



**HARVARD UNIVERSITY PH.D. PROGRAM IN HEALTH POLICY  
DECISION SCIENCES CONCENTRATION  
2011-2012**

Decision sciences are the collection of quantitative techniques that are used for decision-making at the individual and collective level. They include decision analysis, risk analysis, cost-benefit and cost-effectiveness analysis, decision modeling, and behavioral decision theory, as well as parts of operations research, microeconomics, statistical inference, management control, cognitive and social psychology, and computer science. The concentration in decision sciences prepares students for research careers that involve the application of these methods to health problems. Examples of research topics in health decision sciences include: cost-effectiveness analysis of medical technologies and pharmaceuticals; optimal screening policies for cancer and other chronic diseases; measurement and evaluation of health outcomes, including quality of life; policy simulation modeling of diseases such as AIDS, tuberculosis, cancer, and asthma; and optimal resource allocation for biomedical research.

- REQUIRED COURSES
- ADDITIONAL COURSES
- FACULTY MEMBERS
- COURSE DESCRIPTIONS

Verification of all course offerings listed below, including instructors and class times, is suggested before determining a final course schedule. Final course information may be accessed from the following sources:

- Graduate School of Arts and Sciences (<http://www.registrar.fas.harvard.edu/fasro/courses/>)
- Harvard School of Public Health  
(<http://www.hsph.harvard.edu/administrative-offices/registrar/courses-and-schedules/>)
- Kennedy School of Government (<http://www.hks.harvard.edu/degrees/teaching-and-courses/courses>)
- MIT (<http://web.mit.edu/registrar/www/schedules>)
- Harvard Business School (<http://www.hbs.edu/doctoral/registrar/course.html>)
- Graduate School of Education (<http://www.gse.harvard.edu/academics/catalogue/>)

Incoming students should have completed courses that cover multivariate calculus and linear algebra before entering the program. For reference, the Harvard course equivalents would be Mathematics 21a and 21b. This prerequisite may be satisfied by taking courses during the summer prior to matriculation.

**REQUIRED COURSES**

Students in the decision sciences concentration must satisfy the requirements listed below. If students have had prior courses or training that would make any of these courses redundant and wish to be waived from a specific requirement, they should discuss this situation with their advisors. Further, students may petition to substitute alternative courses that cover the required course contents. In unusual circumstances, students may petition to be exempt from any specific course content requirements, if they state the case that this material is not relevant to their area of application. However, they may face the risk that some of this content would be useful in completing the qualifying examination.

Highly recommended course options within each category are marked with an asterisk (\*). Any future changes in the core requirements for the PhD in Health Policy program supersede the requirements listed below.

Decision Analysis, Cost-Effectiveness and Cost-Benefit Analysis

The following five classes are required.<sup>+</sup> Students are also required to attend an advanced methods research seminar beginning in their second year.

RDS 280†	Decision Analysis for Health and Medical Practices	Goldie; TTh 1:30–3:20 (Fall 2)
RDS 282	Economic Evaluation in Health Policy and Program Management	Resch; MW 1:30–3:20 (Spring 2)
RDS 285	Decision Analysis Methods in Public Health	Kim; MW 1:30–3:20 + section (Spring 1)

API-302	and Medicine	
ENG SCI 201	Analytic Frameworks for Policy	Zeckhauser; TTh 10:10–11:30 + F section
	Decision Theory	Khaneja, MWF 10 (Spring)

+ *Note: RDS 284 (Decision Theory) is not being given in 2011-2012. It is possible that the course may be required for students entering in 2012 or after. The portions of its content that are required for Ph.D. students but are not included in other required courses will be covered in the Advanced Methods Seminar.*

† *Note: RDS 286 Decision Analysis in Clinical Research may be substituted for RDS 280, but RDS 286 is only open to MDs enrolled in the Summer Program in Clinical Effectiveness.*

### Research Seminar in Decision Sciences

This year-long seminar will explore advanced topics in decision science methods. It is required of all students starting in their second year. Third-year PhD students will be required to register for the course officially. The course is offered in GSAS as Health Policy 3060hf. In 2011-2012 the Seminar will be augmented by topics ordinarily covered in RDS 284, which is not being offered in 2011-2012.

### Economics

Two semesters of intermediate microeconomic theory with calculus are required:

ECON 2020a	Microeconomic Theory I	Avery/Kohlberg; MW 8:30–10 + section (Fall)
ECON 2020b	Microeconomic Theory II	Avery/Jamison; MW 8:30–10 + section (Spring)

Some students may find it useful to take either API-101A or ECON 1011a prior to taking ECON 2020a, but these courses will not count toward the concentration requirements:

API-101A	Markets and Market Failure	Kotowski; MW 10:10–11:30 + F section (Fall)
ECON 1011a	Microeconomic Theory	Glaeser; TTh 11:30–1 + section (Fall)

### Probability and Statistics

All students in the decision sciences concentration are required to complete full-semester courses in probability theory, statistical inference, econometrics, survival analysis, and Bayesian data modeling. Suggested courses that meet these requirements include:

- Probability theory & statistical inference:

ECON 2110	Introductory Probability and Statistics for Economists	Ibragimov; MW 10–11:30 (Fall)
STAT 110*	Introduction to Probability	Blitzstein; MWF at 12 + section (Fall)

- Econometrics:

GHP 525	Econometrics for Health Policy	Fink; TTh 8:30–10:20 + section (Spring)
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- Survival analysis:

BIO 223	Applied Survival Analysis	Wei; TTh 10:30–12:20 (Spring)
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- Bayesian data modeling:

BIO 249 OR GOV 2001*	Bayesian Methodology in Biostatistics Advanced Quantitative Research Methodology	Dominici; TTh 10:30–12:20 (Fall) King; M 2–4 (Spring)
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Equivalent courses, or higher level courses in probability and statistics, may be substituted for the courses listed above.

### Operations Research

Students are required to complete one full-semester course in operations research. The following courses satisfy the operations research requirement:

APM 121*	Introduction to Optimization: Models and Methods	Ergun; MW 1–2:30 + section (Spring)
MIT 15.053	Optimization Methods in Management Science	Orlin; TBA (Spring)
MIT 6.251J/15.081J	Introduction to Mathematical Programming	Tsitsiklis/Schulz; TTh 2:30–4 + section (Fall)

### Epidemiology

One half-semester course in epidemiology is required.

EPI 500	Fundamentals of Epidemiology	Cook/Buring; TTh 1:30–3:20 (Fall 1)
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### Teaching Requirement

All decision sciences students are expected to have at least 5 HSPH credits (equivalent to one full semester) of experience as teaching fellows in the core decision sciences courses.

### **ADDITIONAL COURSES**

Upon consultation with their advisors, students may substitute equivalent or higher level courses in place of the courses listed above. These courses may also be used to supplement the required curriculum in decision science.

### Economics

ECON 2460	Health Economics Workshop	Newhouse/Chandra/Cutler; W 4–6 (Spring)
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<b>GHP 291</b>	<b>Microeconomics and Applications to Public Health in Developing Countries</b>	<b>Not offered in 2011–12</b>
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### Uncertainty and Multi-Person Decisions

ECON 1051	Introduction to Game Theory	TBD; TTh 10–11:30 + section (Spring)
<b>ECON 1052</b>	<b>Advanced Game Theory</b>	<b>Not offered in 2011–12</b>
ECON 2052	Game Theory I: Equilibrium Theory	TBD; M 4–7 (Spring)
GOVT 2005	Formal Political Theory I	Bouton, T 10–12 (Fall)
MLD-221	Introduction to Negotiation Analysis	A:Mandell; MW 10:10–11:30, T 4:10–6 (Fall) <i>OR</i> B:Mandell; MW 1:10–2:30, T 4:10–6 (Fall) <i>OR</i> C:Hong; TTh 11:40–1, W 4:10–6:30 (Fall) <i>OR</i> D:Hong; TTh 11:40–1, T 4:10–6 (Spring)

