

## INSTITUTE FOR DATA, SYSTEMS, AND SOCIETY

The mission of the Institute for Data, Systems, and Society (IDSS) (<http://idss.mit.edu>) is to advance education and research in state-of-the-art, analytical methods in information and decision systems; statistics and data science; and the social sciences, and to apply these methods to address complex societal challenges in a diverse set of areas such as energy systems, finance, healthcare, social networks, and urban science. Its mission also includes the creation of an MIT-wide focal point for advancing research and educational programs related to statistics and data science.

Technology advances in areas such as smart sensors, big data, communications, computing, and social networking are rapidly scaling the size and complexity of interconnected systems and networks and, at the same time, are generating massive data that can lead to new insights and understanding. Research at IDSS will aim to understand and analyze data from across these systems, which present unique and substantial challenges due to scale, complexity, and the difficulties of extracting clear, actionable insights.

Our ability to understand data and develop models across complex, interconnected systems is at the core of our ability to uncover new insights and solutions.

Spanning all five schools at MIT, IDSS embraces the collision and synthesis of ideas and methods from analytical disciplines including statistics, data science, information theory and inference, systems and control theory, optimization, economics, human and social behavior, and network science. These disciplines are relevant both for understanding complex systems and for presenting design principles and architectures that allow for the systems' quantification and management. IDSS seeks to integrate these areas, fostering new collaborations, introducing new paradigms and abstractions, and utilizing the power of data to address societal challenges.

### Undergraduate Study

#### **Minor in Statistics and Data Science**

The Minor in Statistics and Data Science (<http://catalog.mit.edu/archive/2018-2019/interdisciplinary/undergraduate-programs/minors/statistics-data-science>) provides students with a working knowledge base in statistics, probability, and computation, along with an ability to perform data analysis. For a description of the minor, see Interdisciplinary Programs (<http://catalog.mit.edu/archive/2018-2019/interdisciplinary/undergraduate-programs>).

### Graduate Study

IDSS provides educational programs anchored in the following intellectual pillars: statistics, information and decision sciences, and human and institutional behavior.

IDSS's academic programs embrace the collision and synthesis of ideas and methods from analytical disciplines, including statistics, stochastic modeling, information theory and inference, systems and control theory, optimization, economics, human and social behavior, and network science. Each of these fields in isolation is an insufficient basis for a deep understanding of complex interactions and systems. However, the intersections of these disciplines provide new tools and perspectives for understanding complex systems, addressing overarching challenges (including sustainability and systemic risk), and presenting design principles and architectures that enable those systems' quantification, management, and regulation.

Inquiries about IDSS academic programs may be directed to the Academic Office ([idss\\_academic\\_office@mit.edu](mailto:idss_academic_office@mit.edu)).

#### **Admission Requirements for Graduate Study**

Application forms for all programs are available online (<http://web.mit.edu/admissions/graduate>). Applicants whose first language is not English must offer evidence of written and oral proficiency in English by registering (<http://www.ielts.org>) for the International English Language Testing System (IELTS) exam, academic format, and achieving a score of 7.5 or better. Information about the Graduate Record Examinations (GRE) can be obtained through the website (<http://www.ets.org/gre>). Applicants should refer to the details of each program concerning specific requirements for admission.

#### **Master of Science in Technology and Policy**

The Technology and Policy Program (TPP) (<http://tpp.mit.edu>) educates students seeking leadership roles in the constructive development and use of technology—an area that is not well served by the traditional education of technical or social science specialists. TPP focuses on meeting the need for leaders who are engineers and scientists—people with not only strong technical foundations but also the skills and abilities to deal cogently and effectively with the economic, political, and administrative dimensions of the technological challenges of the 21st century.

The Master of Science in Technology and Policy is an engineering research degree with a focus on the increasingly central role of technology in the framing, formulation, and resolution of policy problems. Many students combine TPP's curriculum with complementary subjects to obtain dual degrees in TPP and either a specialized branch of engineering or an applied social science, such as political science or urban studies and planning.

TPP's coursework provides a solid grounding in technology and policy by combining advanced subjects in the student's chosen technical field with courses in economics, politics, modern quantitative methods, and social science. All students must complete a satisfactory research thesis that has a substantial technology and policy component. In order to prepare students for effective professional practice, TPP stresses leadership and communication. It also encourages students to participate in TPP's summer internship program, which places students in government and industry in the US and around the world.

The TPP curriculum consists of three blocks of subjects and a research thesis. The first block is a required integrative subject in technology and policy and a subject in applied quantitative methods. The second block focuses on training in formal frameworks for policy development and consists of subjects in microeconomics, political economy, and one restricted elective in microeconomics, social science methods, law, or statistics. The third block comprises a minimum of three coherent electives that fulfill professional and research objectives. The research thesis is the culmination of scholarship integrating technology and policy.

Completion of the academic and research requirements of the TPP SM typically takes four terms.

The TPP curriculum normally begins in September; applications are due by December 15. All applicants should have a strong basis in engineering or science, and must take the GRE. Strong candidates for the program typically score in the top 10 percent of all three GRE areas: verbal, quantitative, and analytic writing. TPP seeks applicants having relevant work or research experience as well as the ability to demonstrate evidence of leadership and initiative in their professional or other activities.

Contact the TPP program office ([tpp@mit.edu](mailto:tpp@mit.edu)), Room E17-373, 617-258-7295, for additional information.

### Doctor of Philosophy in Social and Engineering Systems

The Doctor of Philosophy in Social and Engineering Systems (SES) ([http://idss.mit.edu/academics/ses\\_doc](http://idss.mit.edu/academics/ses_doc)) is focused on addressing concrete and societally significant problems by combining methods from engineering and the social sciences. A student's doctoral program includes coursework that prepares them for advanced, rigorous, and original research leading to a doctoral thesis. Both coursework and research must include breadth and depth in engineering and quantitative methods, as well as in the social sciences, and in a particular application domain.

