. The objectives of the course are: (1) to provide a technical understanding of the methods used, (2) to give the student an

appreciation of the practical problems in applying these methods to the evaluation of clinical interventions and public health policies, and (3) to give the student an appreciation of the uses and limitations of these methods in decision making at the individual, organizational, and policy level both in developed and developing countries.
Course Note: Introductory course in probability and statistics required; BIO200, BIO201, or BIO203 may be taken concurrently; introductory economics is recommended but not required.

❖ **RDS282 Cost-Effectiveness and Cost-Benefit Analysis for Health Program Evaluation**
Spring
Dr. J. Salomon
2.5 credits
Lectures, seminars. Two 2-hour sessions each week.
Provides an introduction to methods for economic evaluation of health and environmental programs, including theory and applications. Topics include theory of benefit-cost and of cost-effectiveness analysis, definition and methods for estimating costs, stated-preference and revealed-preference methods for valuing health and mortality risk, quality adjusted life years.
Course Note: Introductory decision analysis (e.g. RDS280, HPM286) and economics (e.g. HPM205, HPM206) are recommended.

Epidemiology

❖ **EPI200 Principles of Epidemiology**
Fall 1
Dr. J. Buring
2.5 credits
Lectures, seminars. Two 1-hour sessions and one 2-hour seminar each week.
Introduces the basic principles and methods of epidemiology. Lectures are complemented by seminars devoted to exercises or to the discussion of current examples of epidemiologic studies.
Course Activities: Lectures, seminar participation, midtem, final examination.
Course Note: Thursday or Friday lab required. The registration process for EPI200 requires that students first sign up for an appropriate lab (EPI200L) section before enrollment in the course can be completed. Credit is not given for more than one of EPI 200, EPI 201 or EPI 208.

❖ **EPI202 Elements of Epidemiologic Research**
Fall 2
Dr. M. Mittleman
2.5 credits
Lectures, seminars. Two 2-hour sessions and one 2-hour seminar each week
Introduces elements of study design, data analysis and inference in epidemiologic research. Principles and methods are illustrated with examples, and reviewed through homework and in-class exercises. May serve as an introduction to more advanced study or as a concluding course for those desiring a working knowledge of epidemiologic methods.
Course Note: EPI 201 or EPI208 required - concurrent enrollment permitted; BIO 200; or BIO 200s and BIO 200t; or BIO 201 or BIO 202 and 203; or BIO 205; or BIO 219; or BIO 206 and BIO 207, BIO 208 or BIO 209 required - concurrent enrollment permitted. Thursday or Friday lab required; sign up for appropriate section at first class meeting.

❖ **EPI207 Advanced Epidemiologic Methods**
Fall 1
Dr. J. Robins, Dr. M. Hernan
2.5 credits
Lectures. Two 2-hour sessions and one 2-hour lab each week.
Provides an in-depth investigation of statistical methods for drawing causal inferences from observational studies. Informal epidemiologic concepts such as confounding, selection bias, overall effects, direct effects, and intermediate variables will be formally defined within the context of a counterfactual causal model and with the help of causal diagrams. Methods for the analysis of the causal effects of time-varying exposures in the presence of time dependent covariates that are simultaneously confounders and intermediate variables will be emphasized. These methods include g-computation algorithm estimators, inverse probability weighted estimators of marginal structural models, g-estimation of structural nested models. As a

practicum, students will reanalyze data sets using the above methods.
Course Activities: Class discussion, homework, practicum and final examination.
Course Note: EPI204 and BIO210, or BIO233, or signature of instructor required; familiarity with logistic regression and survival analysis is expected; lab time will be announced at first meeting.

❖ **EPI241 Measuring Health Status (Not offered 2009-10)**
Dr. J. Page, Dr. E. F. Cook
2.5 credits
Lectures. One 2-hour session each week.
Examines methodologic issues related to measures of health and disease status encountered in clinical research. Topics to be covered include instrument development, scaling, space assessment of reliability, validity and responsiveness to change; principal component analysis and factor analysis; diagnostic test evaluation. Course Activities: Class discussion, examination, paper. Course *Note:* Minimum enrollment of 10 students required.

Program Evaluation

❖ **EDU S-013 Empirical Analysis and Program Evaluation in Education (Not offered 2004-09)**
Richard J. Light
This course provides a broad overview of ways to gather, analyze, and interpret data to improve education programs. It is a combination of statistics and program evaluation taught for practitioners. Topics will include standard statistical methods such as probability distributions, sample proportions and sample means, confidence intervals, hypothesis testing, regression and correlation analysis, and chi-square analyses for data in tables. A section of this course will focus in detail on research design, including random and stratified sampling, and randomization versus observational studies. Another section will introduce meta-analysis for aggregating findings across different education studies to make policy decisions. Classes will emphasize three themes: choosing an effective design to gather data, analyzing imperfect or messy data, and interpreting findings from several studies to make a decision, even when those findings conflict. All students will be asked to prepare several written interpretations of actual educational policy studies. There will also be three examinations.

