Math 103: Topics in Math for the Liberal Arts

Section 06, Spring 2015

**Format:** This section of Math 103 runs in hybrid format, with one 80-minute meeting per week instead of two. It implements the “flipped classroom” model, which means that you will do much of the learning at home, by watching video lectures and answering follow up questions. This enables the weekly class meeting to be highly interactive, devoted to problem solving in groups.

This section implements the flipped classroom model in order to serve the learning styles of those students who benefit from a highly engaged classroom, rather than a passive lecture experience. This format is not the right choice for every student, however, and requires more self-discipline to keep up with than a traditional face to face course. Moreover, it will involve at least as much work as an ordinary section of the course.

**Prerequisite:** Elementary Algebra at the level of Rutgers Math 025, or equivalent.
A real mastery of elementary algebra and other basic skills is crucial to success in this course.

Math 103: Topics in Mathematics for the Liberal Arts, is taken primarily by students majoring in liberal arts and social science disciplines. The course investigates a variety of areas in which mathematics is concretely applied, in a way which is both engaging and accessible to students who do not necessarily have strong interests in the sciences. These topics include the mathematics of voting, the measurement of power, apportionment, fair division of goods, fair distribution of goods, exponential growth in nature and finance, the Traveling Salesman Problem, and networks.

**Learning goals:**
Math 103 fulfills both the Quantitative Information (QQ) and Mathematical or Formal Reasoning (QR) learning goals of the SAS Core Curriculum:

**QQ:** Formulate, evaluate, and communicate conclusions and inferences from quantitative information.

**QR:** Apply effective and efficient mathematical or other formal processes to reason and to solve problems.

In particular, students who complete course successfully will be able to

- determine winners of elections under different voting methods, and use these to rank the candidates
- determine whether particular election results violate certain mathematically precise notions of fairness
- analyze the power dynamics in a weighted voting system, by different methods
- apply different apportionment methods actually used in the history of the US Congress, both in political and other contexts, and analyze certain paradoxical scenarios
- apply several different methods for dividing valuable continuous goods fairly
- apply two different methods for distributing valuable discrete goods fairly
- compute the future value of assets and value of a deferred annuity, and apply the notion of exponential growth to other contexts than financial ones
- model practical situations as vertex-edge graphs, and in some cases trees in particular
- recognize certain practical problems as instances of the traveling salesman problem
- apply approximate algorithms to solve the traveling salesman problem
- find a minimum spanning tree in a weighted graph and interpret its practical significance
- analyze the feasibility of performing certain brute force computations, in contexts of weighted voting systems, traveling salesman problems, and scheduling of tasks.
- be able to articulate their understanding of the above items, in clear English

By considering a range of topics in some concrete mathematical detail, the course aims to convince the student majoring in a liberal arts discipline that mathematics has a broad range of genuinely relevant applications, many of them outside the physical sciences, and that mathematical research into these areas is ongoing. A major course goal is for students to find the mathematics presented in the course to be interesting, engaging, and accessible, even for those who are convinced that mathematics is not their strongest subject.
Text: *Topics in Mathematics for the Liberal Arts*, Part 1, 2013, by Michael Weingart and Alice Seneres, and *Topics in Mathematics for the Liberal Arts*, Part 2, 2013, by Michael Weingart. The chapters of this book, written specifically for this course by two Rutgers faculty members, will be made available on Sakai at no cost to the student. The motivation for writing this book, and making it available to students at no cost, was both to provide course materials which are well suited to the goals of the course, and to address the significant issue of high textbook costs.

**Meeting times:** Tuesday 8:10-9:30am in HH-A7.

**Instructor:** Prof. Michael Weingart

**Teaching Assistant:** Michael Weingart. If you hesitate to ask the instructor about anything, feel free to ask the TA, whom you may find more approachable.

**Course coordinator:** Prof. Michael Weingart. Feel free to share your thoughts about the course in general with the coordinator.

**Email:** weingart@math.rutgers.edu

**In person office hours:**
- Mondays 2:00-4:00pm in Hill Center 209 (on Busch campus)
- Fridays 8:30am-9:30am in the SAC on George St. (next door to classroom building)
- informally, after class
- or by appointment

**Virtual office hours:**
Each week there will be virtual office hours in the Sakai chat room, time TBA. This means that you can post questions to the chat room and receive responses in real time.

Recurring theme: There is ample opportunity for you to ask questions and get help, and you are warmly invited to take advantage of it. Truly.