Student research in SES is characterized by the following traits:

- It is driven by problems of societal interest, in areas such as energy, finance, health care, social networks, urban science, as well as in policy-related topics.
- It is application domain driven.

- It involves quantitative methods. The program is focused on problems that can be addressed through mathematical modeling and data analysis.
- It relies on real-world data. Research is expected to analyze data from the application domain of interest, and draw upon the training provided in statistics, etc., through the program's coursework.
- It engages societal aspects of the problem. The research incorporates theories and tools from the social sciences.

The program's subject requirements follow. Waivers for some of the requirements are possible in special circumstances.

#### Core

Select three of the following:

6.251[[	Introduction to Mathematical Programming
6.436[[	Fundamentals of Probability
14.121 & 14.122	Microeconomic Theory I and Microeconomic Theory II
21A.809	Designing Empirical Research in the Social Sciences

#### Information Systems and Decision Science

Five subjects in the areas of probabilistic modeling, statistics, optimization, or systems/control theory, including:

- One subject that involves the statistical processing of data
- One subject of substantial mathematical content <sup>1</sup>
- Two subjects belonging to a sequence that provides increasing depth on a particular topic <sup>2</sup>

#### Social Science

Four subjects that create a coherent and rigorous program of study in the social sciences, providing necessary background for research, including:

- Three subjects comprising a coherent collection that builds depth in a particular social science focus area <sup>2</sup>

#### Problem Domain

Two subjects in the application domain of the student's research <sup>3,4</sup>

<sup>1</sup> Criteria defined by the graduate program committee.  
<sup>2</sup> Subjects used to satisfy the core can be counted toward this requirement. However, the remaining subjects should be at a more-advanced level.  
<sup>3</sup> One subject may be satisfied by an internship or independent study in which the student is evaluated on their performance of hands-on work in a particular domain.  
<sup>4</sup> One subject may also be counted toward the social science requirement.

The program begins in September and applications are due by December 15 of the preceding year.

Further information about SES is available on the program website ([http://idss.mit.edu/academics/ses\\_doc](http://idss.mit.edu/academics/ses_doc)) or by contacting the IDSS Academic Office ([idss\\_academic\\_office@mit.edu](mailto:idss_academic_office@mit.edu)), Room E17-375, or 617-253-1182.

## Research Centers

Research in IDSS addresses overarching challenges, including the modeling and prediction of system behavior and performance; systems design and architecture; and issues including social welfare, monetization, and regulation, as well as sustainability and resilience, cascades and contagion phenomena, and systemic risk.

IDSS will sustain this research agenda by fostering and prioritizing several types of strong connections, including:

- A community of experts, at MIT and elsewhere, with demonstrated success performing impactful, multidisciplinary research in these domains.
- A close connection between research and domain expertise, to enable a contextually-informed understanding of the challenges and opportunities in complex systems.
- Educational and research methodologies, not considered in isolation, but instead anchored in one or several of the cross-disciplinary fields of statistics, information and decision sciences, the science of interconnections, as well as the study of social and institutional behavior.

### **Laboratory for Information and Decision Systems**

The Laboratory for Information and Decision Systems (LIDS) (<http://lids.mit.edu>) is an interdepartmental laboratory devoted to research and education in systems, networks, and control, staffed by faculty, research scientists, and graduate students from many departments and centers across MIT. The mission of LIDS is to develop and apply rigorous approaches and tools for system modeling, analysis, design, and optimization. It encompasses the development of novel analytical methodologies, as well as the adaptation and application of advanced methods to specific contexts and application domains.

LIDS research addresses physical and man-made systems, their dynamics, and the associated information processing. Some of the lab's core research areas are: statistical inference and machine learning; optimization; systems theory, control, and autonomy; and networks.

For further information, see the Research and Study (<http://catalog.mit.edu/archive/2018-2019/mit/research/laboratory-information-decision-systems>) section.

### **Sociotechnical Systems Research Center**

The Sociotechnical Systems Research Center (SSRC) (<http://ssrc.mit.edu>) is an interdisciplinary research center that focuses

on the study of high-impact, complex, sociotechnical systems that shape our world.

SSRC brings together faculty, researchers, students, and staff from across MIT to study and seek solutions to complex societal challenges that span healthcare, energy, infrastructure networks, the environment, and international development.

For further information on SSRC and its programs, see the Research and Study (<http://catalog.mit.edu/archive/2018-2019/mit/research/sociotechnical-systems-research-center>) section.

## Faculty and Teaching Staff

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### **Professors**

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### ***Professors of the Practice***

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## **Research Staff**

### ***Senior Research Engineers***

Frank R. Field III, PhD  
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## **Professors Emeriti**

Daniel Roos, PhD  
Professor Emeritus of Data, Systems, and Society  
Professor Emeritus of Civil and Environmental Engineering

### **IDS.012[J] Statistics, Computation and Applications**

Same subject as 6.419[J]  
Subject meets with 6.439[J], IDS.131[J]  
Prereq: ((2.087, 6.0002, 6.01, 18.03, or 18.06) and (6.008, 6.041B, 14.30, 16.09, or 18.05)) or permission of instructor  
U (Fall)  
3-1-8 units

Hands-on analysis of data demonstrates the interplay between statistics and computation. Includes four modules, each centered on a specific data set, and introduced by a domain expert. Provides instruction in specific, relevant analysis methods and corresponding algorithmic aspects. Potential modules may include medical data, gene regulation, social networks, finance data (time series), traffic, transportation, weather forecasting, policy, or industrial web applications. Projects address a large-scale data analysis question. Students taking graduate version complete additional assignments. Enrollment limited; priority to Statistics and Data Science minors, and to juniors and seniors.

*S. Jegelka, C. Uhler*

### **IDS.013[J] Statistical Thinking and Data Analysis**

Same subject as 15.075[J]  
Prereq: 6.041B or 15.0791  
U (Spring)  
3-1-8 units. Institute LAB  
Credit cannot also be received for 18.650[J], 18.6501, IDS.014[J]

See description under subject 15.075[J].

