MA 310: Mathematical Problem Solving for Teachers[1]
MWF 1:00-1:50 PM   CB 339
Spring 2020

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Class webpage: Canvas — `https://uk.instructure.com`

Course Description: Heuristics of problem solving. Practice in solving problems from algebra, number theory, geometry, calculus, combinatorics and other areas. Primarily for secondary school teachers.

Prerequisites: The prerequisite is MA 123 or MA 113

Textbook: MODULE(S^2) Mathematical Modeling: Online in Canvas

Course Structure and Student Learning Outcomes: Let's begin with two axioms that come from Federico Ardila, a professor at San Francisco State University.

> **Axiom #1**: *Mathematical talent is uniformly distributed, irrespective of geographic, demographic, and economic boundaries.* (Growing and harvesting it is the right/smart thing to do.)
>
> **Axiom #2**: *Everyone can have meaningful and rewarding mathematical experiences.* (Mathematics needs users, fans, and ambassadors.)

This is a course designed to grow and harvest the talents that each of you have (and yes, each of you have mathematical talents and value, though these typically take different forms from person to person). In this course we will work collaboratively on meaningful and rewarding mathematical experiences through these experiences, we will deepen our abilities to serve as responsible citizens in society, to effectively use mathematics, and to enjoy mathematics and share that joy with the people around us.

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[1]I reserve the right to change or amend this syllabus at any time for any reason.

The presentation uses a guided inquiry, active learning pedagogy. You will benefit from the axiomatic development because you yourselves solve the problems and prove the theorems with me, the instructor, serving as a guide and mentor. You are thereby empowered with the knowledge that you can solve problems on your own without reference to authority.

The course emphasizes conceptual understanding and communication of mathematical topics through modeling, problem solving, and technology. An emphasis is on modeling with linear, exponential, and trigonometric functions; curve fitting; discrete and continuous models. Use of appropriate technology is explored.

Upon successful completion of this course, you will understand and be able to apply the ideas of mathematics to a variety of problems. You will be able to translate ordinary language descriptions of problems into mathematical expression, derive solutions by rigorous mathematical methods, interpret their results, and explain them.

The curriculum we will use is produced by the Mathematics of Doing, Understanding, Learning and Educating for Secondary Schools (MODULE(S^2)) Project is an outgrowth of the work of the Mathematics Teacher Education Partnership (MTE-Partnership), a national collaborative working towards improving the number and quality of secondary mathematics teachers prepared in institutions of higher education. The MTE-Partnership is founded on a set of Guiding Principles (MTE-Partnership, 2014) which include a focus on transforming preparation programs so that prospective teachers develop and convey views that "mathematics is a living and evolving human endeavor" (p. 4), and develop teaching practices that "demonstrate a dedication to equitable pedagogy" (p. 5).

Course Policy on Discourse Students are not allowed to make disparaging comments, at any time or for any reason, about themselves, their mathematical ability, their peers, or the abilities of their peers. Here are example statements that are prohibited, along with acceptable replacement phrases.

- I can't do this. $\rightarrow$ I am still learning how to do this.
- That was stupid. $\rightarrow$ That was a productive mistake.
- This is impossible. $\rightarrow$ There is something interesting and subtle in this problem.
- I'm an idiot. $\rightarrow$ This is going to take careful thought.
- I'll never understand this. $\rightarrow$ This might take me a long time and a lot of work to figure out.
- This is terrible. $\rightarrow$ I think I've done something incorrectly, let me check it again.

The banned phrases represent having a fixed view of your own intelligence, which does not reflect the reality that you are all capable of dynamic, continued learning. The suggested replacement phrases support and represent having a growth mindset regarding your abilities and your capacity for improvement.

Grades: There will be five elements to assessment and grading in this course: Participation, Homework, Written SoP's, Video SoP's, and a final project.

Participation:

- You must be present and engaged in class each day.