**Calculator:** A scientific calculator will be needed for in-class work, homework, and examinations. Please bring one with you to every class meeting. Graphing calculators will not be permitted on exams. Cell phones, tablets, and other cellular or internet capable devices are strictly prohibited on exams, and the consequences of attempting to use one, or even having one visible during an exam, are serious (see the item below on academic integrity).

**Online resources:** This course makes extensive use of Sakai, accessible at sakai.rutgers.edu. Students can log in with their ordinary Rutgers NetID and password. Students in all sections will need to use Sakai to access the textbook, to watch the video lectures, to submit their homework and view feedback on it, and to view fully worked out solutions to the homework problems. Sakai is also used as a way of posting announcements, exam review materials, and grades.

**Academic Integrity:** All Rutgers students are expected to be familiar with and abide by the academic integrity policy (http://academicintegrity.rutgers.edu/academic-integrity-at-rutgers). Violations of the policy are taken very seriously. During exams, cell phones and tablets must be turned off (not just silenced), and completely put away; having a cell phone or tablet visible during the exam will automatically be reported as an academic integrity violation, with a minimum penalty of receiving a 0 on the exam.

**Homework:** In this course you will need to watch video lectures on Sakai, and also submit written homework assignments.

- Each week you will watch video lectures, which replace the classroom lectures of an ordinary section. Each video ends with a question you should answer, but not submit for grading. It is important for your learning and for your preparation for the class meeting that you work through this problem before going to the next video, which explains the solution before continuing with new material.

- There will be two types of written homework assignments to be submitted each week. Each Monday night there will be an assignment due based on the video lectures, which must be submitted via Sakai. This is very important preparation for the class meeting. Each Thursday night there will be an assignment due, based primarily on the
problems worked on in class, with a grace period for submission until Friday night.

- Since the solutions to each homework assignment will be posted in the Resources section of Sakai shortly after the assignment is due, **late homework will not be accepted**.

- **All written work must be submitted online via the Assignments area of Sakai**; it may not be submitted on paper, nor by email. There are no exceptions.

**Important guidelines for submitting homework:**

1. To access Sakai, be sure that you have an active email account and know your NetID and password.
2. The order of the homework problems in your submitted work should be the same as the order in which they are listed in the assignment on Sakai.
3. If you upload a file, it must be in one of the following formats: .doc, .docx, .pdf, or .jpg. Files which are not in this format, and which the instructor cannot open, will be given a grade of 0.
4. If you need to scan your homework assignment, the campus computer labs and libraries do have scanners, and there are technical assistants there if you need help. **Note:** Scanned documents should be saved as pdf files.
5. A popular technique for producing images of handwritten work is to photograph each page, or each half of each page, using a cell phone. This is acceptable.
6. It is entirely your responsibility to make certain that the file you upload has the appearance you intend. Please check this by opening the file after you have uploaded it, and see that it does open, that the image is right side up and generally readable, etc. If the file format is incorrect or the image is blurry, you will be given a grade of 0.
7. If you ever have technical difficulties with Sakai, especially in uploading homework, please contact the excellent and very responsive Sakai help desk at sakai@rutgers.edu or 848-445-8721.
8. Do not wait until the last hour to upload your homework, since the system may be unexpectedly busy.
9. Whether you upload a file or type your answers into the textbox, be sure to hit “submit” at the bottom of the screen to submit your assignment.
10. You will very quickly get a confirmation email from the Sakai system that your assignment was submitted. Make sure that you get this confirmation email, because it is your responsibility to make sure that your submission goes through.
11. If you do not receive the confirmation email, your work probably did not go through, in which case you should log back in to confirm that your work was posted, and if it wasn’t posted then you should resubmit.

Unless specified otherwise, **you must write your answers in complete, grammatically correct English sentences**. Being able to do this is a crucial aspect of quantitative literacy, which goes beyond mere computational proficiency.

Doing the homework is crucial to learning the subject thoroughly, and the system of electronic submission makes it possible for you to get feedback quickly on whether you have done the homework correctly.

You are permitted, and in fact encouraged, to work together on homework problems, but all written work which you submit must ultimately be your own.

**Quizzes:** There will be a quiz at the beginning of each class meeting. Studying for and taking the quiz is important preparation for the interactive work of the class meeting. Two quiz scores will be dropped from the course grade computation.

