Mathematical Modeling

Instructor: Lia Vas

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Office Hours: Monday 2-4, Friday 2-4 (no appointment necessary). Feel free to make an appointment if you cannot come to my regular office hours.

Text: No textbook is required. Handouts with new material and practice problems will be distributed for each teaching unit. Some textbooks used for the class preparation include:

- **D. Edwards and M. Hamson**, *Guide to Mathematical Modeling*, Published by CRC Press, 1990.
- **Giordano, Weir, and Fox,** *First Course in Mathematical Modeling*, Thomson Brooks/Cole, 2003.

Technology: Matlab will be used extensively and spreadsheets (Excel or equivalent) occasionally.

Topics covered:
1. Basic ideas and techniques of mathematical modeling: Modeling methodology. Modeling skills. Model testing.
2. Programing in Matlab. M-files.
3. Modeling with differential equations. Continuous dynamical systems.
4. Modeling with difference equations. Discrete dynamical systems.
5. Dimensional analysis.
6. Empirical (experimental) models. Effectiveness and validity.
7. Interpolation and model fitting.
8. Simulation modeling. Monte Carlo simulations.
9. Discrete and continuous optimization modeling.
10. Modeling with systems of difference equations. Basic idea of Markov chains.
11. Modeling with systems of differential equations. Steady states and stability.
12. Report writing and result presentation.

Grading:

Assignment 1	25%
Assignment 2	25%
Assignment 3	25%
Student Project	25%
TOTAL	**100%**

Grades are computed according to the following system:

grade	A+	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
number grade	97 to 100	93 to 96	90 to 92	87 to 89	83 to 86	80 to 82	77 to 79	73 to 76	70 to 72	67 to 69	63 to 66	60 to 62	0 to 59

Relevant Course Elements

Number of credits: 3

Prerequisites: Calculus 2 or the permission of instructor.

Attendance: Since the course is mostly based on material covered in class handouts, it is absolutely imperative that students attend all classes. Students are responsible for all material covered in class, even if attendance is not checked or assignments collected.

Assignments and projects: There will be **3 assignments** and one **student project**. Assignments turned in after their due date will receive an automatic reduction in grade. No assignment grade will be dropped. See my website for instructions on presentations and presentation topics.

Response time: The assignments, projects and exams are typically graded in three days after they are turned in. Special circumstances like snow days, school closing or holidays, may occasionally delay the response time. Barring special circumstances, students' emails are usually responded to within one working day.

More on Mathematical Modeling:
 • Mathematical models are used widely in natural, health and social sciences. The course will cover a variety of topics related to mathematical modeling and modeling techniques: discrete and continuous models, dynamical systems, stability of solutions, steady states.
 • Algebra and calculus techniques that students have encounter in previous courses will be used for successful mathematical modeling of more complex problems. Because of this, the course can be considered a continuation of earlier mathematics courses and the next step in building students' problem solving skills.
 • The course provides the students interested in continuing their education at a graduate level with mathematical techniques that certain graduate programs use.
 • The course emphasizes research ideas, not just mastering various techniques or methods. These ideas are often used in various fields and will be a useful concept for students to acquire.

Course Objectives. By passing the course elements, student will be able to:
 ● identify a problem and choose an appropriate mathematical model,
 ● create a model that adequately describes the problem, using the appropriate technology if necessary,
 ● test the validity of the model,
 ● solve the problem using the appropriate technology if necessary,
 ● present the results orally, on computer and in a form of a written report.

Learning outcomes:
 ● Students will develop understanding of various mathematical concepts and modeling techniques required for successful application of mathematics.
 ● Students will be able to model data using the language and techniques of mathematics.
 ● Students will be able to understand and solve multidisciplinary application problems using mathematical models.
 ● Students will demonstrate proficiency in using mathematical software.
 ● Students will know how to use appropriate technology to solve problems involving mathematical models.

- Students will demonstrate ability to cover a topic independently and present their results in an oral presentation as well as in a written report.

Academic Integrity Statement: Saint Joseph's University encourages the free and open pursuit of knowledge; we consider this to be a fundamental principle and strength of a democratic people. To this end, SJU expects its students, its faculty, its administrators, and its staff to uphold the highest standards of academic integrity. The University expects all members of the University community to both honor and protect one another's individual and collective rights.

Students with Disabilities Statement: Reasonable academic accommodations may be provided to students who submit appropriate documentation of their disability. If students have need of assistance or questions with this issue, they are encouraged to contact the Office of Student Disability Services (SDS) at sds@sju.edu or by phone at 610.660.1774. The Office of SDS also provides an appeal/grievance procedure for complaints regarding requested or offered reasonable accommodations. More information can be found at: www.sju.edu/sds.

Health and Wellness Statement: Saint Joseph's University recognizes that physical and mental health strongly impact one's ability to do well in school and in life. As a result, there are many helpful campus resources designed to help students to care for their physical, mental, and spiritual health. Students may experience stressors that can impact both their academic experience and their personal well-being. These may include academic pressure and challenges associated with relationships, mental health, alcohol or other drugs, identities, finances, etc. All of us benefit from support during times of struggle and challenges. If you are experiencing concerns, seeking assistance sooner rather than later is a courageous thing to do for yourself and those who care about you. The resources at https://sites.sju.edu/counseling/ can help you to cope with stress and to achieve your academic and personal goals.

COVID-19: SJU's Covid-19 policy is available at:
https://www.sju.edu/hawk-hill-ahead/health-and-safety/monitoring
In particular, it states that all faculty, staff, students and visitors are asked to carry a mask at all times while on campus and that they should wear it if asked to. Since my office is relatively small, please note that I ask you to wear a mask when you are in my office.