Homework:

- Homework will be due daily, for the most part. I will announce the homework in class and put it on Canvas, as well.
- No late work will be accepted.
- You should work with other students and share your ideas as part of our course community. However, you should not let your collaboration devolve into letting someone else do all the "hard parts" and then copying their answers.
- Four Rules for Assignments:
    - You must write up the solutions on your own.
    - If it is a group assignment, write the names of any other students with whom you worked.
    - I am always available for you to ask questions and get help on the homework.

Written Simulations of Practice (SoP): You will complete these assignments by writing a 1-2 page report that describes how you would plan to facilitate a discussion with your students which will allow you to elicit student thinking about the modeling process while addressing given questions about certain lessons. The three written SOPs go along with the following lessons:

- Water Conservation, Shower v. Bath Task

- Memorization

- Area of Sioux Reservation Land

Video Simulations of Practice (SoP) You will complete these assignments by submitting a short video (5-7 minutes) of yourself responding to a mock teaching situation. The three video SOPs go along with the following lessons:

- Critical Reading of Mathematical Models: Muffin Sale Task

- Lost Cell Phone

- Flint Water Crisis

Final Modeling Project As a final project for the modeling course, you will choose a situation to model based on your own preferences and what you find interesting to end

the course. Options will be given to choose from or you may choose your own topic. This assignment can be done as a group or individually.

Use of the Internet You will have to use the internet to access articles, find data, and the like. You will want to have a computer or iPad or the like for this access. I don't know if you will be able to read the materials that we will need on your smartphone. That will be something that you have to determine for yourself.

Most likely you will not be able to find solutions to our homework problems online so there is no need looking.

Course Grades Your course grade will be determined by your participation, homework, and project.

- Homework: 20%
- Participation: 5%
- Written SoP: 30%
- Video SoP: 30%
- Project 15%

Mid-term Grades: Mid-term grades will be posted on myUK by the deadline established in the Academic Calendar
(`http://www.uky.edu/Registrar/AcademicCalendar.htm`).

Course Policies:

- *Attendance*: Attend lectures and recitations regularly. Be on time and remain until dismissed. Do not leave in the middle of class. Instructors have the right to take off attendance points for coming late or leaving early. If you cannot come to lecture or recitation and would like to request an excused absence, inform the instructor as early as possible and provide documentation.
- *Unexcused Absences:* You are allowed 2 unexcused absences. Beyond that, you will lose 2% of your overall course grade for each unexcused absence.
- *Excused Absences:* Students need to notify the professor of absences prior to class when possible. Senate Rule 5.2.4.2 defines the following as acceptable reasons for excused absences: (a) serious illness, (b) illness or death of family member, (c) University-related trips, (d) major religious holidays, and (e) other circumstances found to fit "reasonable cause for nonattendance" by the professor.
  Students anticipating an absence for a major religious holiday are responsible for notifying the instructor in writing of anticipated absences due to their observance of such holidays no later than the last day in the semester to add a class.
- Students are expected to withdraw from the class if more than 20% of the classes scheduled for the semester are missed (excused) per University policy. Per Senate Rule 5.2.4.2, students missing any graded work due to an excused absence are responsible: for informing the Instructor of Record about their excused absence within

one week following the period of the excused absence (except where prior notification is required); and for making up the missed work. The professor must give the student an opportunity to make up the work and/or the exams missed due to an excused absence, and shall do so, if feasible, during the semester in which the absence occurred.

- *Verification of Absences:* Students will be asked to verify their absences in order for them to be considered excused. Senate Rule 5.2.4.2 states that faculty have the right to request "appropriate verification" when students claim an excused absence because of illness or death in the family. Appropriate notification of absences due to university-related trips is required prior to the absence when feasible and in no case more than one week after the absence.

- *Accommodations due to disability:* If you have a documented disability that requires academic accommodations, please see your instructor as soon as possible during scheduled office hours. In order to receive accommodations in this course, you must provide the instructor with a Letter of Accommodation from the Disability Resource Center (Suite 407, Multidisciplinary Science Building, 725 Rose Street. Contact Susan Fogg, Disability Accommodations Consultant, drc@uky.edu, (859) 257-2754) for coordination of campus disability services available to students with disabilities.

