Math 033: Math for Sustainability

Sections: Spring 2015

- Math 033.001, MWF 02:30-03:20 pm, 115 Osmond Building

Welcome to Math 033: Course Description

How long can a system – a collection of different organisms living and interacting together, like the animals and plants in a rainforest or the people and companies in an economy – remain diverse, active and productive? This is the *sustainability question*, and asking and answering this question with regard to the systems of *human* society will be an increasingly urgent concern for the 21st century. It is not just a question for technical experts in this or that branch of science or economics: ultimately, the answers we give will affect everyone on earth.

Sustainability has a mathematical side, even in its basic question "how long?". **The aim of this course is to help you, the citizens and leaders of the future, engage more effectively with mathematical discussion about sustainability** so that you can make more informed decisions about it. We *don't* assume that you are a "math person", in fact the course is not open to math majors at all; even if you hate or fear mathematics, as long as you are open and willing to learn, this course may be for you! We also *don't* enforce any "politically correct" view about specific sustainability questions; the point of the course is to give you tools that will enable you to reach your own well-justified conclusions for yourself, not to tell you in advance what those conclusions should be. You *will* have to write a lot in this course using electronic media (see the "digital expression" requirement later on, in the Assessment section).

So how is the course organized? *Mathematically*, there are four "themes" and we will spend about ¼ of the semester on each:

- *Measuring* – ways in which information can be represented numerically.
- *Changing* – ways in which a system can change over time.
- *Risking* – ways to quantify risk and uncertainty, and how we use them.
- *Networking* – how to think mathematically about the way a complex system is interconnected.

In terms of *content*, we will spend about half of the in-class time for each theme to look at the theme by itself, in an abstract way. The other half of the time we will be carrying out specific "case studies" where we use the mathematical tools to analyze sustainability issues, on various scales from the local (waste management on the Penn State campus?) to the global (tipping points for the Earth's climate?). Often, a guest instructor will present one of these case studies.

Instructors

- John Roe (Professor), 204 McAllister Building, email: john.roe@psu.edu, web: http://sites.psu.edu/johnroe is the developer of the course and co-instructor. He has been a professor at PSU since 1998.
- Sharzhad (Sara) Jamshidi, 419 McAllister Building, email: sxj937@psu.edu, web: http://jamshidi.weebly.com is co-instructor for the course.   She is a fourth year graduate student in the Department of Mathematics.
- Kaley Weinstein (kdw5156@psu.edu) is the Teaching Assistant for this course. Kaley is an undergraduate student majoring in Energy, Business and Finance
- Guest instructors may include:
    - *Richard Alley* is Evan Pugh Professor of Geosciences at Penn State and host of the 2011 PBS series "Earth: The Operator's Manual". He studies the Earth's ice and snow coverage and its connection with climate change.
    - *John Baez* is a mathematical physicist at the University of California, Riverside. In 2010 he founded the *Azimuth Project*, an online resource which aims to be a focal point for scientists and engineers interested in planetary survival, and to make clearly presented, accurate information on the relevant issues easy to find.
    - *Susannah Barsom* directs the academic programs at Penn State's Sustainability Institute, including the Sustainability Leadership Minor. As coordinator of the minor, she works with faculty to identify sustainability courses across colleges and campuses; advises students; works with academic administrators and faculty to ensure that the minor and the SUST 200 core course are offered at all campuses; and regularly teaches a section of SUST 200 at University Park.
    - *Andrew Gutberlet* is manager of engineering services in Penn State's Office of Physical Plant. His group is responsible for energy procurement and energy savings across all PSU campuses, as well as for implementing greenhouse gas reduction goals.
    - *Darla Lindberg* is a professor in Penn State's Stuckeman School of Architecture, whose work engages with the sustainability and resilience of building systems and human interactions. She received the college's Outstanding Teaching Award in 2010.
    - *Al Matyasovsky* is the supervisor of support services in Penn State's Office of Physical Plant, working on waste management issues. His team created Penn State's patented ReDi Index—a tool that is poised to become the global standard for measuring solid-waste efficiencies.
    - *Chris Uhl* is a professor of biology at Penn State, with research interests in human ecology and pedagogy. He is the author of the books "Developing Ecological Consciousness" and "Teaching As If Life Matters".

