MATH 330: The Art and Science of Mathematical Modeling  (3 credits)
Fall 2015,  MWF 9-9:50am,  CST 219

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CST 210  
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Office hours: The following hours are tentative - I'll finalize office hours after the 1st week
M, T & W: 2:30-3:30 pm.  Th: TBA.  F: 2-3 pm.

Open door policy: I view my posted office hours as a formality, just to give you some minimum options! Students may find in more effective to just drop by whenever needed. Anytime my office door is open you're welcome to stop in and check whether I am available. Also, please do not hesitate to make an appointment if my posted office hours don't work for you.

Class website: http://www.earlham.edu/~pardhan/courses/modeling/
The website is a central component of this class, and you are responsible for regularly checking it for announcements, homework assignments and various supplementary handouts. I prepare for class with the assumption that students have reviewed the website and followed through on posted instructions.


Description & Objectives: How effective is the U.S. health care system? How will a 10% melt in the polar ice cap affect the coastline of Florida? How does one synchronize traffic light timings for optimal traffic flow? What strategy would accelerate the composting of food wastes from SAGA?
Mathematical modeling is the science and art of addressing real-world problems such as these, and many others. The inherently interdisciplinary nature of the real-world is reflected in the practice of mathematical modeling, and makes it an endeavor appropriate for students from all disciplines. This course is designed to introduce students to fundamental concepts and methods of mathematical modeling, through a hands on, project-oriented approach. The applications studied will motivate the mathematics covered, contrary to traditional math courses where it is the other way round. We will study a variety of common model types, and learn techniques to construct and analyze appropriate models for a range of application areas. Topics include discrete and continuous dynamical systems; proportionality and geometric similarity models; fitting models to data; simulations; probabilistic modeling; discrete optimization and linear programming; and modeling with differential equations.
We will make extensive use of projects, resources and real-world applications available from the Consortium for Mathematics and its Applications
(COMAP). Their annual Mathematical Contest in Modeling for undergraduate students is world-renowned for its rigor, quality and relevance to a broad range of current applications. Problems from past modeling contests will be widely used throughout the semester in the form of class examples, assignments, and student projects.

A key goal throughout the course will be to integrate a diverse suite of familiar mathematical tools and techniques in new and creative ways, resulting in a powerful framework for design and analysis applicable to a wide range of disciplines.

**Student learning outcomes:**

Upon successful completion of this course, students will be able to

1. Translate real-world problems into mathematical form (model).
2. Find solutions, either exact or approximate, to mathematical models.
3. Translate model solutions back to the real-world context.
4. Assess the quality and reliability of mathematical models.
5. Interpret and communicate their analyses in written and oral form.
6. Strengthen logical reasoning, and quantitative skills.

**Prerequisites:** College-level skills in algebra.

**Grading:**

- Homework 20%
- Labs/case studies 20%
- Projects 20%
- Mid-semester test 20%
- Final exam 20%

Letter grades will be assigned according to the following scale (%):

- A+: 97.0-100;  A: 93.0-96.9;  A-: 90.0-92.9;
- B+: 87.0-89.9;  B: 83.0-86.9;  B-: 80.0-82.9;
- C+: 77.0-79.9;  C: 73.0-76.9;  C-: 70.0-72.9;
- D+: 67.0-69.9;  D: 63.0-66.9;  D-: 60.0-62.9;  F: below 60.

NOTE that all students must also satisfy the following minimum requirements to receive a grade of C- or better:

* Take all the exams (mid-semester, plus the final).
* Turn in at least 75% of the homework assignments.
* Complete and turn in all assigned case studies, explorations & projects.

**Homework:**

Exercises will be regularly assigned from the textbook and other sources, some of which will require the use of a software package such as Excel, Sage or Maple. Students may freely discuss and work on homework problems with the instructor and/or with other classmates. However, work handed in for a grade must be your own (or that of your group, if it is a designated group assignment) in that it is written in your own words and formulated in your own steps.

**Projects, labs & case studies:**

Mathematical modeling is one of the most perfect courses for learning through projects and hands on discovery. Thus, a significant portion of the grade in this class will be based on labs, case studies and project work. Some of these
will be team projects and others will be for individual work. All projects and case studies will require a comprehensive written report to be turned in. Further details will be provided in class and via the class website.

**Exams:**
There will be one mid-semester test, plus a comprehensive final exam at the end of the semester. Tentative date of the mid-semester test is **October 2**.

**Final exam:** The final exam date and time is set by the registrar's office. According to their calendar, the final exam will be held **Monday, December 14, in CST 219, at 2 pm.**

**Important dates:**
- Last day to add this course: September 1.
- Last day to drop: November 6.
- Date of final exam: December 14.

**NOTE:** Last drop date applies to Earlham students only. Students registered through IU-East or other institutions must follow the dates and rules of their own institution.

**Makeups:**
Past-due assignments will not be accepted except in rare circumstances, provided the student receives prior consent from the instructor.

**Exams.** Make-up exams will not be given except in the case of a documented emergency.

**Academic integrity:**
The College trusts students who enroll at Earlham to be honest seekers of truth and knowledge. This trust is extended to all students by other students and by teachers, and is manifested in a variety of forms. Exams are rarely proctored. Unlike many colleges and universities, Earlham does not ask students to sign an oath affirming that they did not cheat on an assignment, since this would imply that people are either inherently dishonest, or will be honest only when they explicitly swear to it.

Students must be mindful that, although Earlham encourages cooperative and collaborative, rather than competitive, modes of learning, one's work must still be one's own, unless explicitly assigned to a group. Giving or receiving aid inappropriately on assignments and tests, or plagiarizing by using another person's words or ideas without credit, constitutes a serious breach of our trust in one another and in the integrity of the search for truth.

Those who believe they have witnessed violations of academic integrity should feel the obligation to speak about this to the suspected offender. The witness also should feel obligated to report the suspected offender to the instructor if the person fails to offer a satisfactory explanation and refuses to report him or herself.

Penalties for violations of academic integrity range from failing assignments or tests to suspension or expulsion from the College.

**Academic accommodations:**
Students with a documented disability (e.g., physical, learning, psychiatric, visual, hearing, etc.) who need to arrange reasonable classroom accommodations must request accommodation memos from the Academic Enrichment Center (main floor of Lilly Library) and contact their instructors each semester. For greater success, students are strongly encouraged to visit
the Academic Enrichment Center within the first two weeks of each semester to begin the process. For further details, please visit https://www.earlham.edu/academic-enrichment-center/disability-services/

**Other sources of help:**

**The Academic Enrichment Center.** The Academic Enrichment Center (AEC), located in Lilly Library, provides assistance with study habits and skills as well as a peer tutoring service. The AEC is staffed by trained peer tutors for either pre-arranged group tutoring sessions (provided for many math, science and social science courses) or one-on-one tutoring sessions for other courses. Peer tutoring is a free service offered to all Earlham students. Please visit http://www.earlham.edu/academic-enrichment-center/peer-tutoring/ for more information.

**The Earlham Writing Center.** The Writing Center is dedicated to providing students with advice and resources about writing. Students can meet one-on-one with trained consultants who will contribute feedback to writers at any stage of the writing process: brainstorming, drafting, researching, revising, and polishing. This is a free, walk-in service on the main level of Lilly Library from 8-11 pm Sunday through Thursday, with additional hours on Sunday, 2-5 pm. In addition to dropping by, students may also schedule an appointment up to 10 days in advance using the online scheduler found at: http://www.earlham.edu/writing-center/. If you have questions, please contact Laura Tabor, The Writing Center Director at taborla@earlham.edu.