

## SOCIAL SCIENCE COURSES 2019-2020

### ANTROPOLOGY

**An 14. Introduction to Sociocultural Anthropology.** *9 units (3-0-6); second term.* Introduction to anthropological theory. Exploration of the diversity of human culture. Examination of the relationship between ecology, technology, and subsistence, patterns of marriage and residence, gender and sexual division of labor, reproduction, kinship, and descent. Links between economic complexity, population, social stratification, political organization, law, religion, ritual, and warfare are traced. Ethnic diversity and interethnic relations are surveyed. The course is oriented toward understanding the causes of cross-cultural variation and the evolution of culture. Instructor: Ensminger.

**An 15. Human Evolution.** *9 units (3-0-6); first term.* Introduction to human evolution, which is essential for understanding our species. Natural selection, sexual selection, genetics, systematics, behavioral ecology, and life history theory are covered. The order Primates is surveyed. Primary emphasis is on the hominid fossil and archeological record. Behavior, cognition, and culture of nonhuman primates and humans, as well as physical variation in present-day humans, is examined. Instructor: Alex. **Not offered 2016–17, 2017-2018 & 2018-2019.**

**An 97. Undergraduate Research.** *Units to be arranged; any term. Prerequisites: advanced Anthropology and instructor's permission.* This course offers advanced undergraduates the opportunity to pursue research in Anthropology individually or in a small group. Graded pass/fail.

**An 101. Selected Topics in Anthropology.** *Units to be determined by arrangement with the instructor; offered by announcement.* Topics to be determined by instructor. Instructor: Staff.

**An/PS 127. Corruption.** *9 units (3-0-6); second term. Prerequisites: AN 14 or PS 12.* Corruption taxes economies and individuals in both the developing and the developed world. We will examine what corruption means in different places and contexts, from grand financial scandals to misappropriation of development funds, ethnic patronage, and the theft of elections. How do we measure it? What are its costs and social consequences? What are its correlates? Does freedom of information matter? Students will read across a range of topics, and write an in-depth research paper on one topic. Limited enrollment. Instructor: Ensminger.

**An 135. Primate Behavior.** *9 units (3-0-6); third term.* This course will examine how natural selection has shaped the social organization, life histories, reproductive strategies, social behavior, and cognitive abilities of nonhuman primates. It will review natural and sexual selection, examine the ecological and social pressures that shape primate behavior, and consider the role these principles play in shaping modern human behavior. **Not offered 2016–17, 2017-2018, 2018-2019 & 2019-2020.**

## **BUSINESS, ECONOMICS, AND MANAGEMENT**

**BEM/Ec/PS 80. Frontiers in Social Sciences.** *1 unit (1-0-0); first term.* Weekly seminar by a member of the Caltech Social Sciences faculty to discuss a topic of their current research or teaching at an introductory level. The course can be used to learn more about different areas of study and about undergraduate courses within the Social Sciences. The course will also be useful to those interested in pursuing the BEM, EC or PS options, or participating in research (SURF, for example) under supervision of the Social Science faculty. Graded pass/fail. Instructor: Cvitanic.

**BEM 97. Undergraduate Research.** *Units to be arranged; any term. Prerequisites: advanced BEM and instructor's permission. This course offers advanced undergraduates the opportunity to pursue research on a business problem individually or in a small group. Graded pass/fail.*

**BEM 101. Selected Topics in Business Economics and Management.** *Units to be determined by arrangement with the instructor; offered by announcement. Topics to be determined by instructor. Instructors: Staff, visiting lecturers.*

**BEM 102. Introduction to Accounting.** *9 units (3-0-6); third term.* This course provides the knowledge and skills necessary for the student to understand financial statements and financial records and to make use of the information for management and investment decisions. Topics include: an overview of financial statements and business decisions; the balance sheet, the income statement, and the cash flow statement; sales revenue, receivables, and cash; cost of goods sold and inventory; long-lived assets and depreciation, and amortization; current and long-term liabilities; owners' equity; investments in other corporations and an introduction to financial statement analysis. Instructor: Ewens.

