



Massachusetts Institute of Technology
Sloan School of Management

15.871 Introduction to System Dynamics (H1) 15.872 System Dynamics II (H2)

Spring 2017 General information

Background 15.871 (Introduction to System Dynamics) is a 6 unit course meeting in H1.
871 & 872 15.872 (System Dynamics II) is a 6 unit course meeting in H2.

Together they constitute the introductory sequence in system dynamics. You can take 871 alone, or combine the two. Successful completion of both 871 and 872 is a prerequisite for advanced courses in system dynamics, work as an RA or TA in the field, or careers using system dynamics.

Schedule
871, H1 The H1 Introductory class runs from 8 February to 15 March:
Section A meets Monday, Wednesday, 1:00-2:30 in E51-325
Section B meets Monday, Wednesday, 2:30-4:00 in E51-325

872, H2 The H2 class, System Dynamics II, meets from 5 April to 17 May:
The sections combine and meet Monday, Wednesday, 1:00-2:30 in E51-325

Instructor **15.871 and 15.872** (H1 and H2)
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Office hours To be announced; check Stellar

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Teaching Assistants

Please use sd-ta-spring2017@mit.edu for all TA related communication so that you can get timely reply from any available TA.

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Recitations TAs will lead a weekly review session to answer questions about assignments in progress, present related materials, and discuss solutions to past assignments.

In H1, 871 sections A and B recitations take place on Fridays from 1:00-2:30 pm and from 2:30-4:00 pm in E51-325. Plans for drop-in office hours will be announced shortly. The first recitation session is on Friday, Feb 10th.

For H2, recitations continue on Fridays. Times will be determined.

Grading	Assignments:	85%
	Class participation:	15%

Assignments should be submitted electronically, using Stellar. Assignments are due by 5 pm on the due date – you should never skip class to complete an assignment. Each assignment is graded on a 10-point scale. A minimum of two points will be forfeited for assignments turned in late. Assignments handed in more than one class late receive no credit. *This policy is strictly enforced.*

Web site We use Stellar to post course materials online. Once the Stellar site is restricted to participants, non-MIT students must be added by the course administrator or TAs, or via the MIT Registrar, to gain access to the site.

The site contains the syllabus, assignments, simulation models, readings, helpful tips, software access, and other useful information. We use it to send emails with assignment hints, schedule changes for TA sessions, etc. You can also use the site to find partners for group assignments, or to pose questions to the class as a whole.

<https://stellar.mit.edu/courseguide/course/15/sp17/15.871/index.html>

Coursepack Readings are posted on Stellar, but you must also purchase some required material online via Study.Net; see below.

Handouts Available on the class Stellar site. Any extra hard copies will be placed in the System Dynamics Group area near E62-431.

Academic standards

We expect the highest standards of academic honesty and behavior from all participants in class. Please go to <http://bit.ly/1hO6fUR>, the Sloan Values website, which presents standards for individual and group work, requirements for citing the work of others (proper referencing to avoid plagiarism) and personal conduct in the classroom and as a member of our community. Be sure to read this document. If you have any questions about standards and expectations regarding individual and team assignments, please ask us after you have read the standards and before doing the assignments.

Course objectives and scope

Why do so many business strategies fail? Why do so many others fail to produce lasting results? Why do businesses suffer from periodic crises and fluctuations in sales, earnings, and morale? Why do some firms grow while others stagnate? And how can an organization's leadership and managers identify and design high-leverage policies, policies that are not thwarted by unanticipated side effects?

Accelerating economic, technological, social, and environmental change challenges managers to learn at increasing rates. Today's economy requires us to design and manage complex systems where dynamic complexity is unavoidable, thanks to multiple feedback effects, long time delays, and nonlinear responses to our decisions. Yet learning in such environments is difficult precisely because we never confront many of the consequences of our most important decisions. Effective learning in such environments requires methods to develop systems thinking by representing and assessing dynamic complexity. It also requires tools that managers can use to accelerate learning throughout an organization.

15.871 and 872 introduce you to system dynamics modeling for the analysis of business policy and strategy. You will learn to visualize a business organization in terms of the structures and policies that create dynamics and regulate performance. System dynamics allows us to create 'microworlds,' management flight simulators where space and time can be compressed, slowed, and stopped so we can experience the long-term side effects of decisions, systematically explore new strategies, and develop our understanding of complex systems. In these system dynamics courses we use simulation models, case studies, and management flight simulators to develop principles of policy design for successful management of complex strategies. Case studies of successful strategy design and implementation using system dynamics will be stressed. We consider the use of systems thinking to promote effective organizational learning.