**Exams:** There will be two midterm exams and a comprehensive, cumulative final exam. Missing an exam is a serious matter, and should only occur as a result of a genuine, verifiable emergency situation. "Verifiable" means that there should be a doctor's note, notice of court appearance, etc. indicating that you were unable to attend at the time of the exam. If circumstances beyond your control prevent you from attending an exam, it is important that you contact the instructor as quickly as possible.

**Makeups:** There are **no makeup quizzes or exams**. As noted above, under truly compelling circumstances an absence from a quiz or exam can be excused, but instead of having a makeup, the portion of the final exam pertaining to the content of the missed midterm exam will count correspondingly more heavily.

**Special accommodations:** Full disability policies and procedures are at [http://disabilityservices.rutgers.edu/](http://disabilityservices.rutgers.edu/)

Students with disabilities requesting accommodations must follow the procedures outlined at [http://disabilityservices.rutgers.edu/request.html](http://disabilityservices.rutgers.edu/request.html)
Date and time of the final exam: Tuesday May 12, 8am-11am.

Grading: The overall course grade will be based on the results of the exams, written homework, and quizzes given in class, according to the following scheme:

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<table>
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<tbody>
<tr>
<td>Homework, quizzes, and class work</td>
<td>25%</td>
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<tr>
<td>Midterm Exams (combined)</td>
<td>35%</td>
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<tr>
<td>Final Exam</td>
<td>40%</td>
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The one midterm on which you perform better will count for 20% of the course grade, while the other will count for 15%. Thus the midterm exams are relatively low-stress opportunities to pull together your knowledge of the subject matter several times through the course, so that you are never behind, and a weak performance on one exam won’t hurt you too badly overall.

Attendance, and the classroom setting: Because of the hybrid format, attendance is truly essential. The course is set up so that the interactive work that occurs in the classroom is what cannot really be replicated on your own at home. Moreover, in the classroom your full participation and engagement are required, and are part of the course grade.

Here is some good news about the classroom setting, and the value of the learning experience you will have there: the cell phone of the person next to you will not ring or vibrate during class, nor will he/she engage in the very distracting activity (to self and others) of sending or viewing text messages or surfing the internet during class, nor will he/she distract you by talking about matters unrelated to the course – though you will do a great deal of talking in class about the course content. This is excellent news for you, and everyone else, since you have all paid a significant amount of money to be here, and there are ample opportunities for conversation and texting and updating Facebook and Twitter and Instagram outside of class time.

Caution: The information in this syllabus is subject to change, as announced in class or via email/Sakai. No major changes are anticipated, but you are expected to attend class and check email regularly.

Extra help: If you are having difficulty, please take advantage of the opportunity to visit office hours. Do not hesitate to ask questions by email, or in the Sakai Chat Room. The Rutgers Learning Centers also provide drop-in, free tutoring for Math 103, according to a schedule accessible at http://lrc.rutgers.edu/content/tutoring.

A few friendly words of advice:
• Never fall behind in a math course!!!!! The ideas we will discuss need time to sink in, and are very difficult to learn quickly right before an exam, so it is important to clear up your confusions sooner rather than later.
• An excellent way to improve your understanding of the subject is to study and work on homework together with classmates. Explaining mathematical ideas to others is often the most effective way to sort out your own confusions and clarify your understanding; you don't know just what it is that you don't know until you try explaining it to someone else.
• You are also warmly invited to ask questions in class, which students are far too hesitant to do in math courses, or in office hours, or by email, or in the Sakai Chat Room! I very much want you to succeed in this course.
### Tentative schedule of topics (subject to change as circumstances require!):

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic(s)</th>
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<tbody>
<tr>
<td>1</td>
<td>Voting</td>
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<tr>
<td>2</td>
<td>Voting</td>
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<tr>
<td>3</td>
<td>Measuring power</td>
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<tr>
<td>4</td>
<td>Measuring power, Apportionment</td>
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<tr>
<td>5</td>
<td>Apportionment, review</td>
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<tr>
<td>6</td>
<td>Exam 1</td>
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<tr>
<td>7</td>
<td>Fair division</td>
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<tr>
<td>8</td>
<td>Fair division</td>
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<td>Spring break</td>
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<td>9</td>
<td>Fair distribution</td>
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<td>10</td>
<td>Growth and finance, review</td>
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<tr>
<td>11</td>
<td>exam 2</td>
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<tr>
<td>12</td>
<td>Growth and finance</td>
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<tr>
<td>13</td>
<td>Growth and finance, graph theory</td>
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<td>14</td>
<td>Exam 3</td>
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May 13, 8am-11am: Final exam (cumulative)