*R. Mazumder*

### **IDS.014[J] Fundamentals of Statistics**

Same subject as 18.650[J]  
Subject meets with 18.6501  
Prereq: 6.041B or 18.600  
U (Fall, Spring)  
4-0-8 units  
Credit cannot also be received for 15.075[J], IDS.013[J]

See description under subject 18.650[J].

*Fall: P. Rigollet. Spring: P. Kempthorne*

**IDS.045[J] System Safety (New)**

Same subject as 16.63[J]

Prereq: None

Acad Year 2018-2019: Not offered

Acad Year 2019-2020: U (Fall)

3-0-9 units. REST

See description under subject 16.63[J].

*N. Leveson*

**IDS.055[J] Science, Technology, and Public Policy**

Same subject as 17.309[J], STS.082[J]

Prereq: None

U (Spring)

4-0-8 units. HASS-S; CI-H

Credit cannot also be received for 17.310[J], IDS.412[J], STS.482[J]

See description under subject 17.309[J].

*K. Oye, N. Selin*

**IDS.060[J] Environmental Law, Policy, and Economics: Pollution Prevention and Control**

Same subject as 1.801[J], 11.021[J], 17.393[J]

Subject meets with 1.811[J], 11.630[J], 15.663[J], IDS.540[J]

Prereq: None

U (Fall)

3-0-9 units. HASS-S

Reviews and analyzes federal and state regulation of air and water pollution, hazardous waste, green-house gas emissions, and the production and use of toxic chemicals. Analyzes pollution as an economic problem and the failure of markets. Explores the role of science and economics in legal decisions. Emphasizes use of legal mechanisms and alternative approaches (such as economic incentives and voluntary approaches) to control pollution and encourage chemical accident and pollution prevention. Focuses on the major federal legislation, the underlying administrative system, and the common law in analyzing environmental policy, economic consequences, and the role of the courts. Discusses classical pollutants and toxic industrial chemicals, green-house gas emissions, community right-to-know, and environmental justice. Develops basic legal skills: how to read/understand cases, regulations, and statutes. Students taking graduate version are expected to explore the subject in greater depth.

*N. Ashford, C. Caldart*

**IDS.061[J] Regulation of Chemicals, Radiation, and Biotechnology**

Same subject as 1.802[J], 11.022[J]

Subject meets with 1.812[J], 10.805[J], 11.631[J], IDS.436[J], IDS.541[J]

Prereq: IDS.060[J] or permission of instructor

U (Spring)

Not offered regularly; consult department

3-0-9 units

Focuses on policy design and evaluation in the regulation of hazardous substances and processes. Includes risk assessment, industrial chemicals, pesticides, food contaminants, pharmaceuticals, radiation and radioactive wastes, product safety, workplace hazards, indoor air pollution, biotechnology, victims' compensation, and administrative law. Health and economic consequences of regulation, as well as its potential to spur technological change, are discussed for each regulatory regime. Students taking the graduate version are expected to explore the subject in greater depth.

*N. Ashford, C. Caldart*

**IDS.062[J] Global Environmental Negotiations**

Same subject as 12.346[J]

Subject meets with 12.846[J], IDS.525[J]

Prereq: Permission of instructor

U (Fall)

Not offered regularly; consult department

2-0-4 units

Practical introduction to global environmental negotiations designed for science and engineering students. Covers basic issues in international negotiations, such as North-South conflict, implementation and compliance, trade, and historical perspective on global environmental treaties. Offers hands-on practice in developing and interpreting international agreements through role-play simulations and observation of ongoing climate change negotiating processes. Students taking graduate version complete additional assignments.

*N. E. Selin*

**IDS.063[J] People and the Planet: Environmental Governance and Science**

Same subject as 12.387[J], 15.874[J]

Prereq: None

Acad Year 2018-2019: Not offered

Acad Year 2019-2020: U (Fall)

3-0-6 units

See description under subject 12.387[J].

*N. Selin, S. Solomon, J. Sterman*



**IDS.064 Engineering, Economics and Regulation of the Electric Power Sector**

Subject meets with 6.695[], 15.032[], IDS.505[]

Prereq: 14.01, 22.081[], IDS.060[], or permission of instructor U (Spring)

3-0-9 units

Provides an in-depth and interdisciplinary look at electric power systems, focusing on regulation as the link among engineering, economic, legal, and environmental viewpoints. Topics include electricity markets, incentive regulation of network utilities, retail competition, tariff design, distributed generation, rural electrification, multinational electricity markets, environmental impacts, and the future of utilities and strategic sustainability issues under both traditional and competitive regulatory frameworks. Background in policy, microeconomics, or engineering desirable. Students taking graduate version complete additional assignments.  
*I. Perez-Arriaga*

**IDS.131[] Statistics, Computation and Applications**

Same subject as 6.439[]

Subject meets with 6.419[], IDS.012[]

Prereq: ((2.087, 6.0002, 6.01, 18.03, or 18.06) and (6.008, 6.041B, 14.30, 16.09, or 18.05)) or permission of instructor

G (Fall)

3-1-8 units

Hands-on analysis of data demonstrates the interplay between statistics and computation. Includes four modules, each centered on a specific data set, and introduced by a domain expert. Provides instruction in specific, relevant analysis methods and corresponding algorithmic aspects. Potential modules may include medical data, gene regulation, social networks, finance data (time series), traffic, transportation, weather forecasting, policy, or industrial web applications. Projects address a large-scale data analysis question. Students taking graduate version complete additional assignments. Limited enrollment; priority to Statistics and Data Science minors and to juniors and seniors.