Course materials

There is no required textbook for the course.   Course notes are written by the instructors and will be posted online in advance of the lessons that they apply to. They may be downloaded from the web at http://sites.psu.edu/mathforsust/resources/course-text/ Note that for this first offering of the course, the notes are a work in progress. There is extra credit available for suggestions that substantially improve them – see below.

Online resources

This course makes heavy use of online resources and, in order to participate, it is *essential* that you have reliable Internet access (either via your own personal computer, or by using Penn State's computer labs). Important notifications will be made **by email to your PSU Access Account**. It is your responsibility to **check your email frequently** (daily) at your Access Account address; if you fail to do so, you will not be allowed to make up any assignment that you miss as a result.

The main course website is http://sites.psu.edu/mathforsust/   Tabs on this website give links to the other sites mentioned below. This site contains the instructors' blog, class timetable, links to useful resources (including the syllabus and the course notes), tech FAQ, and similar materials. This website is visible to the whole world.

We use Penn State's course management system, ANGEL (https://cms.psu.edu) for time sensitive or restricted material like lecture notes, daily quizzes, and other tests. Multiple-choice tests are taken within ANGEL and automatically graded. This website is password protected (using your Penn State login).

The course blog is at http://sites.psu.edu/mfsblog/ All course participants are expected to post regularly on this blog (see additional information about blogging requirements, below). Again, this website is visible to the world, but posting and commenting access is limited to registered class participants – to post something, log in with your PSU login information.

Class Participation

Lecture notes and similar media are not a substitute for attending class. In fact, **there is no substitute for attending class**. The best way to succeed in this or in any other class, and to make the most of what college has to offer, is to **attend class every day** and to participate as much as possible in classroom interaction. There will be lots of pop quizzes throughout the semester – if you miss more than the occasional one, you are not coming to class enough! Pop quizzes contribute to the attendance portion of your grade (see the "grading" section for more details).

When you attend class make every effort to be an active participant.   Think, argue, try to apply the ideas, ask questions! You can raise your hand any time, and instructors will frequently ask questions and look for your response. In most classes we will open a real-time channel for you to comment or ask questions by text to Poll Everywhere, http://www.polleverywhere.com/ Poll Everywhere software may

also be used for in-class quizzes and questions from the instructors. More detailed instructions about how to use this may be found on the Tech FAQ page on the website.

Blogging

It is impossible to succeed in this course without actively posting to the **course blog** (http://sites.psu.edu/mfsblog/). There are two types of posts, "entries" (introducing a new topic) and "comments" (continuing the discussion of a topic that you or someone else introduced in an "entry"). Blog posts will be graded according to the rubric below. What topics should they be about? They should be relevant to the course – which means that they should have mathematical content and be related to sustainability in some way – but beyond that, it is up to you. Responses to or questions about the course material? Real-life examples that you have found that use (or misuse) mathematics in the service of an environmental agenda? Calculations using a specific mathematical model? Interesting background to some of the class discussion? Mistakes the instructors have made (hopefully a small category, but keep alert, we are human too)? All of these are suitable for blog posts. Instructors will likely get involved too. A good post could steer the whole class in a new direction.

The *Resources* tab on the course web page will link to a selection of materials that could give you ideas for blog posts. You are not limited to posting on these materials, however; you can post about anything that meets the criteria above.

You are required to make an *initial blog post* within the first week of class. You should introduce yourself and say (i) why you are doing this course and (ii) what you understand by "sustainability". You are also required to *comment* on someone else's initial post. Your blog post is required to include a picture (could be of you, but any picture is fine) and a hyperlink (a "clickable" piece of text taking the reader to another web page). This requirement helps us work out any technical problems early on in the course.

Course blog posts will be **graded** by the instructional team and you will receive feedback on the grading. More details about the grading process are below.