**BEM 103. Introduction to Finance.** *9 units (3-0-6); second term. Prerequisites: Ec 11 required; Ma 1abc.* Finance, or financial economics, covers two main areas: asset pricing and corporate finance. For asset pricing, a field that studies how investors value securities and make investment decisions, we will discuss topics like prices, risk, and return, portfolio choice, CAPM, market efficiency and bubbles, interest rates and bonds, and futures and options. For corporate finance, a field that studies how firms make financing decisions, we will discuss topics like security issuance, capital structure, and firm investment decisions (the net present value approach, and mergers and acquisitions). In addition, if time permits, we will cover some topics in behavioral finance and household finance such as limits to arbitrage and investor behavior. Instructor: Jin.

**BEM 104. Investments.** *9 units (3-0-6); third term. Prerequisites: Ec 11, BEM 103, some familiarity with statistics.* Examines the theory of financial decision making and statistical techniques useful in analyzing financial data. Topics include portfolio selection, equilibrium security pricing, empirical analysis of equity securities, fixed-income markets, market efficiency, and risk management. Instructor: Roll.

**BEM 105 Options.** *9 units (3-0-6); first term. Prerequisites: One of the following: Ec 122, Ge/ESE 118, Ma 1/103, MA 112a, MA 112b, or instructor's permission; BEM 103 strongly recommended; some familiarity with differential equations is helpful.* An introduction to option

pricing theory and risk management in the discrete-time, binomial tree model, and the continuous-time Black-Scholes-Merton framework. Both the partial differential equations approach and the martingale approach (risk-neutral pricing by expected values) will be developed. The course will cover the basics of Stochastic, Ito Calculus. Since 2015, the course is offered in the flipped format: the students are required to watch lectures online, while problem solving and case and paper presentations are done in class. Instructor: Cvitanic.

**BEM 107. Applied Corporate Finance and Investment Banking.** 9 units (3-0-6); third term. *Prerequisites: BEM 103.* This course builds on the concepts introduced in BEM 103 and applies them to current issues related to the financial management, regulation, and governance of both ongoing corporations and new start-up companies. The fundamental theme is valuation. The course discusses how valuation is affected by, among others, the role of directors, regulation of mergers and acquisitions, and management incentives. Instructors: Cornell. **Not offered 2019-2020.**

**BEM 109. Fixed-Income and Credit-Risk Derivatives.** 9 units (3-0-6); second term. *Prerequisites: BEM 105.* An introduction to the models of interest rates, credit/default risk, and risk management. The focus is on continuous time models used in the practice of Financial Engineering for pricing and hedging fixed income securities. Two main models for credit risk are considered: structural and reduced form/intensity models. Instructors: Cvitanic. **Not offered 2017-2018, 2018-2019 & 2019-2020.**

**BEM 110. Venture Capital.** 9 units (3-0-6); second term. *Prerequisites: BEM 102, 103.* An introduction to the theory and practice of venture capital financing of start-ups. This course covers the underlying economic principles and theoretical models relevant to the venture investment process, as well as the standard practices used by industry and detailed examples. Topics include: The history of VC; VC stages of financing; financial returns to private equity; LBOs and MBOs; people versus ideas; biotech; IPOs; and CEO transitions. Instructors: Ewens.

**BEM 111. Quantitative Risk Management.** 9 units (3-0-6); second term. *Prerequisites: GE/ACM 118, BEM 105, or Ma 112.* An introduction to financial risk management. Concepts of Knightian risk and uncertainty; coherent risk; and commonly used metrics for risk. Techniques for estimating equity risk; volatility; correlation; interest rate risk; and credit risk are described. Discussions of fat-tailed (leptokurtic) risk, scenario analysis, and regime-switching methods provide an introduction to methods for dealing with risk in extreme environments. Instructor: Winston.

**BEM 112. International Financial Markets.** 9 units (3-0-6); second term. *Prerequisites: BEM 103 or instructor permission.* The course offers an introduction to international financial markets, their comparative behavior, and their inter-relations. The principal focus will be on assets traded in liquid markets: currencies, equities, bonds, swaps, and other derivatives. Attention will be devoted to (1) institutional arrangements, taxation, and regulation, (2) international arbitrage and parity conditions, (3) valuation, (4) international diversification and portfolio management, (5) derivative instruments, (6) hedging, (7) dynamic investment strategies, (8) other topics of particular current relevance and importance. **Not offered 2018-2019 & 2019-2020.**

**BEM 117. Behavioral Finance.** 9 units (3-0-6); third term. Prerequisites: Students are recommended (but not required) to take BEM 103 to become familiar with some basic concepts in finance. Much of modern financial economics works with models in which agents are fully rational, in that they maximize expected utility and use Bayes' law to update their beliefs. Behavioral finance is a large and active field that develops and studies models in which some agents are less than fully rational. Such models have two building blocks: limits to arbitrage, which makes it difficult for rational traders to undo the dislocations caused by less rational traders; and psychology, which provides guidance for the kinds of deviations from full rationality we might expect to see. We discuss these two topics and consider a number of applications: asset pricing; individual trading behavior; the origin of bubbles; and financial crises. Instructor: Jin.