*S. Jegelka, C. Uhler*

**IDS.136[] Graphical Models: A Geometric, Algebraic, and Combinatorial Perspective (New)**

Same subject as 6.244[]

Prereq: 6.431B and 18.06

Acad Year 2018-2019: G (Spring)

Acad Year 2019-2020: Not offered

3-0-9 units

Provides instruction in the geometric, algebraic and combinatorial perspective on graphical models. Presents methods for learning the underlying graph and inferring its parameters. Topics include exponential families, duality theory, conic duality, polyhedral geometry, undirected graphical models, Bayesian networks, Markov properties, total positivity of distributions, hidden variables, and tensor decompositions.

*C. Uhler*

**IDS.145[] Data Mining: Finding the Models and Predictions that Create Value**

Same subject as 15.062[]

Subject meets with 15.0621

Prereq: 15.060, 15.075[], or permission of instructor

G (Fall; second half of term)

2-0-4 units

See description under subject 15.062[].

*R. E. Welsch*

**IDS.147[] Statistical Learning and Data Mining**

Same subject as 15.077[]

Prereq: Permission of instructor

G (Spring)

4-0-8 units

See description under subject 15.077[].

*R. E. Welsch*

**IDS.190 Doctoral Seminar in Statistics and Data Science (New)**

Prereq: None

G (Fall)

Not offered regularly; consult department

1-0-2 units

Interdisciplinary seminar explores diverse topics in statistics and data science. Restricted to students in the Interdisciplinary Doctoral Program in Statistics.

*Consult D. Shah*

**IDS.200[] Optimization Methods**

Same subject as 6.255[], 15.093[]

Subject meets with 6.215

Prereq: 18.06

G (Fall)

4-0-8 units

See description under subject 15.093[].

*D. Bertsimas, P. Parrilo*

**IDS.250[] The Theory of Operations Management**

Same subject as 1.271[], 15.764[]

Prereq: (6.436[] and (6.251[] or 6.251[])) or permission of instructor

G (Spring)

3-0-9 units

Can be repeated for credit.

See description under subject 15.764[].

*D. Simchi-Levi, N. Trichakis, K. Zheng*

**IDS.305[] Business and Operations Analytics**

Same subject as 1.275[]

Prereq: Permission of instructor

G (Spring; first half of term)

2-0-4 units

Provides instruction on identifying, evaluating, and capturing business analytics opportunities that create value. Also provides basic instruction in analytics methods and case study analysis of organizations that successfully deployed these techniques.

*D. Simchi-Levi*

**IDS.330 Real Options for Product and Systems Design**

Prereq: IDS.333 or permission of instructor

G (Spring; second half of term)

3-0-3 units

Focuses on implementation of flexibility (real options) in the design of products and systems. Applies the methods presented in IDS.333: recognition of uncertainty, identification of best opportunities for flexibility, and valuation of these options and their effective implementation. Students' work culminates in a dynamic business plan for design and deployment of products, start-ups, ongoing management of operations, or policy plans. Students bring their own project concept, which they will analyze during the class. Useful complement to thesis or research projects.

*R. de Neufville*

**IDS.332 Engineering Systems Analysis for Design**

Engineering School-Wide Elective Subject.

Offered under: 1.146, 16.861, IDS.332

Prereq: Permission of instructor

G (Fall)

3-0-9 units

Credit cannot also be received for IDS.333

Covers theory and methods to identify, value, and implement flexibility in design, also known as "real options." Topics include definition of uncertainties, simulation of performance for scenarios, screening models to identify desirable flexibility, decision and lattice analysis, and multidimensional economic evaluation. Students demonstrate proficiency through an extended application to a systems design of their choice. Provides a complement to research or thesis projects. Meets with IDS.333 first half of term. Enrollment limited.

*R. de Neufville*

**IDS.333 Risk and Decision Analysis**

Prereq: None

G (Fall; first half of term)

3-0-3 units

Credit cannot also be received for 1.146, 16.861, IDS.332

Focuses on design choices and decisions under uncertainty. Topics include identification and description of uncertainties using probability distributions; the calculation of commensurate measures of value, such as expected net present values; Monte Carlo simulation and risk analysis; and the use of decision analysis to explore alternative strategies and identify optimal initial choices. Presents applied analysis of practical examples from a variety of engineering systems using spreadsheet and decision analysis software. Meets with IDS.332 first half of term.

*R. de Neufville*

**IDS.336[] Systems Architecting Applied to Enterprises**

Same subject as 16.855[]

Prereq: Permission of instructor

G (Spring)

3-0-9 units

Focuses on principles and practices for architecting new and evolving sociotechnical enterprises. Includes reading and discussions of enterprise theory, contemporary challenges, and case studies of evolving enterprises. Covers frameworks and methods for ecosystem analysis, stakeholder analysis, architecture design and evaluation, and implementation strategies. Students work in small teams on projects to design a future architecture for a selected real-world enterprise.

*D. Rhodes*

**IDS.337[J] Aerospace Biomedical and Life Support Engineering**

Same subject as 16.423[J], HST.515[J]  
 Prereq: 16.06, 16.400, or permission of instructor  
 Acad Year 2018-2019: Not offered  
 Acad Year 2019-2020: G (Spring)  
 3-0-9 units

See description under subject 16.423[J].  
*D. J. Newman*

**IDS.338[J] Multidisciplinary Design Optimization**

Same subject as 16.888[J]  
 Prereq: 18.085 or permission of instructor  
 Acad Year 2018-2019: Not offered  
 Acad Year 2019-2020: G (Spring)  
 3-1-8 units

Systems modeling for design and optimization. Selection of design variables, objective functions and constraints. Overview of principles, methods and tools in multidisciplinary design optimization (MDO). Subsystem identification, development and interface design. Design of experiments (DOE). Review of linear (LP) and non-linear (NLP) constrained optimization formulations. Scalar versus vector optimization problems. Karush-Kuhn-Tucker (KKT) conditions of optimality, Lagrange multipliers, adjoints, gradient search methods, sensitivity analysis, geometric programming, simulated annealing, genetic algorithms and particle swarm optimization. Constraint satisfaction problems and isoperformance. Non-dominance and Pareto frontiers. Surrogate models and multifidelity optimization strategies. System design for value. Students execute a term project in small teams related to their area of interest.  
*O. de Weck*