The principal purpose of modeling is to improve our understanding of the ways in which an organization's performance is related to its internal structure and operating policies as well as those of customers, competitors, suppliers, and other stakeholders. During the course you will use several simulation models to explore such strategic issues as fluctuating sales, production and earnings; market growth and stagnation; the diffusion of new technologies; the use and reliability of forecasts; the rationality of business decision making; and applications in health care, energy policy, environmental sustainability, and other topics.

Students will learn to recognize and deal with situations where policy interventions are likely to be delayed, diluted, or defeated by unanticipated reactions and side effects. You will have a chance to use state of the art software for computer simulation and gaming. Assignments give hands-on experience in developing and testing computer simulation models in diverse settings.

Course materials

The required text is *Business Dynamics*.

Sterman, J. (2000). *Business Dynamics: Systems Thinking and Modeling for a Complex World* (Text and CD-ROM). Irwin/McGraw Hill. ISBN 0-07-238915X. (Available at the MIT Coop.)

Additional readings are required. Articles and case studies as assigned will be made available via Stellar, with the exception of the *People Express* case which you must buy from the MIT Sloan vendor, Study.Net. Instructions on our course Stellar explain how to do this.

The syllabus notes the days for which readings are to be prepared (NOTE: *before* the class in which we discuss them). It also indicates which sections of the text you should be sure to read to learn the material you will need to do the assignments and which sections you can skim (NOTE: ‘skim’ ≠ ‘skip’). Additional readings will be handed out on an occasional basis.

In addition, we will use modeling software. Several excellent packages for system dynamics simulation are available, including **iThink**, from High Performance Systems, **Powersim**, from Powersim Corporation, and **Vensim**, from Ventana Systems. All are highly recommended. You may wish to learn more about these packages, as all are used in the business world and expertise in them is increasingly sought by potential employers. For further information, see the following resources:

iThink: See the isee Systems web site at <www.iseesystems.com>

Powersim: See the Powersim web site at <www.powersim.com>.

Vensim: See the Ventana Systems web site at <www.vensim.com>.

The required modeling software is VensimPLE. In this course, we will be using the Vensim Personal Learning Edition (**VensimPLE**) by Ventana Systems. The current version is 6.2. It is free for academic use and is available for Windows and Mac. VensimPLE comes with sample models, help engine, and Adobe Acrobat format User’s Guide, all available from <www.vensim.com/venple.html>

NOTE: The disc that comes with the *Business Dynamics* textbook includes a version of VensimPLE. However, the version available online is much newer and has enhanced functionality. Be sure to download the current version of VensimPLE from the website above. Vensim models on the textbook CD will work with it.

Prerequisites and admission to the class

No prior computer modeling experience is needed.

Those on the wait list, those who did not register through the Sloan bidding system, and listeners or auditors are welcome only if space permits (in that order).

15.871 SCHEDULE

NOTE: subject to change

Date		Class	Topic	Reading Due	Assn Out	Assn Due
2/8	W	1	Introduction: Purpose and concepts of system dynamics	Read <i>Business Dynamics</i> [BD], Ch. 1 and <i>Classroom Values in Practice</i>	#1	
2/13	M	2	System Dynamics Tools Part 1: Building a model	Read <i>BD</i> , Ch. 3.1 -3.5		
2/15	W	3	System Dynamics Tools Part 2: Problem definition and model purpose; feedback and causal loop diagrams	Read <i>BD</i> , Ch. 5.1 – 5.4	#2	#1
2/20	M		<i>No Class—Presidents' Day Observed</i>			
2/21	Tu	4	System Dynamics Tools Part 3: Building theory with causal loop diagrams	Read <i>BD</i> , Ch. 5.5 – 5.7 (Skim Chapter 4)		
2/22	W	5	System Dynamics Tools Part 4: Mapping the stock and flow structure of systems	Read <i>BD</i> , Ch. 6 (Skim sections 6.2.7-6.2.9, 6.3.4, 6.3.6)	#3	#2
2/27	M	6	System Dynamics Tools Part 5: Dynamics of stocks and flows; linking feedback with stock and flow structure	Read <i>BD</i> , Ch.7 Skim <i>BD</i> , 8.1, 8.2.1, 8.2.2, 8.3, 8.4		
3/1	W	7	Dynamics of Growth: New product adoption	<i>BD</i> , Ch. 9.1-9.4	#4	#3
3/6	M	8	Growth Strategies: Network externalities, complementarities, and path dependence	Read <i>BD</i> Ch. 10 (Skim section 10.2)		
3/8	W	9	Interactions of Operations, Strategy, and Human Resource Policy: The case of People Express	Prepare for case discussion <i>People Express (A)</i>	#5	#4
3/13	M	10	Guest Lecture: Mark Paich <i>System Dynamics at General Motors and beyond</i>	Barabba et al. 2002 (OnStar)		
3/15	W	11	Lessons from People Express. Course wrap up and evaluations.			#5