**BEM/Ec/ESE 119. Environmental Economics.** 9 units (3-0-6); first term. Prerequisites: Ec 11 or equivalent. This course provides a survey from the perspective of economics of public policy issues regarding the management of natural resources and the protection of environmental quality. The course covers both conceptual topics and recent and current applications. Included are principles of environmental and resource economics, management of nonrenewable and renewable resources, and environmental policy with the focus on air pollution problems, both local problems (smog) and global problems (climate change). Instructor: Ledyard.

**BEM/Ec 150. Business Analytics.** 9 units (3-0-6); first term. Prerequisites: GE/ESE 118 or Ec 122, and knowledge of R. This class teaches how to use very large, cross-media datasets to infer what variables influence choices and trends of economic and business interest. Topics include database management, cleaning and visualization of data, statistical and machine learning methods, natural language processing, social and conventional media, personal sensors and devices, sentiment analysis, and controlled collection of data (including experiments). Grades are based on hands-on data analysis homework assignments and detailed analysis of one dataset. **Not offered 2018-2019 & 2019-2020.**

## ECONOMICS

**Ec 11. Introduction to Economics.** 9 units (3-2-4); first, second terms. An introduction to economic methodology, models, and institutions. Includes both basic microeconomics and an introduction to modern approaches to macroeconomic issues. Students are required to participate in economics experiments. Instructors: Plott, Rangel.

**Ec 97. Undergraduate Research.** Units to be arranged; any term. Prerequisites: Advanced economics and instructor's permission. This course offers advanced undergraduates the opportunity to pursue research in Economics individually or in a small group. Graded pass/fail.

**Ec 98 abc. Senior Research and Thesis.** Prerequisite: instructor's permission. Senior economics majors wishing to undertake research may elect a variable number of units, not to exceed 12 in any one term, for such work under the direction of a member of the economics faculty.

**Ec 101. Selected Topics in Economics.** *Units to be determined by arrangement with the instructor; offered by announcement. Topics to be determined by instructor. Instructors: Staff, visiting lecturers.*

**Ec 105. Industrial Organization.** *9 units (3-0-6); first term. Prerequisites: Ec 11 or equivalent.* A study of how technology affects issues of market structure and how market structure affects observable economic outcomes, such as prices, profits, advertising, and research and development expenditures. Emphasis will be on how the analytic tools developed in the course can be used to examine particular industries—especially those related to internet commerce—in detail. Each student is expected to write one substantial paper. Instructor: Shum

**Ec/Psy 109. Frontiers in Behavioral Economics.** *9 units (3-0-6), first term. Prerequisites: Ec 11.* Behavioral economics studies agents who are biologically limited in computational ability, willpower and pure self-interest. An important focus is how those limits interact with economic institutions and firm behavior. This reading-driven course will cover new papers that are interesting and draw attention to a topic of importance to economics. Readings will cover lab and field experiments, axiomatic models of behavioral phenomena, and welfare. Each weekly discussion will begin with a 10-minute overview, then an inspection of the paper's scientific machinery, judge whether its conclusions are justified, and speculate about the scope of its generalizability. It should help students as referees and as writers. Assignments are two 1000-word summary-critiques. Instructor: Camerer.

**EC/ACM/CS 112. Bayesian Statistics.** *9 units (3-0-6); second term. Pre-requisites: Ma 3, ACM/EE 116 or equivalent.* This course provides an introduction to Bayesian Statistics and its applications to data analysis in various fields. Topics include: discrete models, regression models, hierarchical models, model comparison, and MCMC methods. The course combines an introduction to basic theory with a hands-on emphasis on learning how to use these methods in practice so that students can apply them in their own work. Previous familiarity with frequentist statistics is useful but not required. Instructor: Rangel

**Ec117. Matching Markets.** *9 units (3-0-6); third term.* We will tackle the fundamental question of how to allocate resources and organize exchange in the absence of prices. Examples includes finding a partner, allocating students to schools, and matching donors to patients in the context of organ transplantations. While the main focus will be on formal models, we will also reason about the practical implications of the theory. Instructure: Pomatto.