❖ **API-208 Program Evaluation: Estimating Program Effectiveness with Empirical Analysis**
Alberto Abadie
Spring - Tu, Th,1:10-2:30; F, 11:40-1 Review
Program evaluation comprises a set of statistical tools for assessing the impact of public interventions. This methodological course will develop students' skills in quantitative program evaluation. Students will study a variety of evaluation designs (from random assignment to quasi-experimental evaluation methods) and analyze data from actual evaluations, such as the national Job Training Partnership Act Study. The course evaluates the strengths and weaknesses of alternative evaluation methods. This course meets the PhD requirement for empirical methods.
Prerequisite: Familiarity with the basic concepts of statistical inference and regression analysis (such as API-202 or API-210).

Qualitative Research

❖ **Sociology 209. Qualitative Social Analysis: Seminar**
Catalog Number: 1198
Orlando Patterson
Half course (fall term).T. 10-12. EXAM GROUP: 3, 4
Examines methodological approaches to non-numerical data used by social scientists to obtain valid, reliable, and meaningful insight into the social world through the analysis of ethnographic field notes, interview transcripts, archival and other interpretative data.
Note: Required of and limited to first-year graduate students in Sociology.

❖ **EDU S-520 The Logics of Qualitative Research (Not offered 2009-10)**
Half-course
Spring 2007 Monday and Wednesday, 12:00 p.m. - 2:00 p.m.
This course exposes students to the theory and practice of qualitative research. It distills knowledge from the social sciences and humanities, presenting qualitative inquiry as an art and a science. Students will learn to approach qualitative research as an iterative, "discovery" process. The course is designed to deepen students' thinking about their qualitative research interests, questions, and various epistemological and intellectual conflicts in doing social analysis. Five topics will be covered: paradigms and perspectives in qualitative inquiry (e.g., positivism, interpretivism, hermeneutics, constructivism, "critical" theory, and cultural studies); various strategies of inquiry and design options (e.g., case studies, ethnography, life history, and

portraiture); methods of collecting and analyzing empirical materials (e.g., moving from structured interview questions to narrative text); practices of interpretation, representation, and evaluation (e.g., influencing public debate and policy process with qualitative research); and key debates within the field (e.g., ethics and politics of qualitative research). Students are expected to attend class regularly, participate in class discussions, prepare for class presentations, and conduct written assignments. The final project is a research proposal. This course is required of all doctoral students. Permission of the instructor is required. Preference will be given to those doctoral students who have completed either or both of the fall qualitative modules (S-710B, S-710C); and/or A-010X.
Prerequisite: S-710B and/or S-710C.

❖ **SHH235 Qualitative Research Methods for Public Health (Not offered 2009-10)**
Spring 2
Dr. E. Barbeau
2.5 credits
Lectures, seminars. One 3-hour session each week.
Qualitative research can be used alone or in combination with quantitative research to investigate public health questions. This introductory-level course begins by examining when it is appropriate to use qualitative methods in public health research. The course then explores specific topics, including: developing research questions, sampling, data collection methods (focusing on interviews, focus groups, observation and document review), data management and analysis, and combining qualitative and quantitative research methods. Students will be required to apply concepts covered in class through an assignment to collect and
analyze qualitative data.
Course Activities: Class discussion, primary data collection and analysis using qualitative research methods.
Course Note: Enrollment limited to 30 students; ordinal grading option only.

❖ **S-504 Introduction to Qualitative Research**
(Formerly titled Doing and Writing about Qualitative Research)
Fall
Vanessa L. Fong
Friday 9-12
How does one collect, analyze, and write about data collected from a small number of people who were neither randomly sampled nor numerous enough to serve as the basis for statistically significant generalizations about the populations from which they are drawn? This course will teach students to answer this question by providing a survey of various kinds of qualitative research methods; walking them through the process of formulating a research question; selecting the kinds of research participants and qualitative research methods that can answer the research question; collecting qualitative data to answer the question; analyzing the data; finding the proper fit between theories, data, and practice; and writing an academic paper based on the data. Each student will write a paper based on a small research project (on a topic of the student's own choosing), and develop the skills to evaluate various qualitative research methods through close readings of scholarly work and discussions of student research projects in small workshops. No prerequisites or previous course work is necessary for this course. This course fulfills the qualitative research methods requirement for first-year doctoral students and the research methods and data analysis requirement or the culture and social development requirement for Human Development and Psychology master's students.

Survey Research Methods and Sampling

❖ **BIO212 Survey Research Methods In Community Health**
Spring
Dr. T. Mangione (P), Dr. L. Ryan (S)
2.5 credits
Lectures. One 2-hour session each week.
Covers research design, sample selection, questionnaire construction, interviewing techniques, the reduction and interpretation of data, and related facets of population survey investigations. Focuses primarily on the application of survey methods to problems of health program planning and evaluation. Treatment of methodology is sufficiently broad to be suitable for students who are concerned with epidemiological, nutritional, or other types of survey research.

❖ **Statistics 160. Design and Analysis of Sample Surveys**
(Course information on page 18.)

Other

- **EPI203 Study Design in Epidemiologic Research**
  Spring 1
  Dr. A. Walker
  2.5 credits
  Lectures. Two 2-hour sessions each week.