### Behavioral Economics and Psychology of Decision Making

MLD-304	Judgment and Decision Making	Rogers; TTh 2:40–4 (Spring)
<b>MLD-307</b>	<b>Trust, Emotion, Ethics, and Morality in Decision Making and Negotiation</b>	<b>Not offered in 2011–12</b>
ECON 2030	Psychology and Economics	Laibson/Shleifer; W 1–3 (Fall)
ECON 2040	Experimental Economics	Roth; Hours to be arranged (Spring)
<b>ECON 2057</b>	<b>Rational Choice</b>	<b>Sen; Not offered in 2011–12</b>
PSYCH 2670a	Decision Making and the Psychology of Possibility	Langer; W 9:30–11:30 (Fall)
PSYCH 2670b	Decision Making and the Psychology of Possibility II	Langer; hours to be arranged (Spring)
HBS 4420	Behavioral Approaches to Decision Making and Negotiation	Gino/Cuddy/Bos; M 3–6 (Fall)

### Program Evaluation

API-208	Program Evaluation: Estimating Program Effectiveness with Empirical Analysis	Abadie; TTh 1:10–2:30 (Spring)
GHP 228	Quantitative Methods in Impact Evaluation	Cohen; T 3:30–6:30 (Spring)
HPM 543	Quantitative Methods in Program Evaluation	Baicker; MW 1:30–3:20 (Spring 2)

### Probability and Statistics

BIO 230	Probability Theory and Applications I	Barr; MW 1:30–3:20 + section (Fall)
BIO 231	Statistical Inference I	Betensky; MW 10:30–12:20 + section (Spring)
STAT 110	Introduction to Probability	Blitzstein; MWF at 12 + section (Fall)
STAT 111	Introduction to Theoretical Statistics	Airoldi; TTh 1–2:30 + section (Spring)
STAT 210	Probability Theory	Blitzstein; MW 2:30–4 (Fall)
STAT 211	Statistical Inference	Morris/Blitzstein; MW 2:30–4 (Spring)
MIT 6.431	Applied Probability	Tsitsiklis; MW 12 + section (Fall)

### Data Analysis

BIO 210	The Analysis of Rates and Proportions	Rosner; MW 8:30–10:20 + section (Fall) Glynn; MW 8:30–10:20 + section (Spring)
BIO 211	Regression and Analysis of Variance in Experimental Research	Catalano; TTh 3:30–5:20 + section (Fall)
BIO 213	Applied Regression for Clinical Research	Orav; MW 8:30–10:20 + section (Fall)
BIO 226	Applied Longitudinal Analysis	Hughes; TTh 1:30–3:20 + section (Spring)
BIO 232	Methods I	Lin; MW 10:30–12:20 + section (Fall)
BIO 233	Methods II	Haneuse; MW 8:30–10:20 + section (Spring)
ECON 2120	Introduction to Applied Econometrics	Chamberlain; TTh 2:30–4 (Spring)
ECON 1127	Statistical Methods for Evaluating Causal Effects	Rubin; TTh 2:30–4 (Spring)
ENG SCI 103	Spatial Analysis of Environmental and Social Systems	Srinivasan; Not offered in 2011–12
GHP 274	Applied Quantitative Methods I	Not offered in 2011–12
MIT 17.802	Quantitative Research Methods II: Advanced Empirical Tools	Hainmueller; Hours TBD (Spring)
S-030	Intermediate Statistics: Applied Regression and Data Analysis (School of Education)	Ho; TTh 10–11:30 + section (Spring)
S-052	Applied Data Analysis (School of Education)	Willett; TTh 10–11:30 (Spring)
STAT 139	Statistical Sleuthing Through Linear Models	Pattanayak; TTh 11:30–1 + section (Fall)
STAT 149	Statistical Sleuthing Through Generalized Linear Models	Pillai; MW 1–2.30 (Spring)
STAT 160	Design and Analysis of Sample Surveys	Zaslavsky; MW 2:30–5 (Fall)
STAT 171	Introduction to Stochastic Processes	Kou; TTh 2:30–4 + section (Spring)
STAT 220	Bayesian Data Analysis	Liu; TTh 10–11:30 (Fall)
STAT 221	Statistical Computing and Learning	Not offered in 2011–12

### Epidemiology and Clinical Trials

BIO 214	Principles of Clinical Trials	Ware; MW 1:30–3:20 (Spring 1)
EPI 201	Epidemiological Methods I	Hernan; TTh 10:30–12:20 + section (Fall 1)
EPI 204	Analysis of Case-Control and Cohort Studies	Schwartz; TTh 10:30–12:20 (Spring 2)
EPI 207	Advanced Epidemiologic Methods	Tchetgen/Hernan/Robins; MW 1:30–3:20 + section or Th 3:30–5:20 + section (Fall 1)
EPI 221	Pharmacoepidemiology	Walker; MW 1:30–3:20 (Fall 2)
EPI 233	Research Synthesis and Meta-Analysis	Hsieh/Goodman; W 3:30–5:00 (Spring)
EPI 241	Measuring Health Status	Not offered in 2011–12
EPI 288	Data Mining and Prediction	Not offered in 2011–12
EPI 289	Models for Causal Inference	Hernan; MW 10:30–12:20 (Spring 1)

### Infectious Disease Modeling†

EPI 260	Mathematical Modeling of Infectious Diseases	Not offered in 2011–12
EPI 501	Dynamics of Infectious Diseases	Murray; MW 1:30–3:20 (Fall 2)
ID 298	Inference in Infectious Disease Epidemiology	Not offered in 2011–12

† *Note: Infectious Disease Modeling courses typically are offered in alternate years.*

Decision Theory, Optimization Theory, and Operations Research

ECON 2059	Decision Theory	Strzalecki; M 2:30–5:30 (Spring)
ENG SCI 210	Mathematical Programming	Anderson; TTh 10–11:30 (Fall)
MIT 6.251J/ 15.081J	Introduction to Mathematical Programming	Tsitsiklis/Schulz; TTh 2:30–4 + section (Fall)
MIT 6.255J/ 15.093J	Optimization Methods	Bertsimas/Parrilo; TTh 2:30–4+ section (Fall)
MIT 14.128	Dynamic Optimization and Economic Applications	Not offered in 2011–12
MIT 15.871	Introduction to System Dynamics	Sastry/ Centola; MW 1–2:30 + section OR MW 2:30–4 + section (Fall, first half)
MIT 15.872	System Dynamics II	Serman/ Repenning/Centola; MW 1–2:30 + section OR MW 2:30–4 + section (Fall, second half)
MIT 15.879	Research Seminar in System Dynamics	Not offered in 2011–12

Ethics of Resource Allocation

ECON 2054	Social Choice and Welfare Economics	Sen; Not offered in 2011–12
ID 292	Justice and Resource Allocation	Daniels; TTh 10:30–12:20 (Spring 2)
ID 513	Ethics and Health Disparities	Not offered in 2011–12
ID 250	Ethical Basis of Public Health	Roberts; MW 8:30–10:20 (Fall 1) Wikler; MW 10:30–12:20 (Spring 1)

Biomedical Informatics

HT950	Biomedical Computing	Szolovits; TTh 9:30–11 (Fall)
HT957a/b	Biomedical Informatics Research Seminar	McCray; TBA (Fall and Spring)

## **FACULTY ASSOCIATED WITH THE DECISION SCIENCES TRACK**

**Milton C. Weinstein**, Chair, Decision Sciences concentration, and Henry J. Kaiser Professor of Health Policy and Management, Harvard School of Public Health

**Kenneth A. Freedberg**, Professor of Medicine, Harvard Medical School; Professor in the Department of Health Policy and Management, Harvard School of Public Health

**G. Scott Gazelle**, Professor of Radiology, Harvard Medical School; Professor in the Department of Health Policy and Management, Harvard School of Public Health

**Thomas Gaziano**, Assistant Professor of Health Decision Sciences, Harvard School of Public Health

**Sue J. Goldie**, Roger Irving Lee Professor of Public Health, Harvard School of Public Health

**James K. Hammitt**, Professor of Economics and Decision Sciences, Harvard School of Public Health

**M. G. Myriam Hunink**, Adjunct Professor of Health Policy, Harvard School of Public Health

**Jane J. Kim**, Assistant Professor of Health Decision Science, Harvard School of Public Health

**Karen M. Kuntz**, Professor, University of Minnesota School of Public Health

**Jennifer Lerner**, Professor of Public Policy and Management, Harvard Kennedy School

**Tracy A. Lieu**, Professor of Population Medicine, Harvard Medical School

**Peter J. Neumann**, Professor of Medicine, Tufts University School of Medicine

**Joseph Pliskin**, Adjunct Professor of Health Policy and Management, Harvard School of Public Health

**Lisa A. Prosser**, Adjunct Associate Professor of Health Policy and Management, Harvard School of Public Health

**Howard Raiffa**, Frank Plumpton Ramsey Professor of Managerial Economics, Emeritus, Harvard Kennedy School and Harvard Business School