In addition to the course blog there is also an **instructor blog** at http://sites.psu.edu/mathforsust/blog/ This is where the instructors will blog about the background and motivation for the course, how we think the course is going, why things are being done the way they are, and student reaction. This is also where generic feedback on tests and the blog will appear, together with grade distributions. You (and anyone else on the planet) are very, very welcome to post comments, anonymously if you want. Use the opportunity. Nothing on this blog is subject to assessment – say what you want.

Grading

Your final grade will be composed as follows.

- **Digital Media Expression (blogging): 35%** Your blog contributions are your "homework" for this course. Students are required to post new blog entries and to comment on the posts of others.

Your participation will be assessed using the scoring rubric below. There are three separate blog assessment periods (see *Important Dates* below) and your best score from among the three periods will be used to determine your grade. The assessment periods are defined by the *date* that each post was made – for instance, if you comment during period 2 on an entry posted during period 1, that comment will count towards your grade in period 2. Notice that *frequency of posting* is one of the assessment elements. The minimum passing frequency is one entry and three comments in each assessment period. **Much more** than this is required to achieve an "A" grade.

- **Daily Quizzes: 30%** After most class sessions, a "daily quiz" will be posted on ANGEL. This quiz will be live for a period expiring at midnight two days after class, and will consist of 5 multiple choice questions reviewing the content of that day's class. The 30 best daily quiz scores will each contribute 1% of your grade.

- **Attendance: 10%** There will be a number of in-class (pop) quizzes during the semester. As far as content is concerned, the pop-quizzes are intended simply to give you a template to check your understanding. The score you get on the pop-quizzes therefore does *not* count toward your final grade. However, a 2.5% per quiz "attendance" score will be awarded to those who are in class and participate in four of the pop-quizzes. Note that there will probably be more than four pop-quizzes during the semester. You won't know until afterwards which pop-quizzes are being used to verify attendance.

- **Midterm Exams: 10%** Two midterm exams (5% each) will be administered via ANGEL; they will be available for a specified 24-hour period. These are again multiple choice exams, open-book (you can consult anything you want except each other). The midterm exams will contain 12 questions: six testing your *recall and understanding of in-class material*, and six asking you to analyze a *media report on a sustainability question*. Your score is based on the best 10 questions. You have the opportunity to take each exam twice in the 24-hour period (we take your best score); your feedback from the first attempt will tell you your total score but *not* which questions you got right or wrong.

- **Final Exam: 15%** The format for the final exam is the same as for the midterms, except that it contains 25 questions (thirteen in-class material questions, and two media reports with six questions each). The score is based on the best 20 questions. The exam will be available throughout finals week.

- **Extra Credit: 10%** Extra credit may be awarded for
  - o Finding a mistake in lecture notes or exam
  - o Particularly lucid or well-argued blog posts
  - o Suggestions that improve the course or the text – for example, ideas for case studies, better ways of explaining some topics, locating especially helpful background material.
  - o Other extra credit opportunities may be noted later.

Grades will appear on ANGEL throughout the semester. We will use the standard grading scale (A=90%, B=80%, etc).

Digital Media Assessment Rubric

Blog entries and comments will be assessed by reference to the grading rubric below. The intention is to encourage a creative and lively online dialogue among MATH033 students and between students and the instructors.

Criterion	Unacceptable (D/F)	Acceptable (C)	Good (B)	Excellent (A)
Frequency of posting	No participation or infrequent participation	One entry and three comments in a scoring period	At least one entry and one comment per week	At least two entries and three comments per week
Mathematical Content	Little participation	Posts are adequate, but reflect superficial engagement with the material	Posts are well developed conceptually, but may contain mathematical errors	Posts are conceptually sophisticated and apply correct mathematics in a substantive way
Thematic Content	Posts are of little relevance to sustainability theme	Engaged with theme but does not add much new information or ideas	New information or examples that relate to the course content	Course content brought into substantive interaction with new information, examples or ideas.
Organization and Presentation	Unclear, disorganized, unedited, many typos, no use of organization tools such as MathJax, categories, tagging	Open and respectful tone; may show some disorganization. Little or thoughtless use of organization tools.	Thoughtfully and respectfully composed, well edited and organized. Organization tools used effectively	Clearly articulated theme, easy to read, mathematics and text well integrated (using MathJax), helpful choice of category and tags
References and Connections (hyperlinks)	Few references; few connections with other online material	Infrequent references and connections, appeal to personal opinion	Incorporates and references the work of other students, scholars and experts.	Consistently uses references in ways that support the main thesis and show awareness of alternatives.