Beginning with the randomized clinical trial as a paradigm, this course examines common problems in the design, analysis, and interpretation of observational studies. Cohort and case-control studies are the focus of the discussion, but not to the exclusion of other designs. Problems of exposure and disease definitions, time-dependent effects, confounding, and misclassification are considered in the light of data sources typically available. Relevant statistical methods are introduced but not developed in detail.
Course Activities: Review of published studies, class discussion.
Course Note: EPI 202 or EPI 202t and BIO 200, BIO 201, or BIO 200s and BIO 200t, or signature of instructor required.

- **EPI204 Analysis of Case-Control and Cohort Studies**
  Spring 2
  Dr. D. Spiegelman
  2.5 credits
  Lectures, seminars labs. Two 2-hour sessions each week

Examine, through practical examples, common modeling issues in multivariate regression analyis for etiologic studies. Explore analytic approaches in the presence of missing data, confounding, interaction, and collinearity. Emphasize analysis and interpretation of results in the context of research question and study design.
Course Activities: Written group projects, class discussion, short quiz, homework.
Course Note: EPI200, EPI201 or EPI208, EPI202 and EPI203 required. Concurrent enrollment permitted. BIO210 required. Concurrent enrollment permitted. Lab optional.

- **SHH263 Multilevel Statistical Methods: Concept and Application**
  Spring
  Dr. S V Subramanian
  5 Credits
  Lectures: Two 2-hour sessions each week; One 1-hour lab each week.

This course is designed to provide doctoral students with a training experience in the concept and application of multilevel statistical modeling. Students will be motivated to think about correlated and dependent data structures that arise due to sampling design and/or are inherent in the population (such as pupils nested within schools; patients nested within clinics; individuals nested within neighborhoods and so on). The substantive motivation for analyzing such complex data structures would be to make quantitative assessments about the role of contexts (e.g., schools, clinics, neighborhoods) in predicting individual outcomes. In particular, the principles of recognizing and modeling the underlying heterogeneity in average relationships would be emphasized. Linear, non-linear, and multivariate multilevel models will be covered. Upon completion, students should be able to conceptualize multilevel modeling strategies and to undertake empirical, quantitative multilevel research. The course will be lecture-based with substantial hands-on component.
Course Activities: Data management, modeling and analysis; individual assignments; project submission and class participation. *Course Notes:* SHH245 or instructor's permission required; this course is a requirement for all SHDH doctoral students.

- **HBS 4070. Design of Field Research Methods**
  Half course – Spring, Tu 12-3
  Robin Ely

Field research involves collecting original data (qualitative or quantitative) in field sites. The course will combine informal lecture and discussion with practical sessions designed to build specific skills for conducting field research in organizations. Readings include books and papers about research methodology, as well as articles that provide exemplars of field research, including both theory driven and phenomenon driven work. Specific topics covered include variance versus process models, blending qualitative and quantitative data (in one paper, one study, or one career), collecting and analyzing different kinds of data (observation interview, survey, archival), levels of analysis, construct development, and writing up field research for publication. A core aim of the course is to help students understand the contingent relationship between the nature of the research question and the field research methods used to answer it, and to use this understanding to design and carry out original field research. Course requirements include several short assignments assessing readings and a final paper designed to

help students' further their own field research goals.
Prerequisite: Previous course work in research methods is a prerequisite. Although statistics are not a focus of this course, students will be expected to understand basic principles of statistical analysis as a foundation for engaging in discussions about effective field research.

- **Statistics 140: Design of Experiments**
  Catalog Number: 7112
  Tirthankar Dasgupta
  Half course (spring term). Tu, Th, 11:30–1

Statistical designs for estimation of treatment effects in randomized experiments. Topics include analysis of variance, randomized block and Latin square designs, balanced incomplete block designs, factorial designs, nested factorial designs, confounding in blocks, fractional replications, orthogonal arrays, response surface designs, applications in engineering, biological, and social and management sciences.
Prerequisite: Statistics 100 or equivalent and Mathematics 19a and 19b.

- **Government 2010. Strategies of Political Inquiry**
  Catalog Number: 7421
  Nahomi Ichino and Adam Glynn
  Half course (spring term). W., 2–4. EXAM GROUP: 7, 8
  Introduces how to do research—assessing scholarly literatures, identifying interesting questions, formulating research designs, learning methods, and writing up results. We discuss each for both quantitative and qualitative studies.
  Note: Primarily for graduate students; also taken by undergraduates preparing for senior thesis research.

- **Statistics 240: Matched Sampling and Study Design Course**
  Catalog Number: 4036
  Donald B. Rubin and Tirthankar Dasgupta
  Half course Term: Fall2009 W[10:00 AM-12:30 PM] Exam Group: 3,4,5
  This course provides an accessible introduction to the study of matched sampling and other design techniques in any field (e.g., economics, education, epidemiology, medicine, political science, etc.) conducting empirical research to evaluate the causal effects of interventions. Prerequisite(s): Statistics 110, Statistics 111 and Statistics 139. Department: Statistics Special Notes: Matched Sampling and Study Design Course