**IDS.339[J] Space Systems Engineering**

Same subject as 16.89[J]  
 Prereq: 16.851 or permission of instructor  
 G (Spring)  
 4-2-6 units

See description under subject 16.89[J].  
*E. F. Crawley, J. A. Hoffman*

**IDS.340[J] System Safety Concepts**

Same subject as 16.863[J]  
 Prereq: Permission of instructor  
 Acad Year 2018-2019: Not offered  
 Acad Year 2019-2020: G (Fall)  
 3-0-9 units

See description under subject 16.863[J].  
*N. G. Leveson*

**IDS.341[J] Concepts in the Engineering of Software**

Same subject as 16.355[J]  
 Prereq: Permission of instructor  
 Acad Year 2018-2019: Not offered  
 Acad Year 2019-2020: G (Spring)  
 3-0-9 units

See description under subject 16.355[J].  
*N. G. Leveson*

**IDS.345[J] Digital Evolution: Managing Web 3.0**

Same subject as 15.565[J]  
 Prereq: Permission of instructor  
 Acad Year 2018-2019: Not offered  
 Acad Year 2019-2020: G (Fall)  
 3-0-6 units

See description under subject 15.565[J].  
*S. Madnick*

**IDS.410 Modeling and Assessment for Policy**

Prereq: None  
 G (Spring)  
 Not offered regularly; consult department  
 3-0-6 units

Explores how scientific information and quantitative models can be used to inform policy decision-making. Develops an understanding of quantitative modeling techniques and their role in the policy process through case studies and interactive activities. Addresses issues such as analysis of scientific assessment processes, uses of integrated assessment models, public perception of quantitative information, methods for dealing with uncertainties, and design choices in building policy-relevant models. Examples focus on models and information used in Earth system governance.  
*N. E. Selin*

**IDS.411 Concepts and Research in Technology and Policy**

Prereq: 17.310[J] and permission of instructor  
 G (Fall)  
 3-0-6 units

Core integrative subject, with substantive participation from a series of guest faculty lecturers, examines key technology-policy concepts. Explores alternative framings of roles of technology in policy, emphasizing the implications of these alternatives upon problem-solving in the area. Exercises prepare students to apply these concepts in the framing of their thesis research. Preference to first-year students in the Technology and Policy Program.  
*F. Field*

**IDS.412[J] Science, Technology, and Public Policy**

Same subject as 17.310[J], STS.482[J]

Prereq: Permission of instructor

G (Spring)

4-0-8 units

Credit cannot also be received for 17.309[J], IDS.055[J], STS.082[J]

See description under subject 17.310[J].

*K. Oye, N. Selin*

**IDS.435[J] Law, Technology, and Public Policy**

Same subject as 15.655[J]

Prereq: None

G (Spring)

3-0-9 units

Examines the relationship between law and technological change, and the ways in which law, economics, and technological change shape public policy. Addresses how law can be used to influence and guide technological change; responses of the legal system to environmental, safety, social and ethical problems created by new or existing technology; how law and markets interact to limit or encourage technological development; and how law can affect distribution of wealth and social justice. Covers climate change; genetic engineering; telecommunications; industrial automation; the effect of health, safety, and environmental regulation on technological innovation; the impacts of intellectual property law on innovation and equity; pharmaceuticals; nanotechnology; cost/benefit analysis as a decision tool; public participation in governmental decisions affecting science and technology; corporate influence on technology; and law and economics as competing paradigms to encourage sustainability. Permission of instructor required for freshmen and sophomores.

*N. Ashford, C. Caldart*

**IDS.436[J] Technology, Law, and the Working Environment**

Same subject as 10.805[J]

Subject meets with 1.802[J], 1.812[J], 11.022[J], 11.631[J], IDS.061[J], IDS.541[J]

Prereq: Permission of instructor

G (Spring)

Not offered regularly; consult department

3-0-6 units

Addresses relationship between technology-related problems and the law applicable to work environment. National Labor Relations Act, Occupational Safety and Health Act. Toxic Substances Control Act, state worker's compensation, and suits by workers in the courts discussed. Problems related to occupational health and safety, collective bargaining as a mechanism for altering technology in the workplace, job alienation, productivity, and the organization of work addressed. Prior courses or experience in the environmental, public health, or law-related areas.

*N. A. Ashford, C. C. Caldart*

**IDS.437[J] Technology, Globalization, and Sustainable Development**

Same subject as 1.813[J], 11.466[J], 15.657[J]

Prereq: Permission of instructor

G (Fall)

3-0-9 units

Investigates sustainable development, taking a broad view to include not only a healthy economic base, but also a sound environment, stable employment, adequate purchasing power, distributional equity, national self-reliance, and maintenance of cultural integrity. Explores national, multinational, and international political and legal mechanisms to further sustainable development through transformation of the industrial state. Addresses the importance of technological innovation and the financial crisis of 2008.

*N. Ashford*

**IDS.449 Technology Policy Internship Seminar**

Prereq: IDS.411 or permission of instructor

G (Fall)

1-1-1 units

Can be repeated for credit.

Seminar examines what technology policy is in practice. Considers the question of "Who achieves what, when, how, and why?" regarding technology policy. Students who completed summer internships present and dissect their experiences with special reference to specific cases in which they participated.

*F. Field*

**IDS.505[J] Engineering, Economics and Regulation of the Electric Power Sector**

Same subject as 6.695[J], 15.032[J]

Subject meets with IDS.064

Prereq: 14.01, 22.081[J], IDS.060[J], or permission of instructor

G (Spring)

3-0-9 units

Provides an in-depth and interdisciplinary look at electric power systems, focusing on regulation as the link among engineering, economic, legal, and environmental viewpoints. Topics include electricity markets, incentive regulation of network utilities, retail competition, tariff design, distributed generation, rural electrification, multinational electricity markets, environmental impacts, and the future of utilities and strategic sustainability issues under both traditional and competitive regulatory frameworks. Background in policy, microeconomics, or engineering desirable. Students taking graduate version complete additional assignments.