**Stephen Resch**, Lecturer on Health Decision Science, Harvard School of Public Health

**Joshua Salomon**, Associate Professor of International Health, Harvard School of Public Health

**Uwe Siebert**, Adjunct Professor of Health Policy and Management, Harvard School of Public Health

**Natasha Stout**, Instructor in Population Medicine, Harvard Medical School

**Rochelle P. Walensky**, Associate Professor of Medicine, Harvard Medical School

**Jane C. Weeks**, Professor of Medicine, Harvard Medical School; Professor of Health Policy and Management, Harvard School of Public Health

**Richard C. Zeckhauser**, Frank Plumpton Ramsey Professor of Political Economy, Harvard Kennedy School

## COURSE DESCRIPTIONS

### REQUIRED COURSES

Decision Analysis, Cost-Effectiveness and Cost-Benefit Analysis

#### **(SPH) RDS 280. Decision Analysis for Health and Medical Practices**

**Sue Goldie**

**Fall 2, TTh 1:30-3:20, 2.5 credits**

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 technology assessment, medical and public health decision making, and health resource allocation. The objectives of the course are: (1) to provide a basic 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 economics is recommended but not required.

#### **(SPH) RDS 282. Economic Evaluation in Health Policy and Program Management**

**Stephen Resch**

**Spring 2, MW 1:30-3:20, 2.5 credits**

This course features case studies in the application of health decision science to policymaking and program management at various levels of the health system. Both developed and developing country contexts will be covered. Topics include: [1] theoretical foundations of cost-effectiveness analysis (CEA); [2] controversies and limitations of CEA in practice; [3] design and implementation of tools and protocols for measurement and valuation of cost and benefit of health programs; [4] integration of evidence of economic value into strategic planning and resource allocation decisions, performance monitoring and program evaluation; [5] the role of evidence of economic value in the context of other stakeholder criteria and political motivations.

#### **(SPH) RDS 285. Decision Analysis Methods in Public Health and Medicine**

**Jane Kim**

**Spring 1, MW 1:30-3:20 + section, 2.5 credits**

An intermediate-level course on methods and health applications of decision analysis and other modeling techniques. Topics include Markov models, life expectancy modeling, deterministic and probabilistic sensitivity analysis, simulation models, ROC analysis and diagnostic technology assessment, quality of life valuation, multi-attribute utility, and behavioral decision theory.

Course Note: RDS 280, RDS 286, or equivalent introductory course on decision analysis required or signature of instructor required; familiarity with matrix algebra and elementary calculus may be helpful but not required; lab or section times to be announced at first meeting.

#### **(HKS) API-302. Analytic Frameworks for Policy**

**Richard Zeckhauser**

**Fall, TTh 10:10-11:30 + F section**

Develops abilities in using analytic frameworks in the formulation and assessment of public policy. It considers a variety of analytic techniques, particularly those directed toward uncertainty and interactive decision problems. It 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.

#### **(FAS) Engineering Sciences 201. Decision Theory**

**Navin Khaneja**

**Half course (spring term). M., W., F., at 10. EXAM GROUP: 3**

Mathematical analysis of decision making. Bayesian inference and risk. Maximum likelihood and nonparametric methods. Algorithmic methods for decision rules: perceptrons, neural nets, and back propagation. Hidden Markov models, Blum-Welch, principal and independent components.

Prerequisite: Applied Mathematics 21a,b or Mathematics 21a,b, and Statistics 110 or equivalents.

#### **(FAS) Health Policy 3060hf - Research Seminar in Decision Sciences**

### **Joshua A. Salomon (Public Health) 5759**

**Half course (throughout the year). Hours to be arranged.**

Explores key conceptual and methodological issues relevant to research in health decision sciences. Faculty members and invited speakers will assign readings and present examples of theoretical and applied work. Students are required to participate in class discussion and to present their own research work in progress.

### Economics

#### **(FAS) Economics 2020a. Microeconomic Theory I**

**Christopher N. Avery (Kennedy School) and Elon Kohlberg (Business School)**

**Half course (fall term). M., W., 8:30–10, and a weekly section to be arranged. EXAM GROUP: 1, 2**

A comprehensive course in economic theory designed for doctoral students in all parts of the University. Consumption, production, uncertainty, markets, general equilibrium. Applications to policy analysis and business decisions. Emphasizes the use of economic theory in practical research.

Note: Offered jointly with the Kennedy School as API-111 and with the Business School as 4010.

Prerequisite: Two years of calculus and one course in probability theory. Thorough background in microeconomic theory at the intermediate level. Undergraduates with the appropriate background are welcome.

#### **(FAS) Economics 2020b. Microeconomic Theory II**

**Christopher N. Avery (Kennedy School) and Julian Jamison**

**Half course (spring term). M., W., 8:30–10, and a one-hour weekly section to be arranged. EXAM GROUP: 1, 2**

A continuation of Economics 2020a. Topics include game theory, economics of information, incentive theory, and welfare economics.

Note: Offered jointly with the Kennedy School as API-112 and with the Business School as 4011.

Prerequisite: Economics 2010a or 2020a.

#### **(HKS) API-101A. Markets and Market Failure**

**Maciej Kotowski**

**Fall, MW 10:10-11:30 + F section**

This course applies microeconomic reasoning to public issues, policies, and programs. It considers economic incentives and organizations; models of economic behavior, including markets, the absence of markets, and interventions in markets; the price system and how it works; and policy objectives and instruments. All sections cover a common set of core topics; the pedagogical approaches vary with the individual instructor.

Prerequisite: The A section of this course presumes some prior exposure to the field and the ability to use basic calculus.

#### **(FAS) Economics 1011a. Microeconomic Theory**

**Edward Glaeser**

**Half course (fall term). Tu., Th., 11:30–1. EXAM GROUP: 13, 14**

Economics 1011a is similar to Economics 1010a, but is more mathematical and covers more material. The course teaches the basic tools of economics and to apply them to a wide range of human behavior. Tools include consumer theory, optimization under uncertainty, game theory, welfare economics, incentive theory, and the economics of information.

Topics include industrial organization, public finance, law and economics, the economics of the family, religion, and riots.

Note: Economics 1011a fulfills the intermediate microeconomic theory requirement for Economics concentrators. Students may take **either** Economics 1010a **or** Economics 1011a for credit. This course, when taken for a letter grade, meets the Core area requirement for Social Analysis.

Prerequisite: Mathematics 21a or permission of the instructor.

### Probability and Statistics

#### **(FAS) Economics 2110. Introductory Probability and Statistics for Economists**

**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).

**(FAS) Statistics 110. Introduction to Probability**

**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 spaces and events, conditional probability, and Bayes' Theorem. Univariate distributions: density functions, expectation and variance, bounds, Normal, t, Binomial, Negative Binomial, Poisson, and Gamma distributions. Multivariate distributions: joint and conditional distributions, independence, transformations, and Multivariate Normal. Limit laws: law of large numbers, central limit theorem. Markov chains: transition probabilities, stationary distributions, 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.

**(SPH) GHP 525. Econometrics for Health Policy**

**Gunther Fink**

**Spring, TTh 8:30-10:20 + optional section, 5 credits**

At the end of the course the student will be able to:

- replicate standard econometric techniques applied in the empirical social science and health policy literature
- describe the methodological assumptions underlying the various estimation techniques and their empirical implications
- independently apply econometric models to their own research

Course Prerequisites: Participants in this course will be expected to be proficient in introductory level calculus and linear algebra, and should have taken Match 274, Bio 200 and Bio 211 or equivalent courses. Students are expected to be familiar with probability theory (density and distribution functions) and the concepts underlying ordinary least square (OLS) estimation.