**Ec 121 ab. Theory of Value.** *9 units (3-0-6); first, third terms. Prerequisites: Ec 11 and Ma 2 (may be taken concurrently).* A study of consumer preference, the structure and conduct of markets, factor pricing, measures of economic efficiency, and the interdependence of markets in reaching a general equilibrium. Instructors: Border, Schenone.

**Ec 122. Econometrics.** *9 units (3-0-6); first term. Prerequisites: Ma 3.* The application of statistical techniques to the analysis of economic data. Instructor: Sherman.

**Ec 123. Econometric Analysis of Discrete Choice.** *9 units (3-0-6); second term. Prerequisites: Ec 122.* This course uses advanced econometric tools to analyze why people make the choices that they do in many domains- whether to make investments in peer-to-peer lending, consumer shopping between brands, where to go to college (Caltech or MIT?),

choosing between modes of transportation (car, metro, Uber/Lyft, or bicycle), etc. We will focus on applications of discrete choice models (in which the dependent variable to be explained is usually a 0-1, Yes or No choice). The statistical models create estimates of behavioral parameters which describe numerically how much people value different goods or outcomes and how random their responses are. Models studied include logit, nested logit, probit, and mixed logit etc. Simulation techniques that allow estimation of otherwise intractable models will also be discussed. Models of this kind are routinely used in business and government, but are often misused and misinterpreted unless they are deeply understood. Instructor: Xin.

**Ec/SS 124. Identification Problems in the Social Sciences.** 9 units (3-0-6); second term.

*Prerequisites: Ec 122.* Statistical inference in the social sciences is a difficult enterprise whereby we combine data and assumptions to draw conclusions about the world we live in. We then make decisions, for better or for worse, based on these conclusions. A simultaneously intoxicating and sobering thought! Strong assumptions about the data generating process can lead to strong but often less than credible (perhaps incredible?) conclusions about our world. Weaker assumptions can lead to weaker but more credible conclusions. This course explores the range of inferences that are possible when we entertain a range of assumptions about how data is generated. We explore these ideas in the context of a number of applications of interest to social scientists. Instructors: Sherman.

**Ec/SS 129. Economic History of the United States.** 9 units (3-0-6); second term.

*Prerequisites: Ec 11.* An examination of certain analytical and quantitative tools and their application to American economic development. Each student is expected to write two substantial papers - drafts will be read by instructor and revised by students. **Not offered 2016-2017, 2017-2018, 2018-2019 & 2019-2020.**

**Ec/SS 130. Economic History of Europe from the Middle Ages to the Twentieth Century.** 9

*units (3-0-6); third term. Prerequisites: Ec 11.* Employs the theoretical and quantitative techniques of economics to help explore and explain the development of the European cultural area between 1000 and 1980. Topics include the rise of commerce, the demographic transition, the Industrial Revolution, and changes in inequality, international trade, social spending, property rights, and capital markets. Each student is expected to write nine weekly essays and a term paper. **Not offered 2016-2017, 2017-2018 & 2018-2019 & 2019-2020.**

**Ec 131. Market Design.** 9 units (3-0-6); first term. *Prerequisites: Ec 11, Ec 121, and PS/Ec*

*172.* The class studies different mechanisms to allocate a scarce resource, frequently called markets, using theoretical models. We will cover centralized markets, which clear via a single price, waiting or rationing, or use centralized algorithms to allocate demand and supply; decentralized markets, which clear via search; and auction markets. In each case, we will study how market rules determine the incentives of market participant and how to design these markets, focusing on efficiency and revenue maximization. Applications to electricity markets, concert tickets, ride-sharing, labor markets, school choice, dating markets, sponsored search ad auctions, and spectrum auctions will be covered. Instructor: Doval.

**Ec 135. Economics of Uncertainty and Information.** 9 units (3-0-6); first term. *Prerequisites:*

*Ec 11.* An analysis of the effects of uncertainty and information on economic decisions. Included among the topics are individual and group decision making under uncertainty, expected utility



maximization, insurance, financial markets and speculation, product quality and advertisement, and the value of information. Instructor: Agranov.