*J. Perez-Arriaga*

**IDS.521 Energy Systems and Climate Change Mitigation**

Prereq: Permission of instructor

G (Spring)

Not offered regularly; consult department

3-0-9 units

Explores the contributions of energy systems to global greenhouse gas emissions and the potential levers for reducing emissions. Lectures and projects focus on decomposing contributions to greenhouse gas emissions, with emphasis on technology related variables such as per unit cost and carbon intensity of energy. Reviews other performance attributes of energy technologies. Student projects explore pathways for realizing emissions reduction scenarios.

*J. Trancik*

**IDS.522 Mapping and Evaluating New Energy Technologies**

Prereq: Permission of instructor

Acad Year 2018-2019: Not offered

Acad Year 2019-2020: G (Fall)

3-0-9 units

Project-based seminar covers recent developments in energy conversion and storage technologies. Merits of alternative technologies are debated based on their environmental performance and cost, and their potential improvement and scalability. Project teams develop quantitative models and interactive visualization tools to inform the future development of these technologies. Models may probe how the impact of a technology depends on assumptions about future advancements in materials or device design. Other projects may develop models for rational design choices (the selection of a particular material or processing technique) based on economic and environmental performance and physical constraints.

*J. Trancik*

**IDS.524[J] People and the Planet: Environmental Histories and Engineering (New)**

Same subject as 11.204[J]

Subject meets with 11.004[J], STS.033[J]

Prereq: None

Acad Year 2018-2019: Not offered

Acad Year 2019-2020: G (Spring)

3-3-6 units

See description under subject 11.204[J].

*J. Knox-Hayes, A. Slocum, R. Scheffler, J. Trancik*

**IDS.525[J] Global Environmental Negotiations**

Same subject as 12.846[J]

Subject meets with 12.346[J], IDS.062[J]

Prereq: None

G (Fall)

Not offered regularly; consult department

2-0-4 units

Practical introduction to global environmental negotiations designed for science and engineering students. Covers basic issues in international negotiations, such as North-South conflict, implementation and compliance, trade, and historical perspective on global environmental treaties. Offers hands-on practice in developing and interpreting international agreements through role-play simulations and observation of ongoing climate change negotiating processes. Students taking graduate version complete additional assignments.

*N. Selin*

**IDS.526[J] Sustainability Science and Engineering**

Same subject as 12.845[J]

Prereq: None

G (Fall)

Not offered regularly; consult department

3-0-6 units

Introduces and develops core ideas and concepts in the field of sustainability science and engineering from an engineering systems perspective. Takes an interdisciplinary approach to discuss case studies of sustainability systems research. Exposes students to techniques for sustainability research across engineering, natural and social science disciplines. Term projects focus on applying techniques.

*N. E. Selin*

**IDS.540[J] Environmental Law, Policy, and Economics: Pollution Prevention and Control**

Same subject as 1.811[J], 11.630[J], 15.663[J]

Subject meets with 1.801[J], 11.021[J], 17.393[J], IDS.060[J]

Prereq: None

G (Fall)

3-0-9 units

Reviews and analyzes federal and state regulation of air and water pollution, hazardous waste, green-house gas emissions, and the production and use of toxic chemicals. Analyzes pollution as an economic problem and the failure of markets. Explores the role of science and economics in legal decisions. Emphasizes use of legal mechanisms and alternative approaches (such as economic incentives and voluntary approaches) to control pollution and encourage chemical accident and pollution prevention. Focuses on the major federal legislation, the underlying administrative system, and the common law in analyzing environmental policy, economic consequences, and the role of the courts. Discusses classical pollutants and toxic industrial chemicals, green-house gas emissions, community right-to-know, and environmental justice. Develops basic legal skills: how to read/understand cases, regulations, and statutes. Students taking graduate version are expected to explore the subject in greater depth.

*N. Ashford, C. Caldart*

**IDS.541[J] Regulation of Chemicals, Radiation, and Biotechnology**

Same subject as 1.812[J], 11.631[J]

Subject meets with 1.802[J], 10.805[J], 11.022[J], IDS.061[J],

IDS.436[J]

Prereq: IDS.540[J] or permission of instructor

G (Spring)

Not offered regularly; consult department

3-0-9 units

Focuses on policy design and evaluation in the regulation of hazardous substances and processes. Includes risk assessment, industrial chemicals, pesticides, food contaminants, pharmaceuticals, radiation and radioactive wastes, product safety, workplace hazards, indoor air pollution, biotechnology, victims' compensation, and administrative law. Health and economic consequences of regulation, as well as its potential to spur technological change, are discussed for each regulator regime. Students taking the graduate version are expected to explore the subject in greater depth.

*N. Ashford, C. Caldart*

**IDS.620[J] Principles and Practice of Drug Development**

Same subject as 7.547[J], 10.547[J], 15.136[J], HST.920[J]

Prereq: Permission of instructor

G (Fall)

3-0-6 units

See description under subject 15.136[J].

*T. J. Allen, C. L. Cooney, S. N. Finkelstein, A. J. Sinskey, G. K. Raju*

**IDS.670[J] Planning and Design of Airport Systems**

Same subject as 1.231[J], 16.781[J]

Prereq: Permission of instructor

Acad Year 2018-2019: G (Fall)

Acad Year 2019-2020: Not offered

3-0-9 units

See description under subject 1.231[J].

*R. de Neufville, A. R. Odoni*

**IDS.700[J] Applied Probability and Stochastic Models**

Same subject as 1.203[J], 15.073[J]

Prereq: 6.041B or 18.600

G (Fall)

3-0-9 units

See description under subject 15.073[J].