**(SPH) BIO 223. Applied Survival Analysis**

**Lee-Jen Wei**

**Spring, TTh 10:30–12:20 + optional section, 5 credits**

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, BIO 213, or BIO 230 required, or signature of instructor.

**(SPH) BIO 249. Bayesian Methods in Biostatistics**

**Francesca Dominici**

**Fall, TTh 10:30-12:20 + section, 5 credits**

General principles of the Bayesian approach, prior distributions, hierarchical models and modeling techniques, approximate inference, Markov chain Monte Carlo methods, model assessment and comparison. Bayesian approaches to GLMMs, multiple testing, nonparametrics, clinical trials, survival analysis.

Course Note: BIO 231 (Statistical Inference I), and BIO 232 (Methods I), or the signature of the instructor is required. BIO 233 (Methods II) will also be helpful for the second part of the course.

**(FAS) Government 2001. Advanced Quantitative Research Methodology**

**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 2000 or the equivalent.

## Operations Research

### **(FAS) \*Applied Mathematics 121. Introduction to Optimization: Models and Methods**

**Ozlem Ergun**

**Half course (spring term). M., W., 1–2:30. EXAM GROUP: 6, 7**

Introduction to basic mathematical ideas and computational methods for solving deterministic and stochastic optimization problems. Topics covered: linear programming, integer programming, branch-and-bound, branch-and-cut, Markov chains, Markov decision processes, queuing theory. Emphasis on modeling. Examples from business, society, engineering, sports, e-commerce. Exercises in AMPL, complemented by Maple or Matlab.

Note: May not be taken in addition to Engineering Sciences 102.

Prerequisite: Applied Mathematics 21b or Mathematics 21b (linear algebra) and some knowledge of probability and statistics at the level of Statistics 110 or Engineering Sciences 101 or permission of instructor.

### **(MIT) 15.053. Optimization Methods in Management Science**

**J. B. Orlin**

**Prereq: None**

**(Spring)**

Course Description: Introduces students to the theory, algorithms, and applications of optimization. The optimization methodologies include linear programming, network optimization, integer programming, and decision trees. Applications to logistics, manufacturing, transportation, marketing, project management, and finance.

### **(MIT) 6.251J. Introduction to Mathematical Programming**

**(Same subject as 15.081J)**

**J. N. Tsitsiklis, Schulz**

**Prereq: 18.06**

Introduction to linear optimization and its extensions emphasizing both methodology and the underlying mathematical structures and geometrical ideas. Covers classical theory of linear programming as well as some recent advances in the field. Topics: simplex method; duality theory; sensitivity analysis; network flow problems; decomposition; integer programming; interior point algorithms for linear programming; and introduction to combinatorial optimization and NP-completeness.

## Epidemiology

### **\*(SPH) EPI 500. Fundamentals of Epidemiology**

**Julie Buring, Earl Cook**

**Fall 1, TTh 1:30-3:20, 2.5 credits**

This course will provide an orientation to epidemiology as a basic science for public health and clinical medicine. It will address the principles of the quantitative approach to clinical and public health problems. The course will discuss measure of frequency and association, introduce the design and validity of epidemiologic research, and give an overview of data analysis. This course is an introduction to the skills needed by public health professionals and clinicians to interpret critically the epidemiologic literature. It will provide students with the principles and practical experience needed to initiate the development of these skills. Lectures are complemented by seminars devoted to case studies, exercises, or critique of current examples of epidemiologic studies.

## **ADDITIONAL COURSES**

## Economics

### **(FAS) Economics 2460. Health Economics Workshop**

**Joseph P. Newhouse, Amitabh Chandra, and David M. Cutler**

**Half course (spring term). W., 4–6. EXAM GROUP: 9**

Focuses on theory, econometric models, and public policy of health care. Frontier work in health economics presented and discussed by instructors and outside speakers.

Note: May be taken for credit only by dissertation students writing a research paper. Offered jointly with the Kennedy School as SUP-951.

**(SPH) GHP 291. Microeconomics and Applications to Public Health in Developing Countries**

**Not offered 2011-2012**

**A. Mahal, 5 credits**

This is a course in applied microeconomic theory (formerly GHP271). We use basic calculus, differentiation, and simple constrained maximization theory to develop empirical models of the behavior of individuals, households, firms, and markets, as well as normative theories of social welfare and resource allocation within the health sector. All applications will be drawn from population and public health issues in developing countries. Empirical applications include individuals' demand for health care, health insurance, and retirement saving; the determinants of fertility and educational investments in children; the distribution of resources within households; formal and informal mechanisms for risk sharing; the supply of physician and health services; market failures and inefficiencies due to asymmetric information in health insurance markets; and applications of the theory externalities and public goods to disease control and environmental policy. Normative applications include the trade-off between equity and efficiency, criteria for resource allocation and project evaluation within the health sector such as cost-benefit and cost-effectiveness analysis, and ethical issues such as the valuation of life, the multiple competing objectives of health policy, and fairness.

Course note: The course makes use of calculus and constrained maximization at the level of GHP274 or equivalent.

Uncertainty and Multi-Person Decisions

**(FAS) Economics 1051. Introduction to Game Theory**

**Instructor TBD**

**Half course (spring term). Tu., Th., 10–11:30. EXAM GROUP: 12, 13**

Presents an introduction to the modern game theory, focusing on its use in economics. Main ideas of game theory are introduced and illustrated using examples from industrial organization, labor economics, and macroeconomics.

Note: Students may not take both Economics 1051 and Economics 1052 for credit.

Prerequisite: Economics 1010a or 1011a.

**(FAS) Economics 1052. Advanced Game Theory**

**Not offered in 2011-2012**

**Half course (spring term). Hours to be arranged.**

Introduction to game theory and its applications to economics at a high level of rigor. Topics include extensive form and strategic form games, Nash's equilibrium and existence theorem, subgame-perfect equilibrium, Bayesian equilibrium, and applications to repeated games, auctions, and bargaining.

Note: Expected to be given in 2011–12. Students may not take both Economics 1051 and Economics 1052 for credit.

Prerequisite: Economics 1011a and Mathematics 21a, or equivalent.

**(FAS) Economics 2052. Game Theory I: Equilibrium Theory**

**Instructor TBD**

**Half course (spring term). M., 4–7 pm. EXAM GROUP: 9**

Equilibrium analysis and its applications. Topics vary, but typically include equilibrium refinements (sequential equilibrium), the equilibria of various classes of games (repeated games, auctions, signaling games) and the definition and application of common knowledge.

Prerequisite: Economics 2010a or permission of the instructor.

**(FAS) Government 2005. Formal Political Theory I**

**Laurent Bouton**

**Half course (fall term). Tu., 10–12.**

A graduate seminar on microeconomic modeling, covering price theory, decision theory, social choice theory, and game theory.

**(HKS) MLD-221 A/B/C/D. Introduction to Negotiation Analysis**

**Brian Mandell/Kessely Hong**

**Fall, various times**

This course introduces students to the theory and practice of negotiation. The ability to successfully negotiate rests on a combination of analytical and interpersonal skills. Analysis is important because negotiators cannot develop promising strategies without a deep understanding of the context of the situation, the interests of the other parties, and the range of possible moves and countermoves. Interpersonal skills are important because negotiation is essentially a process of communication, trust building (or breaking), and mutual persuasion. This course will develop a set of conceptual frameworks that should help students analyze future negotiation situations and prepare more effectively. Through

participation in negotiation simulations, students will have the opportunity to exercise powers of communication and persuasion and to experiment with a variety of negotiation tactics and strategies.

#### Behavioral Economics and Psychology of Decision Making

##### **(HKS) MLD-304. Judgment and Decision Making**

**Todd Rogers**

**Spring, TTh 2:40-4**

Decision science focuses on understanding and improving the judgment and decision making of individuals, groups, and organizations. This course — an introduction to decision science — draws primarily on economics and psychology, examining the interplay between how people “should” make decisions and how people actually do. Through a combination of interactive exercises, quantitative analysis, and case studies, students will learn to analyze the ways decisions are made and to improve their own judgments and decisions. Students will also learn ways to ground public policies and leadership plans in realistic assumptions about human nature. Some of the lessons will be applied to questions in organizational behavior, environmental management, poverty alleviation, law, health and politics.