**Ec 136. Behavioral Decision Theory.** 9 units (3-0-6); second term. Prerequisites: Ma 3. Ec 121 is recommended as background, but is not a prerequisite. This course is an intermediate-level class on individual-level theory. The method used posits precise assumptions about general behavior (axioms) then finds equivalent ways to model them in mathematically convenient terms. We will cover both the traditional "rational" approach, and more recent "behavioral" models that incorporate psychological principles, in domains of intertemporal choice, random (stochastic) choice, menu choice, and revealed preferences. Students are expected to understand rigorous mathematical proofs. The class also includes serious discussion of the value of experimental evidence motivating new theories. Instructors: Saito.

**Ec 140. Economic Progress.** 9 units (3-0-6); third term. Prerequisites: Ec 11 and Ma 2; Ec 122 recommended. This course examines the contemporary literature on economic growth and development from both a theoretical and historical/empirical perspective. Topics include a historical overview of economic progress and the lack thereof; simple capital accumulation models; equilibrium/planning models of accumulation; endogenous growth models; empirical tests of convergence; the measurement and role of technological advancement; and the role of trade, institutions, property rights, human capital, and culture. Instructors: Hoffman.

**CS/SS/Ec 149. Introduction to Algorithmic Economics.** 9 units (3-0-6); second term. This course will equip students to engage with active research at the intersection of social and information sciences, including: algorithmic game theory and mechanism design; auctions; matching markets; and learning in games. **Not offered 2018-2019 & 2019-2020.**

**Ec/PS 160 abc. Laboratory Experiments in the Social Sciences.** 9 units (3-3-3); first, second, third terms. Section a required for sections b and c. An examination of recent work in laboratory testing in the social sciences with particular reference to work done in social psychology, economics, and political science. Students are required to design and conduct experiments. Instructor: Plott.

**Ec 181 ab. Convex Analysis and Economic Theory.** 9 units (3-0-6); first, second terms. Prerequisites: Ma 2 ab, Ec 121 a. Introduction to the use of convex analysis in economic theory. Includes a rigorous discussion of separating hyperplane theorems, continuity and differentiability properties of convex and concave functions, support functions, subdifferentials, Fenchel conjugacy, saddle-point theory, theorem of the alternative, and linear programming. Emphasis is on the finite-dimensional case, but infinite-dimensional spaces will be discussed. Applications to the theory of cost and production functions, decision theory, and game theory. Instructor: Border.

## **POLITICAL SCIENCE**

**PS 12. Introduction to Political Science.** 9 units (3-0-6); first, third terms. Introduction to the tools and concepts of analytical political science. Subject matter is primarily American political

processes and institutions. Topics: spatial models of voting, redistributive voting, games, presidential campaign strategy, Congress, congressional-bureaucratic relations, and coverage of political issues by the mass media. Instructors: Ordeshook, Kiewiet.

**PS 20. Political-Economic Development and Material Culture.** *9 units (3-0-6); second term.* During the 19th-century the American economy, despite the Civil War, caught up to and surpassed all European economies. How did the likes of Singer, John Deere and Seth Thomas - latecomers to the markets they served - come to dominate those markets both domestically and internationally? Why did the technology of interchangeable parts and mass production become known as 'the American system' when much of that technology was imported from Europe? What role did government play in facilitating or thwarting innovation and economic growth? This course will explore such questions as reflected in the ordinary things people collect under the label 'antiques'. What do we learn from the fact that we can document a half dozen American manufacturers of apple peelers but not a single comparable European company? Why is the hand sewn quilt a nearly unique American folk art form and what does the evolution of quilting patterns tell us about technology and economic prosperity? What do baking powder cans as a category of collectible tell us about the politics of federal versus state regulation? Students will be expected to each choose a topic that asks such questions and to explore possible answers, all with an eye to understanding the interplay of economics, politics, and demography. Instructor: Ordeshook.

**PS 97. Undergraduate Research.** *Units to be arranged; any term. Prerequisites: advanced political science and instructor's permission.* This course offers advanced undergraduates the opportunity to pursue research in political science individually or in a small group. Graded pass/fail.