How to get help

Office hours:

- Kaley Weinstein: Mondays 4:00 – 5:00 pm in 101 McAllister (TA support session)
- Sara Jamshidi: Tuesdays 3:30-4:30 in 419 McAllister
- John Roe: Thursdays 10:30 – 12:00 in 204 McAllister

Course content questions: There are various options here.

- Put your hand up in class! This approach is an oldie but a goodie
- Ask using the on-line real time Poll Anywhere back channel during class time
- Post a question direct to the Course Blog
- Post a comment to the Instructor Blog
- Ask the instructor at the end of class
- E-mail the relevant instructor. They may well post the question and reaction on the course blog.
- E-mail the TA.

Blog and Tech help: See FAQ page on course blog, which has links to further help if needed. If that doesn't help, email Kaley at kdw5156@psu.edu

Course administration and assessment: contact John Roe at john.roe@psu.edu

Important Dates

- **University Deadlines**
  - Drop/Add Deadline: January 21
  - Late Drop Deadline: April 10
  - Withdraw Deadline: May 1
- **Blogging Deadlines**
  - Initial Blog Post Due Before: January 16, midnight.
  - First Blog Assessment Period Ends: February 13, midnight
  - Second Blog Assessment Period Ends: March 27, midnight
  - Third Blog Assessment Period Ends: May 1, midnight
- **Exams**
  - Midterm 1: Available 24 hours during February 16
  - Midterm 2: Available 24 hours during March 30
  - Final: Available 24 hours per day from May 4-8 (weekdays of finals weeks)

Deadlines for online quizzes and exams are hard deadlines. When it's gone, it's gone.

Academic Integrity and Nondiscrimination Statements

All Penn State Policies regarding ethics and honorable behavior apply to this course. Academic integrity is the pursuit of scholarly activity free from fraud and deception and is an educational objective of this institution. All University policies regarding academic integrity apply to this course. Academic dishonesty includes, but is not limited to, cheating, plagiarizing, fabricating of information or citations, facilitating acts of academic dishonesty by others, having unauthorized possession of examinations, submitting work of another person or work previously used without informing the instructor, or tampering with the academic work of other students. For any material or ideas obtained from other sources, such as the text or things you see on the web, in the library, etc., a source reference must be given. Direct quotes from any source must be identified as such. All exam answers must be your own, and you must not provide any assistance to other students during exams. Any instances of academic dishonesty WILL be pursued under the University and Eberly College of Science regulations concerning academic integrity.

Penn State welcomes students with disabilities into the University's educational programs. Every Penn State campus has an office for students with disabilities. The Office for Disability Services (ODS) Web site provides contact information for every Penn State campus. For further information, please visit the Office for Disability Services Web site: http://equity.psu.edu/ods.   In order to receive consideration for reasonable accommodations, you must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation: http://equity.psu.edu/ods/doc-guidelines. If the documentation supports your request for reasonable accommodations, your campus's disability services office will provide you with an accommodation letter. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. You must follow this process for every semester that you request accommodations.

The University is committed to equal access to programs, facilities, admission and employment for all persons. It is the policy of the University to maintain an environment free of harassment and free of discrimination against any person because of age, race, color, ancestry, national origin, religion, creed, service in the uniformed services (as defined in state and federal law), veteran status, sex, sexual orientation, marital or family status, pregnancy, pregnancy-related conditions, physical or mental disability, gender, perceived gender, gender identity, genetic information or political ideas. Direct all inquiries regarding the nondiscrimination policy to Dr. Kenneth Lehrman III, Vice Provost for Affirmative Action, Affirmative Action Office, The Pennsylvania State University, 328 Boucke Building, University Park, PA 16802-5901, Email: mkfl2@psu.edu, Tel (814) 863-0471.