*A. Barnett*

**IDS.720[J] Tools for Analysis: Design for Real Estate and Infrastructure Development**

Same subject as 11.434[J], 15.428[J]

Prereq: None

G (Spring; second half of term)

2-0-4 units

See description under subject 11.434[J].

*D. Geltner, R. de Neufville*

**IDS.730[J] Logistics Systems**

Same subject as 1.260[J], 15.770[J], SCM.260[J]

Prereq: Permission of instructor

G (Fall)

3-0-9 units

See description under subject SCM.260[J].

*Y. Sheffi, C. Caplice*

**IDS.735[J] Supply Chain Planning**

Same subject as 1.273[J], 15.762[J]

Prereq: 15.761 or SCM.260[J]

G (Spring; first half of term)

2-0-4 units

See description under subject 15.762[J].

*D. Simchi-Levi*

**IDS.736[J] Manufacturing System and Supply Chain Design**

Same subject as 1.274[J], 15.763[J]

Prereq: 15.761, 15.778, or SCM.260[J]

G (Spring; second half of term)

2-0-4 units

See description under subject 15.763[J].

*D. Simchi-Levi*

**IDS.900 Doctoral Seminar in Social and Engineering Systems**

Prereq: Permission of instructor

G (Fall)

2-0-1 units

Introduces doctoral students to IDSS research areas. Preference to first-year students in SES.

*A. Abadie, A. Jadbabaie*

**IDS.910 Leadership Development**

Prereq: Permission of instructor

G (Fall; partial term)

Not offered regularly; consult department

1-1-1 units

Seminar environment created to develop leadership capabilities, and to take advantage of leadership opportunities. An initial Outward Bound experience builds trust, teamwork and communications. Readings and assignments emphasize the characteristics of desired leadership skills. Global leaders participate in the Leadership Lunch series to share their experiences and recommendations. Discussions explore leadership development. Culminates in a personal leadership plan. Restricted to entering students in the Technology and Policy program or instructor permission.

*Staff*

**IDS.950 Independent Study in Data, Systems, and Society**

Prereq: Permission of IDSS Academic Office

G (Fall, IAP, Spring, Summer)

Units arranged [P/D/F]

Can be repeated for credit.

For graduate students in IDSS. Individual study in data, systems, and society. Intended to expose student to expert-level domain material. Supervised by a member of MIT's teaching staff.

*Consult IDSS Academic Office*

**IDS.951 Independent Study in Technology and Policy**

Prereq: Permission of TPP Education Office

G (Fall, IAP, Spring, Summer)

Units arranged [P/D/F]

Can be repeated for credit.

For graduate students in TPP. Individual study in technology and policy. Intended to expose student to expert-level domain material. Supervised by a member of MIT's teaching staff.

*Consult TPP Education Office*

### **IDS.955 Practical Experience in Data, Systems, and Society**

Prereq: None

G (Fall, IAP, Spring, Summer)

Units arranged [P/D/F]

Can be repeated for credit.

For IDSS doctoral students participating in off-campus internship experiences in data, systems, and society. Before registering for this subject, students must have an employment offer from a company or organization, must identify a research supervisor, and must receive prior approval from the IDSS Academic Office.

Upon completion of the experience, student must submit a letter from the employer describing the goals accomplished, along with a substantive final report from the student approved by the MIT supervisor.

*Consult IDSS Academic Office*

### **IDS.956 Practical Experience in Technology and Policy**

Prereq: None

G (Fall, IAP, Spring, Summer)

Units arranged [P/D/F]

For TPP students participating in off-campus internship experiences in technology and policy. Before registering for this subject, students must have an employment offer from a company or organization, must identify a research supervisor, and must receive prior approval from the TPP Education Office. Upon completion of the internship, student must submit a letter from the employer describing the work accomplished, along with a substantive final report from the student approved by the MIT supervisor.

*Consult TPP Education Office*

### **IDS.960 Teaching in Data, Systems, and Society**

Prereq: None

G (Fall, IAP, Spring)

Units arranged [P/D/F]

Can be repeated for credit.

For Teaching Assistants in IDSS, in cases where teaching assignment is approved for academic credit. Laboratory, tutorial, or classroom teaching under supervision of a faculty member. Credit for this subject may not be used for any degree granted by IDSS.

*Consult IDSS Academic Office*

### **IDS.961 Teaching in Technology and Policy**

Prereq: None

G (Fall, IAP, Spring)

Units arranged [P/D/F]

Can be repeated for credit.

For Teaching Assistants in TPP, in cases where teaching assignment is approved for academic credit. Laboratory, tutorial, or classroom teaching under supervision of a faculty member. Credit for this subject may not be used for any degree granted by IDSS.

*Consult TPP Academic Office*

### **IDS.970 Research in Data, Systems, and Society**

Prereq: None

G (Fall, Spring, Summer)

Units arranged [P/D/F]

Can be repeated for credit.

For Research Assistants in IDSS when assigned research is not used for thesis, but is approved for academic credit. Credit for this subject may not be used for any degree granted by IDSS.

*Consult IDSS Academic Office*

### **IDS.971 Research in Technology and Policy**

Prereq: None

G (Fall, Spring, Summer)

Units arranged [P/D/F]

Can be repeated for credit.

For research assistants in TPP when assigned research is not used for thesis, but is approved for academic credit. Credit for this subject may not be used for any degree granted by IDSS.

*Consult TPP Academic Office*

### **IDS.Soo Special Undergraduate Subject in Data, Systems, and Society**

Prereq: Permission of instructor

U (Fall, IAP, Spring, Summer)

Not offered regularly; consult department

Units arranged

Can be repeated for credit.

Opportunity for study of topics in Data, Systems, and Society not otherwise included in the curriculum. Offerings initiated by faculty on an ad hoc basis subject to IDSS approval.