**PS 99 ab. Political Science Research Seminar.** *9 units (3-0-6); first, second terms. Prerequisites: political science major; completion of a required PS course for major.* Development and presentation of a major research paper on a topic of interest in political science or political economy. The project will be one that the student has initiated in a political science course he or she has already taken from the PS courses required for the PS option, numbered above 101. This course will be devoted to understanding research in political science, and basic political science methodology. Students will be exposed to current research journals, work to understand a research literature of interest, and work to formulate a research project. Fulfills the Institute scientific writing requirement. Instructor: Ordeshook

**PS 101. Selected Topics in Political Science.** *Units to be determined by arrangement with the instructor; offered by announcement.* Instructor: Staff.

**PS 120. American Electoral Behavior and Party Strategy.** *9 units (3-0-6); third term.* A consideration of existing literature on the voting behavior of the citizen, and an examination of theoretical and empirical views of the strategies followed by the parties. Two substantial papers are expected of students. Instructor: Alvarez.

**PS 121. Analyzing Congress.** *9 units (3-0-6); first term.* Introduction to the US Congress with an emphasis on thinking analytically and empirically about the determinants of Congressional behavior. Among the factors examined are the characteristics and incentives of legislators, rules governing the legislative process and internal organization, separation of powers, political



parties, Congressional elections, and interest group influence. Instructor: Hirsch. **Not offered 2019-2020.**

**PS 122. Political Representation.** *9 units (3-0-6); third term. Prerequisite: PS 12.* Theory, practice, and consequence of political representation in the electoral context. Topics include the concept of representation; how the degree of representation of various groups and interests (such as ethnic and racial) is affected by different electoral rules; and the impact of representation of minorities on public policies. The primary focus is on the empirical literature pertaining to the United States, but examples from other countries are also examined for comparative purposes. Instructor: Gilibisco. **Not offered 2019-2020.**

**PS 123. Regulation and Politics.** *9 units (3-0-6); second term. Prerequisite: PS 12.* This course will examine the historical origins of several regulatory agencies and trace their development over the past century or so. It will also investigate a number of current issues in regulatory politics, including the great discrepancies that exist in the cost-effectiveness of different regulations, and the advent of more market-based approaches to regulations instead of traditional "command-and-control." Not offered on a pass/fail basis. Instructor: Kiewiet.

**PS 125. Political Conflict.** *9 units (3-0-6); second term.* This course examines the causes of and solutions for conflict and violence: Why do wars occur and how do we stop them? We cover topics such as terrorism, ethnic violence, civil wars, the Israeli-Palestinian conflict, repression, revolutions, and inter-state wars. We study these phenomena using the rational choice framework and modern tools in data analysis. The goals of the class are to explain conflicts and their terminations as outcomes of strategic decision-making and to understand the empirical strengths and weakness of current explanations. Instructor: Gibilisco.

**PS 130. Introduction to Social Science Surveys: Methods and Practice.** *9 units (3-0-6); third term.* In this course, students will learn the basic methodologies behind social science survey analysis: self-completion and interview-assisted surveying, sampling theory, questionnaire design, theories of survey response, and the basic analysis and presentation of survey results will be covered, as well as contemporary research in survey methodology and public opinion analysis. Students will be involved in the active collection and analysis of survey data and the presentation of survey results; students will be required to complete an independent project involving some aspect of survey methodology. **Not offered 2016-2017, 2017-2018, 2018-2019 & 2019-2020.**

**PS 132. Formal Theories in Political Science.** *9 units (3-0-6); first term. Prerequisites: PS 12 and Ec/PS 172.* Axiomatic structure and behavioral interpretations of game theoretic and social choice models and models of political processes based on them. Instructor: Agranov.

**PS 135. Analyzing Legislative Elections.** *9 units (3-0-6); first term.* The purpose of this course is to understand legislative elections. The course will study, for example, what role money plays in elections and why incumbents do better at the polls. It will also examine how electoral rules impact the behavior both of candidates and voters, and will explore some of the consequences of legislative elections, such as divided government. Instructor: Katz. **Not offered 2016-2017, 2017-2018, 2018-2019 & 2019-2020.**

**PS/SS 139. Comparative Politics.** *9 units (3-0-6); third term. Prerequisites: PS 12.* The politics of non-American political systems with an emphasis on their electoral systems and methodologies for assessing their compliance with democratic standards. Students will be expected to develop data sets appropriate to analyzing elections in individual countries and offering an assessment of the pervasiveness of fraud in those elections. The student's grade will be determined by a final written report reporting the methodology and results of their analysis. Instructor: Lopez-Moctezuma. Note: not offered 2016–17.