##### **(HKS) MLD-307. Trust, Emotion, Ethics, and Morality in Decision Making and Negotiation**

**Not offered in 2011-12**

**Jennifer Lerner**

This seminar addresses classic and contemporary research in trust, emotion, ethics, and morality as these factors shape negotiation and decision making. In addition to abundant reading, expert researchers from around the country will enrich the curriculum through guest lectures. Students enrolled in the course will have the opportunity to interact with the expert speakers and learn about current research. Students will develop research proposals that integrate the current scientific literature with the students’ own interests. An extensive process of feedback will help students prepare high-quality research proposals.

##### **(FAS) Economics 2030. Psychology and Economics**

**Andrei Shleifer and David I. Laibson**

**Half course (fall term). W., 1-3. EXAM GROUP: 6, 7**

Explores economic and psychological models of human behavior. Theoretical topics include bounded rationality, intertemporal choice, decision making under uncertainty, inference, choice heuristics, and social preferences. Economic applications include asset pricing, corporate finance, macroeconomics, labor, development, and industrial organization. Note: Primarily for graduate students but open to undergraduates.

Prerequisite: Knowledge of multivariable calculus and econometrics.

##### **(FAS) Economics 2040. Experimental Economics**

**Alvin E. Roth (FAS, Business School)**

**Half course (spring term). Hours to be arranged. EXAM GROUP: 2, 3, 4**

An introduction to experimental economics, and some of the major subject areas that have been addressed by laboratory experiments. We concentrate on series of experiments, to see how experiments build on one another.

Note: Offered jointly with the Business School as 4160.

##### **(FAS) Economics 2057. Rational Choice**

**Not offered in 2011-12**

**Amartya Sen**

**Half course (spring term). Hours to be arranged.**

The course involves critical examination of alternative approaches to rationality, which is a central concept in economics, politics and the other social sciences, moral and political philosophy, and legal theory, including law and economics.

Note: Expected to be given in 2013–14.

##### **(FAS) Psychology 2670a. Decision Making and the Psychology of Possibility**

**Ellen J. Langer**

**Half course (fall term). W., 9:30–11:30. EXAM GROUP: 2, 3, 4**

Decision theory and research, including the illusions of predictability, probability and control; rational/irrational models of decision-making; interpersonal decisions; risk-taking; learned helplessness; and mindfulness examined in applied contexts, with special focus on health.

Note: Open to qualified undergraduates.

**(FAS) Psychology 2670b. Decision Making and the Psychology of Possibility II**

**Ellen J. Langer**

**Half course (spring term). Hours to be arranged.**

A deeper exploration into the theoretical and experimental issues, pertaining to decision making and mindfulness, raised in Psychology 2670a.

Prerequisite: Psychology 2670a or Psychology 1571a.

**(HBS) 4420. Behavioral Approaches to Decision Making and Negotiation**

**Francesca Gino, Amy Cuddy and Maarten Bos**

**Fall, M., 3-6**

**This course was previously jointly listed in FAS as Psychology 2650.**

This course will provide an overview of the field of behavioral decision making. A focus of the course will be the individual as a less than perfect decision maker in individual and competitive contexts. On the decision making side, we will start with March and Simon's (1958) work on bounded rationality, work through the groundbreaking research of Kahneman and Tversky, and update this line of inquiry through the current decade. We will examine the implications of imperfect behavior for theoretical development, as well as for how to train individuals to make wiser decisions. This course will involve students in an intensive, thorough survey of the intersection of analytic and behavioral perspectives to decision making and negotiation. Each class we will cover an area in depth, explicate some major perspectives in the field, review a select set of readings, and discuss some of the critical issues that have been raised with regard to theory and experimentation.

Program Evaluation

**(HKS) API-208. Program Evaluation: Estimating Program Effectiveness with Empirical Analysis**

**Alberto Abadie**

**Spring, TTh 1:10-2:30 + F section**

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, regression analysis, and instrumental variables (such as API-202 or API-210).

**(SPH) GHP 228. Quantitative Methods in Impact Evaluation**

**Jessica Cohen**

**Spring, T 3:30-6:30, 5 credits**

The objective of this course is to provide students with a set of theoretical, econometric and reasoning skills to estimate the causal impact of one variable on another. Examples from the readings explore the causal effect of policies, laws, programs and natural experiments derived from pension programs to television shows to natural disasters. We will go beyond estimating causal effects to analyze the channels through which the causal impact was likely achieved. This will require that the students are familiar with microeconomic theories of incentives, institutions, social networks, etc.

The course will introduce students to a variety of econometric techniques in impact evaluation and a set of reasoning skills intended to help them become both a consumer and producer of applied empirical research. Students will learn to critically analyze evaluation research and to gauge how convincing the research is in identifying a causal impact. They will use these skills to develop an evaluation plan for a topic of their own, with the aim of stimulating ideas for dissertation research. This is a methods class that relies heavily on familiarity with econometrics and microeconomics. These are pre-requisites for the course without exception. The course is intended for doctoral students who are finishing their course work and aims to help them transition into independent research.

The aim of this course is to prepare doctoral students in the health systems track of the Global Health and Population department for the dissertation phase of their research and thus they will be given priority in enrollment. The course is also open to other GHP doctoral students, other GHP masters students and students from other departments, conditional on having adequate training in economics and the course having enough space.

Pre-Requisites: Econometrics and intermediate micro-economics are required for this course. While students can get by with just these two subjects, some previous experience with regression analysis and applied economic research will be a

huge advantage. Students seeing applied regression analysis for the first time in this course will most likely struggle with the reading.

**(SPH) HPM 543. Quantitative Methods in Program Evaluation**

**Katherine Baicker**

**Spring 2, MW 1:30-3:20, 2.5 credits**

This course will give students the tools that they need to evaluate policy interventions, social programs, and health initiatives. Did the program achieve its goals? Did it reach its target audience? Could it have been more effective? In order to be able to answer these questions, students will develop a flexible set of analytical tools, including both the ability to design an evaluation study and the ability to evaluate existing studies critically. By the end of the course students will be able to construct a well-designed study to answer well-posed questions, gauge the adequacy of available data, implement an econometric analysis, interpret the results of such studies, and draw policy implications. The course will focus on health policies and programs such as public insurance expansions and public health campaigns, but the techniques will be broadly applicable to other realms such as welfare or education.

Probability and Statistics

**(SPH) BIO 230. Probability Theory and Applications I**

**Christopher David Barr**

**Fall, MW 1:30-3:20 + section, 5 credits**

**Jointly listed in FAS as Biostatistics 230**

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.

**(SPH) BIO 231. Statistical Inference I**

**Rebecca Betensky**

**Spring, MW 10:30-12:20 + section, 5 credits**

**Jointly listed in FAS as Biostatistics 231**

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: BIO230 or signature of instructor required; lab or section time to be announced at first meeting; cross-listed: HSPH student must register for HSPH course.

**(FAS) Statistics 110. Introduction to Probability**

**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 spaces and events, conditional probability, and Bayes' Theorem. Univariate distributions: density functions, expectation and variance, bounds, Normal, t, Binomial, Negative Binomial, Poisson, and Gamma distributions. Multivariate distributions: joint and conditional distributions, independence, transformations, and Multivariate Normal. Limit laws: law of large numbers, central limit theorem. Markov chains: transition probabilities, stationary distributions, 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.

**(FAS) Statistics 111. Introduction to Theoretical Statistics**

**Edoardo Maria Airoldi**

**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: Statistics 110 and Mathematics 19a and 19b (may be taken concurrently) or equivalent.

**(FAS) Statistics 210. Probability Theory**

**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.

**(FAS) Statistics 211. Statistical Inference**

**Carl N. Morris and Joseph K. Blitzstein**

**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.

**(MIT) 6.431. Applied Probability**

**J. N. Tsitsiklis**

**Fall**

Meets with undergraduate subject 6.041. Requires the completion of additional advanced home problems.

An introduction to probability theory, and the modeling and analysis of probabilistic systems. Sample space, probabilistic models, conditional probability. Discrete and continuous random variables. Transform techniques. Bernoulli and Poisson processes. Markov processes. Limit theorems and elements of statistical inference.

