MATH 377
Mathematical Models
Class Policies

Mike O'Leary
Office: YR 317
Office Phone: 410-704-4757
Email:moleary@towson.edu

Fall 2017
Class: TuTh 5:00-6:15
Room: YR 127
Section: 101
Office Hours: TuTh 3-4 and by appointment

Prerequisites: MATH265, MATH 274, COSC 236 and at least junior standing.

Catalog Description: Developing appropriate mathematical models and techniques to solve mathematical problems in sociology, psychology, economics, management science, and ecology.

Instructional Material There is no assigned primary text. Useful references include

- Douglas D. Mooney and Randall Swift, *A Course in Mathematical Modeling*, The Mathematical Association of America, 1999
- Frank Giordano, William Fox, Steven Horton, and Maurice Weir, *A First Course in Mathematical Modeling*, Brooks Cole, 2009.
- Stefan Heinz, *Mathematical Modeling*, Springer Verlag, 2011
- Martin Braun, Courtney Coleman, and Donald Drew (eds.), *Differential Equations Models*, Springer Verlag, 1983
- Steven Brams, William Lucas, and Phillip Straffin (eds.), *Political and Related Models*, Springer Verlag, 1983.
- James Keener and James Sneyd, *Mathematical Physiology*, Springer Verlag, 1998.

Methods of Instruction: Class time will be devoted to lectures and, where appropriate, time for joint work on assigned projects.

Learning Outcomes:

- Students will be able to create mathematical models for problems in sociology, psychology, economics, management science, and ecology.
- Students will be able to perform calculations and draw conclusions from mathematical models.
- Students will be able to understand sources of error in mathematical models.
- Students will be able to present their mathematical ideas orally to a group.
- Students will be able to develop well written solutions to a range of mathematical problems.

Attendance: Attendance is expected; you should only miss a class for a compelling reason. If you do miss a class, you are responsible for any material that you miss, including any homework assignments given in that class. Unexcused absences can result in a lower grade.

Grading: A number of major group project problems will be assigned to the class. Students will complete a written report detailing their solution to the problem and will give short oral presentation to the class. Together these are worth 60 points toward the final grade. Presentations for the final project will be during the final exam period, **Thursday, December 14 from 5:15 - 7:15** pm.

A number of problem sets will be posed to the class. Students will need to prepare written solutions for each of these problems, and these problems will be graded. These written solutions must be turned in before the corresponding class discussion of the solution for the solution to receive full credit. Together, all of these problems will account for 30 points of the students final grade.

Students will be asked to participate in class, by leading discussions, working out problems, and presenting material. The total classroom participation grade will account for 5 points of the final grade.

Students who visit the professor outside of class, either during office hours or otherwise will receive an additional 5 points toward their final grade.

Given a final point score p, final grades will be assigned based on the following scheme

- $80 \leq p$: A
- $78 \leq p < 80$: A-
- $77 \leq p < 78$: B+
- $70 \leq p < 77$: B
- $68 \leq p < 70$: B-
- $67 \leq p < 68$: C+
- $60 \leq p < 67$: C
- $50 \leq p < 60$: D
- $p < 50$: F

Guidelines for Homework:
1. Late work will not be accepted without a compelling reason.
2. Assignments are required to be neat, clean, and paper-clipped or stapled.
3. Assignments must include the author's name, and a brief description of the assignment.
4. Students are allowed to discuss homework problems with their classmates, however all work that is turned in must be the student's own work.

Any assignment that does not meet these criteria may receive a deduction in score, or more generally will simply be rejected.

Academic Integrity The nature of higher mathematics requires that students adhere to accepted standards of academic integrity. Violations of academic integrity include cheating, plagiarism, falsification and fabrication, complicity in academic dishonesty, personal misrepresentation and proxy, bribes, favors and threats. Cheating is a serious offense that will have grave consequences for your academic life.

Students who violate these standards will either fail the course outright or, at the instructor's discretion, may merely receive a zero on any assignment for which the student receives inappropriate assistance. Particularly serious violations of these standards will be referred to the administration for possible additional action.

Tentative Schedule:
- 8/29 Pipes linear car following model
- 8/31 Modeling with Excel. Python basics.
- 9/5 Python basics.
- 9/7 Modeling change with difference equations.
- 9/12 Solutions of difference equations
- 9/14 Linear energy consumption; Kepler's third law

- 9/19 Vehicular stopping distance
- 9/21 Project #1 (Dinosaurs) Due Date
- 9/26 Polynomials: Lagrangian Form
- 9/28 Modeling Evaluation; linearized models
- 10/3 Model Errors; Chebyshev Error; Least Absolute Deviations; Least Squares
- 10/5 Applying the least squares criterion
- 10/10 Optimal linear models; mean, variance & correlation
- 10/12 Simulation Modeling
- 10/17 Random number generation. Linear congruential generators
- 10/19 Project #2 (CO_2 Concentration) Due Date
- 10/24 Simulation Modeling: Gasoline inventory and demand
- 10/26 Simulation Modeling: Queuing Models
- 10/31 Dimensional Analysis
- 11/2 Buckingham's Pi theorem
- 11/7 Similitude
- 11/9 Car Following models with delay
- 11/14 Laplace Transforms
- 11/16 Laplace Transforms
- 11/21 Project #3 (Tipple) Due
- 11/23 Thanksgiving Break
- 11/28 Laplace Transforms
- 11/30 Analytic solutions of Pipes Model
- 12/5 Stability of car following models
- 12/7 Stability of car following models
- 12/14 Project #4: Glycolosis & Glycolitic Oscillation (Due Date)

Withdraw: The last day to withdraw from the course with a grade of W is November 7.

Course repeat policy: Students may not repeat a course more than once without prior permission of the Academic Standards Committee.

Students with Disabilities: This course is in compliance with Towson University policies for students with disabilities. Students with disabilities are encouraged to register with Disability Support Services (DSS), 7720 York Road, Suite 232, 410-704-2638 (Voice) or 410-704-4423 (TDD). Students who expect that they have a disability but do not have documentation are encouraged to contact DSS for advice on how to obtain appropriate evaluation. A memo from DSS authorizing your accommodation is needed before any accommodation can be made.

Help: You are welcome to stop by my office, for whatever reason, and at whatever time, even if there are no office hours scheduled then.

Reading: If you have gotten this far, here is your first homework assignment. Tell me a bit about yourself- why you are taking this class, when will you graduate, and what you want to do after graduation. Hand it in at the start of the first class, but do not say anything out loud. Free points for those, like you, who pay attention!