**PS 141 ab. A History of Budgetary Politics in the United States.** *9 units (3-0-6); second, third terms.* This class will examine budgetary conflict at key junctures in U.S. history. Topics include the struggle to establish a viable fiscal system in the early days of the Republic, the ante bellum tariff, the “pension politics” of the post-Civil War era, the growth of the American welfare state, and the battle over tax and entitlement reform in the 1980s and 1990s. Instructor: Kiewiet.

**PS/Ec 172. Game Theory.** *9 units (3-0-6); third term. Prerequisites: Ec 11 or PS 12* This course is an introduction to non-cooperative game theory, with applications to political science and economics. It covers the theories of normal-form games and extensive-form games, and introduces solutions concepts that are relevant for situations of complete and incomplete information. The basic theory of repeated games is introduced. Applications are to auction theory and asymmetric information in trading models, cheap talk and voting rules in congress, among many others. Instructor: Tamuz.

## PSYCHOLOGY

**Psy 13. Introduction to Cognitive Neuroscience.** *9 units (3-0-6); third term.* This course will provide an introduction to what we know about the fascinating link between the brain, the mind, and behavior. We will start with a basic review of the brain as a biological organ, its evolution, development, and its basic operations including visual and others senses. Next, we will discuss how the brain gives rise to a wide variety of complex behaviors, memory, social and emotional behaviors. The course will finally introduce students to the wider neurophilosophical questions concerning freewill, death and morality. Instructor: Mobbs.

**Psy 25. Reading and Research in Psychology.** *Units to be determined by the instructor. Not available for credit toward humanities–social science requirement. Written report required. Graded pass/fail. Not offered 2017–18, 2018-2019 & 2019-2020.*

**Psy 90. Applied Neuropsychology of Learning.** *9 units (3-0-6); first term.* An introduction to the neuropsychological mechanisms associated with learning and creativity, and to how different factors and behaviors impede and enhance them. No previous coursework in psychology or neuroscience is required. The course includes labs in which the students will test various hypothesis about their own learning processes. Graded or P/F. Note that this course can be used to fulfill the overall HSS core requirements, but does not count towards the introductory or advanced social science requirement. **Not offered 2018-2019 & 2019-2020.**

**Psy 101. Selected Topics in Psychology.** *Units to be determined by arrangement with the instructor; offered by announcement.* Instructor: Staff.

**CNS/SS/Psy/Bi 102 ab. Brains, Minds, and Society.** 9 units (3-0-6); second, third terms. Prerequisites: Bi/CNS/NB 150 and CNS/Bi/Ph/CS/NB 187, or instructor's permission. Introduction to the computations made by the brain during economic and social decision making and their neural substrates. First quarter: Reinforcement learning. Unconscious and conscious processing. Emotion. Behavioral economics. Goal-directed and habit learning. Facial processing in social neuroscience. Second quarter: History and mechanisms of reinforcement. Associative learning. Mentalizing and strategic thinking. Neural basis of pro-sociality. Exploration-exploitation tradeoff. Functions of basal ganglia. Instructor: Adolphs, Camerer, O'Doherty.

**Psy/CNS 105 a. Frontiers in Neuroeconomics.** 5 units (1.5-0-3.5); second term. The new discipline of Neuroeconomics seeks to understand the mechanisms underlying human choice behavior, born out of a confluence of approaches derived from Psychology, Neuroscience and Economics. This seminar will consider a variety of emerging themes in this new field. Some of the topics we will address include the neural bases of reward and motivation, the neural representation of utility and risk, neural systems for inter-temporal choice, goals vs habits, and strategic interactions. We will also spend time evaluating various forms of computational and theoretical models that underpin the field such as reinforcement-learning, Bayesian models and race to barrier models. Each week we will focus on key papers and/or book chapters illustrating the relevant concepts. Instructor: O'Doherty.

**Psy 115. Social Psychology.** 9 units (3-0-6); first term. The study of how people think about other people and behave toward or around others. Topics include social cognition and emotions (theory of mind and empathy), their development from childhood to old age, impairments in social functions, altruism and cooperation, social groups (ingroup and outgroup), attribution and stereotypes. The class also presents evidence on how these social phenomena are implemented in the human brain and introduces behavioral and neuroscientific methods used in social psychology and social neuroscience. Instructor: Dubois.