Prerequisite: Calculus II

URL: <http://web.mit.edu/6.041/www/home.html>

Data Analysis

**(SPH) BIO 210. The Analysis of Rates and Proportions**

**Fall: Dr. B. A. Rosner , MW 8:30-10:20 + section, 5 credits**

**Spring: Dr. R. J. Glynn, MW 8:30-10:20 + section, 5 credits**

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: BIO200, or BIO201, or BIO202 and BIO203, or BIO206 and one of BIO207, BIO208, or BIO209, or signature of instructor required; lab or section times to be announced at first meeting.

**(SPH) BIO 211. Regression and Analysis of Variance in Experimental Research**

**Paul Catalano**

**Fall, TTh 3:30-5:20 + section, 5 credits**

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: BIO200, or BIO201, or BIO202 and BIO203, or BIO206 and one of BIO207, BIO208, or BIO209, or signature of instructor required; lab or section times to be announced at first meeting.

**(SPH) BIO 213. Applied Regression for Clinical Research**

**Endel Orav**

**Fall, MW 8:30-10:20 + section, 5 credits**

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: BIO200, or BIO201, or BIO202 and BIO203, or BIO206 and one of BIO207, BIO208, or BIO209, or signature of instructor required; lab or section times to be announced at first meeting.

**(SPH) BIO 226. Applied Longitudinal Analysis**

**Michael Hughes**

**Spring, TTh 1:30-3:20 + section, 5 credits**

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: BIO210, BIO211, BIO213, or BIO232, or signature of instructor required; lab or section times will be announced at first meeting

**(SPH) BIO 232. Methods I**

**Xihong Lin**

**Fall, MW 10:30-12:20 + section, 5 credits**

**Jointly listed at FAS as Biostatistics 232**

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.

**(SPH) BIO 233. Methods II**

**Sebastien Haneuse**

**Spring, MW 8:30-10:20 + section, 5 credits**

**Jointly listed at FAS as Biostatistics 233**

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.

**(FAS) Economics 2120. Introduction to Applied Econometrics**

**Gary Chamberlain (spring term)**

**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.

*Note:* Enrollment limited to PhD candidates in economics, business economics, health policy, public policy, and political economy and government (PEG). Offered jointly with the Kennedy School as API-217.

*Prerequisite:* Economics 2110 or API-209 or the equivalent.

**(FAS) Economics 1127. Statistical Methods for Evaluating Causal Effects**

**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.

Note: Students may not take both Economics 1127 and Statistics 186 for credit.

Prerequisite: Statistics 100 or preferably Statistics 111; Mathematics 20.

**(FAS) Engineering Sciences 103. Spatial Analysis of Environmental and Social Systems**

**Not offered in 2011-12**

**Half course (spring term). Tu., Th., 11:30–1. EXAM GROUP: 13, 14**

Introduces the fundamental statistical and mapping tools needed for analysis of environmental systems. Topics will be linked by environmental and social themes and will include GIS concepts; data models; spatial statistics; density mapping; buffer zone analysis; surface estimation; map algebra; suitability modeling. Students will acquire technical skills in both mapping and spatial analysis. Software packages used will include ArcGis. There will be guest lectures by researchers and practitioners who use GIS for spatial analysis.

Note: Expected to be given in 2012–13.

Prerequisite: Applied Mathematics 21 or equivalent.

### **(SPH) GHP 274. Applied Quantitative Methods I**

**Not offered in 2011-12**

**2.5 credits**

**Lectures. Two 2-hour sessions each week.**

This course will review, as well as introduce, methods of mathematical analysis that form an essential tool kit for doctoral level courses in economic analysis. The course is a pre-requisite for GHP291 (Microeconomics and applications to public health in developing countries) that is taught in the spring semester. Topics covered include differential and integral calculus, and optimization methods. Some applications of these methods to economic analysis will also be discussed.

Participants in the course will be expected to be proficient in introductory level calculus and linear algebra.

Course note: There will be weekly problem sets, a take-home mid-term examination and an in-class final examination. Lab or section time will be announced at first meeting.

### **(MIT) 17.802. Quantitative Research Methods II: Advanced Empirical Tools**

**Hainmueller**

**Spring**

Provides a survey of advanced empirical tools for political science and public policy research. Focuses on applied causal inference, i.e. statistical methods designed to address research questions that concern the impact of an institution, intervention, policy, or event on an outcome, result, or performance. Covers a variety of causal inference designs, including experiments, matching, regression, panel methods, difference-in-differences, synthetic control methods, instrumental variables, regression discontinuity designs, and bounds.

Prerequisite: 17.800 or 17.871

### **(EDU) S-030. Intermediate Statistics: Applied Regression and Data Analysis**

**Andrew Ho**

**Spring, TTh 10-11:30 + section**

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.

### **(EDU) S-052. Applied Data Analysis**

**John B. Willett**

**Spring, TTh 10-11:30**

S-052 is designed for those who want to extend their data-analytic skills beyond a basic knowledge of multiple regression analysis and ANOVA, and who want to communicate their findings clearly to audiences of researchers, scholars, and policymakers. The course contributes directly to the diverse data-analytic tool kit 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, ordinal logit analysis, principal components analysis, cluster analysis, exploratory factor analysis, introduction to discrete-time survival analysis, 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.

**(FAS) Statistics 139. Statistical Sleuthing Through Linear Models**

**Cassandra Wolos Pattanayak**

**Half course (fall term). Tu., Th., 11:30-1, and weekly sections to be arranged. EXAM GROUP: 13, 14**

A serious introduction to statistical inference with linear models and related methods. Topics include t-tools and permutation-based alternatives, multiple-group comparisons, analysis of variance, linear regression, model checking and refinement, and causation versus correlation. Emphasis on thinking statistically, evaluating assumptions, and developing tools for real-life applications.

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

**Statistics 149. Statistical Sleuthing through Generalized Linear Models**

**Natesh S. Pillai**

**Half course (spring term). M., W., 1–2:30. EXAM GROUP: 6, 7**

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 with permission of instructor.

**Statistics 160. Design and Analysis of Sample Surveys**

**Alan M. Zaslavsky (Medical School)**

**Half course (fall term). M., W., 2:30–5. EXAM GROUP: 7, 8, 9**

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 with permission of instructor.

**(FAS) Statistics 171. Introduction to Stochastic Processes**

**S.C. Samuel Kou**

**Half course (spring term). Tu., Th., 2:30-4, and weekly sections to be arranged. EXAM GROUP: 16, 17**

An introductory course in stochastic processes. Topics include Markov chains, branching processes, Poisson processes, birth and death processes, Brownian motion, martingales, introduction to stochastic integrals, and their applications.

Prerequisite: Statistics 110 or equivalent.

**(FAS) Statistics 220. Bayesian Data Analysis**

**Jun S. Liu**

**Half course (fall term). Tu., Th., 10–11.30. EXAM GROUP: 12, 13**

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.

**(FAS) Statistics 221. Statistical Computing and Learning**

**Not offered in 2011-12**

**Half course (spring term). M., W., 1–2:30. EXAM GROUP: 6, 7**

Computational methods commonly used in statistics: random number generation, optimization methods, numerical integration, Monte Carlo methods including Metropolis-Hastings and Gibbs samplers, approximate inference techniques including Expectation-Maximization algorithms, Laplace approximation and variational methods, data augmentation strategies.

Note: Expected to be given in 2012–13. Computer programming exercises will apply the methods discussed in class.

Prerequisite: Linear algebra, Statistics 111, and knowledge of a computer programming language (R or Matlab) required; Statistics 220 recommended.

**(SPH) BIO 214. Principles of Clinical Trials**

**James H. Ware**

**Spring 1, MW 1:30-3:20, 2.5 credits**

Designed for individuals interested in the scientific, policy, and management aspects of clinical trials. Topics include types of clinical research, study design, treatment allocation, randomization and stratification, quality control, sample size requirements, patient consent, and interpretation of results. Students design a clinical investigation in their own field of interest, write a proposal for it, and critique recently published medical literature.