*Consult IDSS Academic Office*



**IDS.S01 Special Undergraduate Subject in Data, Systems, and Society**

Prereq: Permission of instructor  
 U (Fall, IAP, Spring, Summer)  
 Not offered regularly; consult department  
 Units arranged  
 Can be repeated for credit.

Opportunity for study of topics in Data, Systems, and Society not otherwise included in the curriculum at MIT. Offerings are initiated by faculty on an ad-hoc basis subject to IDSS approval.

*Consult IDSS Academic Office*

**IDS.S10 Special Undergraduate Subject in Data, Systems, and Society**

Prereq: Permission of instructor  
 U (Fall, IAP, Spring, Summer)  
 Not offered regularly; consult department  
 Units arranged [P/D/F]  
 Can be repeated for credit.

Opportunity for study of topics in Data, Systems, and Society not otherwise included in the curriculum at MIT. Offerings are initiated by faculty on an ad-hoc basis subject to IDSS approval.

*Consult IDSS Academic Office*

**IDS.S11 Special Undergraduate Subject in Data, Systems, and Society**

Prereq: None  
 U (Fall, IAP, Spring, Summer)  
 Not offered regularly; consult department  
 Units arranged [P/D/F]  
 Can be repeated for credit.

Opportunity for study of topics in Data, Systems, and Society not otherwise included in the curriculum. Offerings initiated by faculty on an ad hoc basis subject to IDSS approval.

*Consult IDSS Academic Office*

**IDS.S20 Special Graduate Subject in Data, Systems, and Society**

Prereq: Permission of instructor  
 G (Fall, IAP, Spring, Summer)  
 Not offered regularly; consult department  
 Units arranged  
 Can be repeated for credit.

Opportunity for study of advanced topics in Data, Systems, and Society not otherwise included in the curriculum at MIT. Offerings are initiated by faculty on an ad-hoc basis subject to IDSS approval.

*Consult IDSS Academic Office*

**IDS.S21 Special Graduate Subject in Data, Systems, and Society**

Prereq: Permission of instructor  
 G (Fall, IAP, Spring, Summer)  
 Not offered regularly; consult department  
 Units arranged  
 Can be repeated for credit.

Opportunity for study of advanced topics in Data, Systems, and Society not otherwise included in the curriculum at MIT. Offerings are initiated by faculty on an ad-hoc basis subject to IDSS approval.

*Information: Consult IDSS Academic Office*

**IDS.S22 Special Graduate Subject in Data, Systems, and Society**

Prereq: Permission of instructor  
 G (Fall, IAP, Spring, Summer)  
 Not offered regularly; consult department  
 Units arranged  
 Can be repeated for credit.

Opportunity for study of advanced topics in Data, Systems, and Society not otherwise included in the curriculum at MIT. Offerings are initiated by faculty on an ad-hoc basis subject to IDSS approval.

*Consult IDSS Academic Office*

**IDS.S23 Special Graduate Subject in Data, Systems, and Society**

Prereq: Permission of instructor  
 G (Fall, IAP, Spring, Summer)  
 Not offered regularly; consult department  
 Units arranged  
 Can be repeated for credit.

Opportunity for study of advanced topics in Data, Systems, and Society not otherwise included in the curriculum at MIT. Offerings are initiated by faculty on an ad-hoc basis subject to IDSS approval.

*Consult IDSS Academic Office*

**IDS.S24 Special Graduate Subject in Data, Systems, and Society**

Prereq: Permission of instructor  
 G (Fall, IAP, Spring, Summer)  
 Not offered regularly; consult department  
 Units arranged  
 Can be repeated for credit.

Opportunity for study of advanced topics in Data, Systems, and Society not otherwise included in the curriculum at MIT. Offerings are initiated by faculty on an ad-hoc basis subject to IDSS approval.

*Consult IDSS Academic Office*

**IDS.S30 Special Graduate Subject in Data, Systems, and Society**

Prereq: None

G (Fall, IAP, Spring, Summer)

Not offered regularly; consult department

Units arranged [P/D/F]

Can be repeated for credit.

Opportunity for study of advanced topics in Data, Systems, and Society not otherwise included in the curriculum. Offerings are initiated by faculty on an ad-hoc basis subject to IDSS approval.

*Staff*

**IDS.S31 Special Graduate Subject in Data, Systems, and Society**

Prereq: None

G (Fall, IAP, Spring, Summer)

Not offered regularly; consult department

Units arranged [P/D/F]

Can be repeated for credit.

Opportunity for individual or group study of advanced topics in Data, Systems, and Society not otherwise included in the curriculum at MIT. Offerings are initiated by faculty on an ad-hoc basis subject to IDSS approval.

*Consult IDSS Academic Office*

**IDS.S32 Special Graduate Subject in Data, Systems, and Society**

Prereq: None

G (Fall, IAP, Spring, Summer)

Not offered regularly; consult department

Units arranged [P/D/F]

Can be repeated for credit.

Opportunity for individual or group study of advanced topics in Data, Systems, and Society not otherwise included in the curriculum at MIT. Offerings are initiated by faculty on an ad-hoc basis subject to IDSS approval.

*Consult IDSS Academic Office*

**IDS.THG Graduate Thesis**

Prereq: Permission of instructor

G (Fall, IAP, Spring, Summer)

Units arranged

Can be repeated for credit.

Program of research, leading to the writing of an SM or PhD thesis to be arranged by the student with a member of the IDSS faculty. A minimum of 24 thesis units are required for the SM degree.

*Consult IDSS Academic Office*

**IDS.UR Undergraduate Research**

Prereq: None

U (Fall, IAP, Spring, Summer)

Units arranged [P/D/F]

Can be repeated for credit.

Undergraduate research opportunities in Data, Systems, and Society.

*IDSS Academic Office*

**IDS.URG Undergraduate Research**

Prereq: None

U (Fall, IAP, Spring, Summer)

Units arranged

Can be repeated for credit.

Undergraduate research opportunities in Data, Systems, and Society.

*Consult IDSS Academic Office*