**Psy 125. Reading and Research in Psychology.** Same as Psy 25, but for graduate credit. *Not available for credit toward humanities–social science requirement.*

**Psy/CNS 130. Introduction to Human Memory.** 9 units (3-0-6); second term. The course offers an overview of experimental findings and theoretical issues in the study of human memory. Topics include iconic and echoic memory, working memory, spatial memory, implicit learning and memory; forgetting: facts vs. skills, memory for faces; retrieval: recall vs. recognition, context-dependent memory, semantic memory, spreading activation models and connectionist networks, memory and emotion, infantile amnesia, memory development, and amnesia. **Not offered 2017–18, 2018-2019 & 2019-2020.**

**CNS/Psy/Bi 131. The Psychology of Learning and Motivation.** 9 units (3-0-6); second term. This course will serve as an introduction to basic concepts, findings, and theory from the field of behavioral psychology, covering areas such as principles of classical conditioning, blocking and conditioned inhibition, models of classical conditioning, instrumental conditioning, reinforcement schedules, punishment and avoidance learning. The course will track the development of ideas from the beginnings of behavioral psychology in the early 20th century to contemporary learning theory. **Not offered 2016-2017, 2017–2018, 2018-2019 & 2019-2020.**

**Psy 133. Computation, Cognition and Consciousness. 9 units (3-0-6); second term.** This course will critically examine the impact of recent advances in computational neuroscience for central problems of philosophy of mind. Beginning with a historical overview of computationalism (the thesis that mental states are computational states), the course will examine how psychological explanation may be understood in computational terms across a variety of levels of description, from sub-neuronal and single neuron computation to circuit and network levels. Specific issues will include: whether computation provides unifying psychological principles across species; whether specific mental states such as pain are computational states; digital/analog computation, dynamical systems, and mental representation; whether conscious experience can be understood as a computational process. **Not offered 2017–18, 2018-2019 & 2019-2020.**

**Bi/CNS/NB/Psy 150. Introduction to Neuroscience. 10 units (4-0-6): third term.** General principles of the function and organization of nervous systems, providing both an overview of the subject and a foundation for advanced courses. Topics include the physical and chemical bases for action potentials, synaptic transmission, and sensory transduction; anatomy; development; sensory and motor pathways; memory and learning at the molecular, cellular, and systems level; and the neuroscience of brain diseases. Instructors: Adolphs, Lester.

**PI/CNS/NB/Bi/Psy 161. Consciousness. 9 units (3-0-6): third term.** One of the last great challenges to our understanding of the world concerns conscious experience. What exactly is it? How is it caused or constituted? And how does it connect with the rest of our science? This course will cover philosophy of mind, cognitive psychology, and cognitive neuroscience in a mixture of lectures and in-class discussion. There are no formal pre-requisites, but background in philosophy (equivalent to PI41, PI110) and in neuroscience (equivalent to BI/CNS 150) is strongly recommended and students with such background will be preferentially considered. Limited to 20. Instructors: Eberhardt, Adolphs.

**CNS/Bi/SS/Psy 176. Cognition. 9 units (4-0-5); third term** The cornerstone of current progress in understanding the mind, the brain, and the relationship between the two is the study of human and animal cognition. This course will provide an in-depth survey and analysis of behavioral observations, theoretical accounts, computational models, patient data, electrophysiological studies, and brain-imaging results on mental capacities such as attention, memory, emotion, object representation, language, and cognitive development. Instructor: Shimojo. **Not offered 2019-2020.**

## **SOCIAL SCIENCE**

**SS 101. Selected Topics in Social Science. Units to be determined by arrangement with the instructor; offered by announcement.** Not available for social science credit unless specifically approved by social science faculty. Instructors: Staff, visiting lecturers..

**H/SS 124. Problems in Historical Demography. 9 units (3-0-6); first term.** Birth, marriage, and death—the most basic events in people's lives—are inextricably linked to larger economic and social phenomena. An understanding of these basic events can thus shed light on the economic and social world inhabited by people in the past. In this course students will be introduced to the sources and methods used by historical demographers to construct demographic measures for past populations. In addition, the course will cover a broad range of problems in historical demography, including

mortality crises, fertility control, infant mortality, and the role of economic and social institutions in demographic change. While the emphasis is on societies in the past, there will be some discussion of modern demographic trends in various parts of the world. **Not offered 2017-2018, 2018-2019 & 2019-2020.**