Course Note: BIO 200, or BIO 201, or BIO202 and BIO203, or BIO206 and one of BIO 207, BIO 208 or BIO 209, or signature of instructor required. (5.06)

**(SPH) EPI 201. Epidemiological Methods I**

**Miguel Hernan**

**Fall 1, TTh 10:30-12:20 + section, 2.5 credits**

EPI201 introduces the principles and methods used in epidemiologic research. The course discusses the conceptual and practical issues encountered in the design and analysis of epidemiologic studies for description and causal inference. The final exam requires the application of the learned skills to a real problem in epidemiology. EPI201 is the first course in the series of methods courses designed for students majoring in Epidemiology or Biostatistics, and those interested in a detailed introduction to the design and conduct of epidemiologic studies. Students who take EPI201 are expected to take EPI202 (Methods II).

**(SPH) EPI 204. Analysis of Case-Control and Cohort Epidemiological Data**

**Joel Schwartz**

**Spring 2, TTh 10.30-12.20 + section, 2.5 credits**

Examine, through practical examples, analysis of case-control and cohort studies using, primarily, conditional logistic and Cox regression model etiologic studies. Explore analytic approaches in the presence of missing data, confounding, and interaction. Emphasize analysis and interpretation of results in the context of research question and study design.

Familiarity with SAS is desirable.

Course Activities: Written group projects, class discussion, quizzes, homework.

Course Note: EPI200, EPI201 or EPI208, EPI202 and EPI203 required. Concurrent enrollment permitted. BIO210 required. Concurrent enrollment permitted. Lab optional.

**(SPH) EPI 207. Advanced Epidemiologic Methods**

**James Robins, Miguel Hernan, Tchetgen**

**Fall 1, MW 3:30-5:20 + section, or Th 1:30-3:20 + section, 2.5 credits**

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, BIO210 and EPI289, or BIO233, or signature of instructor required; familiarity with logistic regression and survival analysis is expected; lab time will be announced at first meeting.

**(SPH) EPI 221. Pharmacoepidemiology**

**Alexander Walker**

**Fall 2, MW 1:30-3:20, 2.5 credits**

Within the framework of formal epidemiologic analysis, this course covers inference about the effects of pharmaceuticals from case reports, case series, vital statistics and other registration schemes, cohort studies, and case-control studies.

Decision-making with inadequate data is examined from the perspectives of manufacturers and of regulators. Students are graded on the basis of group projects. This course is intended primarily for students wishing to pursue a career in the pharmaceutical industry or in national regulatory bodies, but may have more general interest as an applied mid-level course with a heavy methodological emphasis.

Course Activities: Written and oral group projects, individual class presentations, class discussion.

Course Note: Knowledge of epidemiology at the level of EPI 202 and a basic understanding of drug use and nomenclature are assumed; completion of EPI203 preferred; enrollment limited to 25 students; signature of instructor required; course meets Monday through Thursday 1:30 pm to 4 pm during WinterSession.

**(SPH) EPI 233. Research Synthesis & Meta-Analysis**

**C.C. Hsieh, J. Goodman**

**Spring, W 3:30-5, 2.5 credits**

Concerned with the explosion of biological data for etiologic inquiry and the use of existing data to inform clinical decision making and health care policy, the course focuses on research synthesis and evidence-based medicine and public health (meta-analysis.) The epidemiologic principles and relevant statistical methods are reviewed and applied to real case studies. Application of methods includes considerations for randomized clinical trials and observational studies of various topics. The use of meta-analysis to explore data and identify sources of variation among studies is emphasized, as is the use of meta-analysis to identify future research questions.

Course Activities: Students learn the principles of a systematic review, prepare a protocol to conduct a meta-analysis and use existing meta-analysis software to apply principles outlined in the course to many data sets provided for this purpose. Students are encouraged to bring their own data for analysis.

Course Note: EPI200 or EPI201 and BIO200, BIO201, or BIO202 and BIO203 required.

**(SPH) EPI 241. Measuring Health Status**

**Not offered 2011-2012**

**Fall 2, 2.5 credits**

**Lectures. One 2-hour session each week.**

Examines methodologic issues related to measures of health 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.

**(SPH) EPI 288. Data Mining and Prediction**

**Not offered in 2011-12**

**Winter Session, 2.5 credits**

**Dr. N. Cook, Dr. E. F. Cook**

**Lecture, computer lab. Eight 3-hour lectures and 5 2-hour computer labs over two weeks.**

This course will present an introduction to the methods of data mining and predictive modeling, with applications to both genetic and clinical data. Basic concepts and philosophy of supervised and unsupervised data mining as well as appropriate applications will be discussed. Topics covered will include multiple comparisons adjustment, cluster analysis, self-organizing maps, principal component analysis, and predictive model building through logistic regression, classification and regression trees (CART), multivariate adaptive splines (MARS), neural networks, random forests, and bagging and boosting.

Course Activities: Computer labs.

Course Note: Students should be familiar with logistic regression (EPI236, BIO213, BIO210, or equivalent); signature of instructor required; no auditors.

**(SPH) EPI 289. Models for Causal Inference**

**Miguel Hernan**

**Spring 1, MW 10:30-12:20, 2.5 credits**

EPI289 describes models for causal inference, their assumptions, and their practical application to epidemiologic data. The course covers propensity score methods, the parametric g-formula, inverse probability weighting of marginal structural models, g-estimation of nested structural models, and instrumental variable methods. The course also introduces models for causal inference in the presence of time-varying exposures, which will be extensively studied in EPI207. EPI289 is designed to be taken after EPI201/EPI202. The epidemiologic concepts and methods studied in EPI201/202 will be reformulated within a modeling framework in EPI289. Familiarity with the SAS language is strongly recommended.

## Infectious Disease Modeling

### **(SPH) EPI 260. Mathematical Modeling of Infectious Diseases**

**Not offered in 2011-12**

**Dr. M. Lipsitch**

**2.5 credits**

**Lectures, seminars. Two 2-hour sessions each week.**

This course will cover selected topics and techniques in the use of dynamical models to study the transmission dynamics of infectious diseases. Class sessions will primarily consist of lectures and demonstrations of modeling techniques.

Techniques will include design and construction of appropriate differential equation models, equilibrium and stability analysis, parameter estimation from epidemiological data, determination and interpretation of the basic reproductive number of an infection, techniques for sensitivity analysis, and critique of model assumptions. Specific topics will include the use of age-seroprevalence data, the effects of population heterogeneity on transmission, stochastic models and the use of models for pathogens with multiple strains. This course is designed for students with a basic understanding of mathematical modeling concepts who want to develop models for their own work.

Course Note: Previous course in calculus is required; EPI225, EPI285, EPI501, or permission of instructor required.

### **(SPH) EPI 501. Dynamics of Infectious Diseases**

**Megan Murray**

**Fall 2, MW 1:30-3:20, 2.5 credits**

This course covers the basic concepts of infectious disease dynamics within human populations. Focus will be on transmission of infectious agents and the effect of biological, ecological, social, political, economic forces on the spread of infections. We will emphasize the impact of vaccination programs and other interventions. The dynamics of host-parasite interaction are illustrated using basic mathematical modeling techniques.

Course activities: written homework assignments and final exam. Previous coursework in epidemiology helpful.

### **(SPH) ID 298. Inference in Infectious Disease Epidemiology**

**Not offered in 2011-12**

This course will cover advanced issues in the design and interpretation of studies of infectious disease epidemiology. The course will consist of readings and student presentations on topics such as: interpretations of molecular typing data for infectious agents, assessment of incomplete and temporary immunity, immune correlates of protection, spatial effects in disease transmission, and inference about the carrier state. Each session will be led by a student whose responsibility will be to synthesize knowledge on the topic, describe open research areas, and stimulate discussion of the topic based on course readings. This course is intended for advanced students in infectious disease epidemiology.

Course note: Interested students should contact the instructor by the end of Fall 1 to choose a topic for presentation and to discuss possible readings. EPI225 or EPI285 or permission of the instructor required; Minimum enrollment of 7 required. Course dates TBA, 10:30 am to 12:30 pm.

## Decision Theory, Optimization Theory, and Operations Research

### **(FAS) Economics 2059. Decision Theory**

**Tomasz Strzalecki**

**Half course (spring term). M., 2:30–5:30. EXAM GROUP: 7, 8, 9**

The course focuses on classical models of choice in abstract settings, as well as uncertain and intertemporal environments. We will also study recent models that incorporate insights from psychology, such as temptation and self-control.

