

Syllabus for workshop

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Title

System Dynamics in a nutshell: a hands-on, case-study-based demonstration of the modeling process, from problem definition to policy analysis

Overview

This workshop will introduce sensitivity simulation, calibration to data, and model testing, in the context of developing and using a formal theory for the “societal life cycle of cigarette smoking.” We will go through the process of model development and use, building and testing a feedback-rich model, to explore its modes of behavior and adequacy in explaining and addressing a dynamic problem.

Goal and objectives

Our goal for this workshop is to apply a comprehensive set of system dynamics techniques to a specific case to demonstrate the modeling process as a whole, from problem definition to policy analysis, with formulation, sensitivity simulations, calibration to data, model analysis and model testing, used iteratively, as needed, to offer an insightful perspective on a complex system.

Active participation in this course will help with the following learning objectives:

- What are the elements to defining a dynamic problem, including reference modes of behavior
- Formulation and simulation of a feedback-rich model using Vensim® PLE, including using *Synthesim* and user-defined graphs
- Approaches to testing and evaluation, for the purpose of a) model refinement and b) confidence building in insights and recommendations
- To conduct sensitivity simulations, with emphasis on distinguishing different patterns of behavior versus realizations
- To conduct a model calibration using empirical data (time permitting, computing and interpreting statistical measures of “goodness of fit”)
- How to relate model behavior to the structure of the system and to explain endogenously the patterns of behavior produced by the model
- To extend model-based learning to policy insights and implications

Case study

Cigarette smoking presented the most significant public health challenge in the United States in the 20th Century and remains the single most preventable cause of morbidity and mortality in this country. We developed a theory of the societal life cycle of smoking, using a parsimonious set of feedback loops to capture historical trends and explore future scenarios. We present our feedback-rich conceptual model, illustrate the results of a series of simulations, and discuss policy implications for tobacco control.

Outline

1. Case study overview
2. Model development and testing
3. Sensitivity simulations
4. Model calibration
5. Behavior reproduction test
6. Forecasting & policy analysis

In addition to sensitivity simulations and model calibration, we will cover model testing and evaluation, with emphasis on tests that were integral to this model development process. If we have time, we will also demonstrate the statistical behavior reproduction test.

Software

The instruction will be given mostly using Vensim® PLE (Personal Learning Edition), except in exercising functionality that is available only in the commercial versions of the software, such as automated sensitivity analysis or automated model calibration.

Vensim® PLE can be downloaded **for free** for academic or personal use from Ventana Systems, Inc. (<http://www.vensim.com/venple.html>).

Documentation

The case study is written up in the form of a paper distributed with this syllabus. The instructor will make available the slides and models used during the workshop.

Instructors' bios

(Will be added here)