

## **MIE 1699: Introduction to System Dynamics**

Instructor: M. Carter

Friday 1:00 – 3:00 in Med Sci 2290

### **Overview:**

This course will provide an introduction to System Dynamics (SD) modelling.

[Wikipedia] System dynamics is a methodology and mathematical modeling technique to frame, understand, and discuss complex issues and problems. Originally developed in the 1950s to help corporate managers improve their understanding of industrial processes, SD is currently being used throughout the public and private sector for policy analysis and design.

Convenient graphical user interface (GUI) system dynamics software developed into user friendly versions by the 1990s and have been applied to diverse systems. SD models solve the problem of simultaneity (mutual causation) by updating all variables in small time increments with positive and negative feedbacks and time delays structuring the interactions and control. The best known SD model is probably the 1972 *The Limits to Growth*. This model forecast that exponential growth of population and capital, with finite resource sources and sinks and perception delays, would lead to economic collapse during the 21st century under a wide variety of growth scenarios.

System dynamics is an aspect of systems theory as a method to understand the dynamic behavior of complex systems. The basis of the method is the recognition that the structure of any system, the many circular, interlocking, sometimes time-delayed relationships among its components, is often just as important in determining its behavior as the individual components themselves. Examples are chaos theory and social dynamics. It is also claimed that because there are often properties-of-the-whole which cannot be found among the properties-of-the-elements, in some cases the behavior of the whole cannot be explained in terms of the behavior of the parts.

The format of the course will be a reading course in which the students will read one or two chapters of the text each week and then meet to discuss the material and ensure comprehension. Problems will be assigned each week so that students can demonstrate mastery of each chapter. The course will have a final project.

**Text:** Sterman, J. “*Business Dynamics: Systems Thinking and Modeling for a Complex World.*” McGraw-Hill / Irwin. ISBN: 9780072389159.

## Modeling Software

In this course, we 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](#).
- **Powersim**: See [the Powersim web site](#).
- **Vensim**: See [the Ventana Systems web site](#).

**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 6.1. 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 [the Vensim web site](#).