### **(FAS) Engineering Sciences 210. Mathematical Programming**

**Donald G. M. Anderson**

**Half course (fall term). Tu., Th., 10–11:30. EXAM GROUP: 12, 13**

Introduction to basic optimization techniques. Linear programming: the simplex method and related algorithms, duality theory, interior-point methods. Unconstrained optimization, nonlinear programming, convexity.

Note: Expected to be given in 2009–10. Offered in alternate years.

Prerequisite: Applied Mathematics 21a and 21b, or Mathematics 21a and 21b; Applied Mathematics 120, or equivalent.

### **(MIT) 6.251J. Introduction to Mathematical Programming**

(See Description Above)

**(MIT) 6.255J/15.093J. Optimization Methods**

**D. Bertsimas, P. Parrilo**

**Fall**

**Prereq: 18.06**

Introduces the principal algorithms for linear, network, discrete, nonlinear, dynamic optimization and optimal control. Emphasis on methodology and the underlying mathematical structures. Topics include the simplex method, network flow methods, branch and bound and cutting plane methods for discrete optimization, optimality conditions for nonlinear optimization, interior point methods for convex optimization, Newton's method, heuristic methods, and dynamic programming and optimal control methods.

URL: <http://stellar.mit.edu/S/course/15/fa08/15.093/index.html>

**(MIT) 14.128. Dynamic Optimization and Economic Applications**

**Not offered in 2011-12**

Dynamic systems: local and global analysis. Deterministic and stochastic dynamic programming: theory and numerical implementation. Euler equations. Markov processes: weak and strong convergence. Applications.

**(MIT) 15.871. Introduction to System Dynamics**

**Sastry/Centola**

**Fall, first half of term, MW 1-2:30 or MW 2:30-4 + section**

Introduction to systems thinking and system dynamics modeling applied to strategy, organizational change, and policy design. Students use simulation models, management flight simulators, and case studies to develop conceptual and modeling skills for the design and management of high-performance organizations in a dynamic world. Case studies of successful applications of system dynamics in growth strategy, management of technology, operations, supply chains, product development, and others. Principles for effective use of modeling in the real world.

Note: You must pre-register and participate in Sloan's Prioritization process to take this subject.

**(MIT) 15.872. System Dynamics II**

**Sterman/ Repenning/Centola**

**Fall, second half of term, MW 1-2:30 or MW 2:30-4 + section**

Continuation of 15.871, emphasizing tools and methods needed to apply systems thinking and simulation modeling successfully in complex real-world settings. Uses simulation models, management flight simulators, and case studies to deepen the conceptual and modeling skills introduced in 15.871. Through models and case studies of successful applications students learn how to use qualitative and quantitative data to formulate and test models, and how to work effectively with senior executives to implement change successfully. Prerequisite for further work in the field.

Note: You must pre-register and participate in Sloan's Prioritization process to take this subject.

**(MIT) 15.879. Research Seminar in System Dynamics**

**Not offered in 2011-12**

Doctoral level seminar in system dynamics modeling, with a focus on social, economic and technical systems. Covers classic works in dynamic modeling from various disciplines and current research problems and papers. Participants critique the theories and models, often including replication, testing, and improvement of various models, and lead class discussion. Topics vary from year to year.

Ethics of Resource Allocation

**(FAS) Economics 2054. Social Choice and Welfare Economics**

**Not offered in 2011-12**

**Amartya Sen, Anthony Barnes Atkinson**

**Half course (fall term). M., 1–3. EXAM GROUP: 6, 7**

A basic course in social choice theory and its philosophical foundations. An examination of “impossibility” results, collective rationality, domain restrictions, interpersonal comparability, and the role of rights and liberties.

**(SPH) ID 292. Justice and Resource Allocation**

**Norman Daniels**

**Spring 2, TTh 10:30-12:20, 2.5 credits**

This course explores the ethical issues, especially issues of distributive justice, raised by health and health care resource allocation methodologies and decisions. We begin with examination of distributive issues raised by measures of summary population health and their extensions into cost effectiveness analysis, paying special attention to the strengths and

weaknesses of the underlying welfare economic and utilitarian assumptions. Philosophical and empirical efforts to clarify our beliefs about these distributive issues and our commitments to them will also be discussed. We then turn to recent efforts to make health inequalities and inequities a focus of priority in resource allocation, examining both conceptual and moral issues raised by different approaches to such inequalities and by the fact that the distribution of health is so significantly affected by non-health sector factors. We take up two problems of cross-cutting interest, the different concern shown for identified versus statistical victims, and emerging issues about intergenerational equity concerning the elderly and young. Finally, we turn to fair decision process as a way of resolving disputes about allocation. The goal of the course is to equip students with the ethical basis for addressing resource allocation issues in practical public health contexts, and throughout the course there is a focus real cases where controversy surrounds such decisions.

**(SPH) ID 513. Ethics and Health Disparities**

**Not offered in 2011-12**

**Norman Daniels**

**2.5 credits**

**Lectures, case studies. Two 2-hour sessions each week.**

When is an inequality in health status an injustice or inequity? This course examines various aspects of this issue, bringing appropriate perspectives from ethical theories (utilitarian, libertarian, liberal egalitarian, feminist) to bear on case studies revealing a range of important health disparities. Four main cases will be discussed, each focusing on a central type of health disparity: U.S. racial disparities, class disparities, gender disparities in a developing country setting, and global health inequalities. Key questions to be pursued in each case include: when is an inequality in health between this type of demographic variable unjust? When is a policy that produces, or fails to address, such an inequality race- or gender- or class-biased in a morally objectionable way? What ethical issues are raised by different methods of measuring health inequalities? How does ascription of responsibility for health affect the fairness of health inequalities? What kind of obligations exist to address health inequalities across national boundaries? What ethical issues are raised by policy approaches to addressing health inequalities and giving priority to reducing them?

**(SPH) ID 250. Ethical Basis of Public Health**

**Fall 1: Marc Roberts, MW 8:30-10:20, 2.5 credits**

**Spring 1: Dan Wikler, MW 10:30-12:20, 2.5 credits**

Provides students with a broad overview of some of the main philosophical and moral ideas that are used as a basis for resolving debates of public health policy. Helps students develop their own capacities to analyze, criticize, evaluate, and construct policy-oriented arguments

The practice of public health require moral reflection and argument for a number of reasons. Public health measures often make demands on the public, such as changes in lifestyles or restrictions of liberties, and these must be justified.

Practitioners of public health frequently face ethical dilemmas, both in framing policy and in practice in the field, whose optimal resolution is uncertain. The work of public health practitioners is sometimes challenged on moral grounds, which must be examined and, when appropriate, countered.

The resources for moral argument and justification in public health are found in moral philosophy and philosophical theories of justice; and also in history, the social sciences, and in the science of public health itself. Students in this course will survey some of the principle philosophical approaches in addressing a number of ethical controversies in contemporary public health.

Biomedical Informatics

**(MED) HT950. Biomedical Computing**

**Peter Szolovits**

**Fall, TTh 9:30-11**

Analyzes computational needs of clinical medicine, reviews systems and approaches that have been used to support those needs, and the relationship between clinical data and gene and protein measurements. Topics: the nature of clinical data; architecture and design of healthcare information systems; privacy and security issues; medical expert systems; introduction to bioinformatics. Case studies and guest lectures describe contemporary systems and research projects. Term project using large clinical and genomic data sets integrates classroom topics.

Prereq: 6.034

URL: <http://www.chip.org/teaching/hst950/>

**(MED) HT957a/b. Biomedical Informatics Research Seminar**

**Alexa McCray**

**Fall/Spring, Hours TBD**

This seminar complements the didactic materials of other biomedical informatics courses with a continually changing series of presentations on state-of-the-art research topics in biomedical informatics. Representative topics are: biosurveillance; personally controlled health records; data anonymization and privacy; informatics and health literacy; computer simulation and the theory of constraints; predictive model construction, calibration, and evaluation; information technology in chronic disease management; implementing clinical health data exchange and health records in Massachusetts; and personal and family centered care. Faculty or invited guests from biomedical informatics programs will give the opening presentation, for the first hour of each session. Students will lead panel discussions, debates, or other means for exploration of related topics and issues in the second hour of each session.