

# SES Doctoral Program Classes

[version of October 2016]

This document provides partial lists of classes that may be appropriate for satisfying the various requirements of the SES doctoral program, beyond the core. These lists are neither exclusive nor exhaustive; they are provided for general guidance and to indicate the range of possibly relevant course offerings.

Please note the following:

a) Every student's program needs to be approved on an individual basis, to make sure that the overall program is coherent, broad, and deep in certain directions. An arbitrary combination of courses from the lists included here is not automatically approved.

b) Other classes will also be possible, to be approved on a case-by-case basis. For example:

- Suitable classes that are one-time or special subject offerings.
- Suitable classes taken by cross-registering, e.g., at Harvard or Wellesley.
- Classes that have as a prerequisite classes in these lists.
- Other regular MIT classes that fit the philosophy and requirements of the program.

c) The classification of courses into categories is not rigid. For example, some of the courses listed under "Urban Science" intersect with "Sociology."

## **REQUIREMENT: Information, Systems, and Decision Science**

*5 classes. These will be rigorous classes in the areas of probabilistic modeling, statistics, optimization, and systems/control theory. Classes used to satisfy the core can be counted toward this requirement. However, the remaining classes should be at a more-advanced level. One subject must involve the statistical processing of data. One subject must have substantial mathematical content (as defined by the IDSS-GPC). Two classes must belong to a sequence that provides increasing depth on a particular topic.*

### **Optimization**

15.094/1.142 Robust Modeling, Optimization, and Computation  
6.252/15.084 Nonlinear Optimization  
6.256 Algebraic Techniques and Semidefinite Optimization  
15.083/6.859 Integer Programming and Combinatorial Optimization

### **Probability and Stochastics**

6.262 Discrete Stochastic Processes  
6.437 Inference and Information

### **Control**

6.231 Dynamic Programming and Stochastic Control  
6.241/16.338 Dynamic Systems and Control  
16.322 Stochastic Estimation and Control  
16.323 Principles of Optimal Control

### **Other Methodological Classes**

15.764/1.271/IDS.155 The Theory of Operations Management  
1.203/15.073/16.76 Logistical and Transportation Planning Methods  
6.254 Game Theory with Engineering Applications  
6.268 Network Science and Models

### **Statistics**

15.077 Statistical Learning and Data Mining  
14.381 Statistical Methods in Economics  
14.382 Econometrics  
14.387 Applied Econometrics  
6.434/16.391 Statistics for Engineers and Scientists  
6.438 Algorithms for Inference  
6.867 Machine Learning  
9.520/6.860 Statistical Learning Theory and Applications  
17.802 Quantitative Research Methods II: Causal Inference  
17.804 Quantitative Research Methods III: Generalized Linear Models and Extensions  
17.806 Quantitative Research Methods IV: Advanced Topics

## **REQUIREMENT: Social Science**

**4 classes.** *A student proposes a coherent and rigorous program-of-study in the social sciences that provides the background necessary for the student's research. Classes used to satisfy the core can be counted toward this requirement. However, the remaining courses should be at a more-advanced level. Three classes must form a coherent collection that builds depth in a particular social science focus area.*

### **Economics**

14.123 & 14.124 Microeconomic Theory III & IV

14.451 & 14.452 Dynamic Optimization Methods with Applications & Economic Growth

14.453 & 14.454 Economic Fluctuations & Economic Crises

Also, more advanced economics classes with the above as prerequisites

### **Political Science**

17.000/24.611 Political Philosophy

17.100/14.781/15.678 Political Economy I: Theories of the State and the Economy

17.200 American Political Behavior I

17.418 Field Seminar in International Relations Theory

17.588 Field Seminar in Comparative Politics

17.850 Political Science Scope and Methods

17.878 Qualitative Research: Design and Methods

### **Sociology and Organizations**

15.347 Doctoral Seminar in Research Methods I

21A.819 Qualitative Research Methods

21A.859/STS.250 Social Theory and Analysis

21H.991 Theories and Methods in the Study of History

STS.260 Introduction to Science, Technology, and Society

14.282 Introduction to Organizational Economics

15.341 Individuals, Groups, and Organizations

15.342 Organizations and Environments

15.357 Economics of Ideas, Innovation and Entrepreneurship

## **REQUIREMENT: Problem Domain**

**2 classes.** *A student takes a total of two classes in the application domain of their research. One class may also be counted toward the social science requirement. Another class may be satisfied by an internship or independent study in which the student is graded on their performance of hands-on work in a particular domain.*

The listings below refer to only some of the possible problem domains for the SES program. There are several other domains that can be studied under this program, e.g., logistics, cybersecurity, etc.

### **Energy**

6.695/15.032/IDS.505 Engineering, Economics and Regulation of the Electric Power Sector

IDS.521 Energy Systems and Climate Change Mitigation

IDS.522 Mapping and Evaluating New Energy Technologies

5.00/6.929/10.579/22.813 Energy Technology and Policy: From Principles to Practice

14.444/15.038 Energy Economics and Policy

22.811/1.818/2.65/10.391/11.371 Sustainable Energy

11.477/1.286 Urban Energy Systems and Policy

11.381 Infrastructure Systems in Theory and Practice

In addition, students may consider classes on the various underlying technologies

### **Healthcare**

11.475 Navigating Power in Water and Sanitation Planning

15.141/HST.918 Economics of the Health Care Industries

HST.977/15.122 Critical Reading and Technical Assessment of Biomedical Information

15.767 Healthcare Lab: Introduction to Healthcare Delivery in the United States

### **Finance**

15.416/14.416 Introduction to Financial Economics

15.440/14.440 Advanced Financial Economics I

15.441/14.441 Advanced Financial Economics II

15.442/14.442 Advanced Financial Economics III

Also, more advanced classes building on the above.

### **Social Networks**

6.268 Network Science and Models

11.236 & 11.237 Theory of Participatory Action Research (PAR) & Practice of Participatory Action Research (PAR)

11.469 Urban Sociology in Theory and Practice

11.458 Crowd Sourced City: Civic Tech Prototyping Class

### **Urban Science**

1.203/15.073/16.76 Logistical and Transportation Planning Methods

11.478 Behavior and Policy: Connections in Transportation

11.526/1.251 Comparative Land Use and Transportation Planning

### **And Other Domains...**