



UNIVERSITY OF PUERTO RICO
MAYAGÜEZ CAMPUS
COLLEGE OF ENGINEERING
INDUSTRIAL ENGINEERING DEPARTMENT



COURSE SYLLABUS

General Information

Course Number: ININ 4996
Course Title: **Complex Systems Analysis and System Dynamics**
Credit-Hours: Three

Course Description

This course introduces system dynamics modeling for the analysis of business decisions with a focus on industrial, service and public policy applications, particularly those forced by structural changes, policies and strategies that affect how the system behaves. It provides the student with the conceptual tools to understand the structure and dynamics of complex systems. The student will learn how to apply this modeling method to build formal computer simulations of complex systems and use them to design more effective policies and organizations. Students will create decision support systems where space and time can be compressed and slowed for the decision maker to experience the long-term side effects of decisions.

Prerequisites

ININ4077 – Work Systems Design

References

- Serman, J. (2000) Business Dynamics: Systems Thinking and Modeling for a Complex World. Irwin/McGraw Hill¹

Course Goals

After completing the course, the student should be able to:

- Recognize a complex system and its structure
- Apply systems thinking to everyday problems
- Identify the structure and behavior of a system, including causal loops, feedback loops, stock and flow variables
- Construct a system model with those basic structures and simulate its behavior over time using a computer

Requirements

All students are expected to come to class all the time, on time, and prepared, do all homework; actively participate in class discussion; and satisfy all assessment criteria to receive credit for the course. To receive credit for the course, the students must pass all tests.

Department and Campus Policies

Class attendance: Class attendance is compulsory. The University of Puerto Rico, Mayagüez Campus, reserves the right to deal at any time with individual cases of non-attendance. Professors are expected to record the absences of their students. Frequent absences affect the final grade,

¹ This is the classic book in system dynamics and no new edition has appeared yet.

and may even result in total loss of credits. Arranging to make up work missed because of legitimate class absence is the responsibility of the student (Bulletin of Information Undergraduate Studies).

Absence from examinations: Students are required to attend all required examinations. If a student is absent from an examination for a justifiable reason acceptable to the professor, he or she will be given a special examination. Otherwise, he or she will receive a grade of zero or "F" in the examination missed (Bulletin of Information Undergraduate Studies).

Final examinations: Final written examinations must be given in all courses unless, in the judgment of the Dean, the nature of the subject makes it impracticable. Final examinations scheduled by arrangements must be given during the examination period prescribed in the Academic Calendar, including Saturdays (See Bulletin of Information Undergraduate Studies).

Partial withdrawals: A student may withdraw from individual courses at any time during the term, but before the deadline established in the University Academic Calendar (See Bulletin of Information Undergraduate Studies).

Complete withdrawals: A student may completely withdraw from the University of Puerto Rico, Mayagüez Campus, at any time up to the last day of classes (See Bulletin of Information Undergraduate Studies).

Disabilities: After been identified with the professor and the institution, the students with disabilities will receive reasonable accommodations in their courses and evaluations. For more information, please contact *The Office of Quality of Life* at the Student Dean's Building, 787-265-5467 ó 787-832-4040 exts. 5467, 3107 ó 3894.

Ethics: Any academic fraud is subject to the disciplinary sanctions described in article 14 and 16 of the revised General Student Bylaws of the University of Puerto Rico contained in Certification 018-1997-98 of the Board of Trustees. The professor will follow the norms established in articles 1-5 of the Bylaws.

Sexual Harassment: Certification 130-2014-2015 states: Sexual harassment in the workplace and in the study environment is an illegal and discriminatory act and is against the best interests of the University of Puerto Rico. All persons who understand they have been subject to acts of sexual harassment at the University of Puerto Rico may file a complaint and request that the institution investigate, where necessary, and assume the corresponding action by the university authorities. If the complainant is a student, he or she must refer his or her complaint to the Office of the Student Ombudsperson or that of the Dean of Students.

Hostigamiento Sexual: La Certificación 130-2014-2015, indica: El hostigamiento sexual en el empleo y en al ambiente de estudio es una práctica ilegal y discriminatoria, ajena a los mejores intereses de la Universidad de Puerto Rico. Toda persona que entienda ha sido objeto de actuaciones constitutiva de hostigamiento sexual en la Universidad de Puerto Rico podrá quejarse para que se investigue, de ser necesario, y se tome la correspondiente acción por parte de las autoridades universitarias. Si quien reclama fuera estudiante, deberá referir su queja a la Oficina de la Procuradora Estudiantil o al Decanato de Estudiantes.

Certification 36 (2018-2019): Discrimination by Sex and Gender on Modality of Sexual Violence:

“The University of Puerto Rico prohibits discrimination based on sex, sexual orientation, and gender identity in any of its forms, including that of sexual harassment. According to the Institutional Policy Against Sexual Harassment at the University of Puerto Rico, Certification Num. 130, 2014-2015 from the Board of Governors, any student subjected to acts constituting sexual harassment, may turn to the Office of the Student Ombudsperson, the Office of the Dean of Students, and/or the Coordinator of the Office of Compliance with Title IX for an orientation and/or formal complaint.”

Certification 06-43 of the Academic Senate states, "The academic guidelines for offering online courses," defines: Traditional face-to-face courses are those that have less than 25% of the course's regular contact hours via the Internet. Therefore, a three-credit course will be considered "face to face" if, of the 45 hours of regular contact, 11 or less are taught via the Internet. According to certification 16-43 of the Academic Senate, a course may include up to 25% of its total contact hours via the Internet. The objective of this is so that all professors have this alternative in the case of any unscheduled eventuality.

Law 51: The Comprehensive Educational Services Act for People with disabilities states that after identifying with the instructor and the institution, the student with disabilities will receive reasonable accommodation in their courses and evaluations. For more information contact the Department of Counseling and Psychological services at the Office of the Dean of Students (Office DE 21) or call 787-265-3864 or 787-832-4040 x 3772, 2040 and 3864.

General Topics

Outline	Contact Hours
Part I: Introduction to Complex Systems and Systems Thinking The World as a system and systemic structures Systems Thinking: Learning in and about complex systems Problem Definition and Model Purpose	6
The beer game	3
Part II: The modeling process in system dynamics Structure and behavior of dynamic systems Tools for systems thinking: understanding causal loop diagrams and stocks and flows Dynamics of simple structures: the dynamics of growth S-shaped growth: epidemics, innovation diffusion, and the growth of new products Path dependence and positive feedback Modeling delays	12
Laboratory I: Modeling system's structure	3

Part III: Modeling challenges Human behavior: bounded rationality or rational expectations Forecasts and fudge factors: modeling expectation formation Modeling instability and oscillation Supply chains and the origin of oscillations Validation and model testing	12
Laboratory II: Modeling stocks and flow, bounded rationality, validation	3
Project presentations	3
Exam	3
Total hours	45
Total hours (equivalent to contact period)	