- *Missed work* In order to be fair to all students, dates for homework assignments are firm. Missed work may be made up only due to illness with medical documentation or for other unusual (documented) circumstances.

- *Academic Dishonesty:* Per university policy, students shall not plagiarize, cheat, or falsify or misuse academic records. Students are expected to adhere to University policy on cheating and plagiarism in all courses. The minimum penalty for a first offense is a zero on the assignment on which the offense occurred. If the offense is considered severe or the student has other academic offenses on their record, more serious penalties, up to suspension from the university may be imposed.

    Plagiarism and cheating are serious breaches of academic conduct. Each student is advised to become familiar with the various forms of academic dishonesty as explained in the Code of Student Rights and Responsibilities. Complete information can be found at the website Ombud. A plea of ignorance is not acceptable as a defense against the charge of academic dishonesty. It is important that you review this information as all ideas borrowed from others need to be properly credited. Senate Rules 6.3.1 (see Senate Rules for the current set of Senate Rules) states that all academic work, written or otherwise, submitted by students to their instructors or other academic supervisors, is expected to be the result of their own thought, research, or self-expression. In cases where students feel unsure about a question of plagiarism involving their work, they are obliged to consult their instructors on the matter before submission. When students submit work purporting to be their own, but which in any way borrows ideas, organization, wording, or content from

another source without appropriate acknowledgment of the fact, the students are guilty of plagiarism.

Plagiarism includes reproducing someone else's work (including, but not limited to a published article, a book, a website, computer code, or a paper from a friend) without clear attribution. Plagiarism also includes the practice of employing or allowing another person to alter or revise the work, which a student submits as his/her own, whoever that other person may be. Students may discuss assignments among themselves or with an instructor or tutor, but when the actual work is done, it must be done by the student, and the student alone. When a student's assignment involves research in outside sources or information, the student must carefully acknowledge exactly what, where and how he/she has employed them. If the words of someone else are used, the student must put quotation marks around the passage in question and add an appropriate indication of its origin. Making simple changes while leaving the organization, content, and phraseology intact is plagiaristic. However, nothing in these Rules shall apply to those ideas, which are so generally and freely circulated as to be a part of the public domain.

Students are encouraged to work together to understand a problem and to develop a solution. However, the solution you submit for credit must be your own work. In particular, you should submit your answers for web homework. Copying on exams and usage of books, notes, or communication devices during examinations is not allowed. Cheating or plagiarism is a serious offense, and it will not be tolerated. Students are responsible for knowing the University policy on academic dishonesty. The following are a few examples of academic dishonesty

1. using someone else's clicker in class or asking someone to falsely use one's clicker in class;
2. sharing answers on an exam by texting or other messaging apps;
3. having another student complete an assignment for you or give you answers to specific questions;
4. using unauthorized materials or hardware on an exam;
5. looking at another student's answers during an exam;
6. having someone else take your exam for you;
7. lying about having taken an exam or completed an assignment.

- Be on time to class and remain until dismissed. Do not leave in the middle of class.
- *Accommodations due to disability.* If you have a documented disability that requires academic accommodations, please see me as soon as possible during scheduled office hours. In order to receive accommodations in this course, you must provide me with a Letter of Accommodation from the Disability Resource Center (DRC). The DRC coordinates campus disability services available to students with disabilities. It is located on the corner of Rose Street and Huguelet Drive in the Multi-disciplinary Science Building, Suite 407. You can reach them via phone at (859)

257-2754 and via email at drc@uky.edu. Their web address is `http://www.uky.edu/StudentAffairs/DisabilityResourceCenter/`.

Inclement Weather Policy: The University of Kentucky Severe Weather Policy can be found at `http://www.uky.edu/PR/News/severe_weather.htm`. The UK Infoline at (859) 257-5684 or the UK Web site at www.uky.edu are the best places to find the most up-to-date situation.

If you feel that travel during inclement weather would be hazardous, then try to inform your instructor as soon as safely possible. You will be given the opportunity to make up any work missed or due on that day. As always, each student is responsible for any work missed and will be expected to get the notes from another student or from the web.