Final Project

English 125, Rafe Kinsey

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In this course, we've seen and will continue to see examples of mathematical thinking underlying important parts of the real world. The most notable example we're focusing on is theoretical linguistics: by using mathematical structures, we can systematically and scientifically think about how language works. But there are of course many other examples.

This project is your opportunity to learn more about an application of mathematical thinking in the world that's of interest to you. Here, I'll interpret both "mathematical thinking" and "the world" broadly; the point is to find something that takes some of the *abstract*, *deductive*, *logical*, *quantitative* or *formal* properties of math and applies them in an interesting way.

First, you'll chose a topic. To do this, you might read a bit about a few different areas before settling on one that's of interest. (You'll be working on this for the remainder of the semester, so you definitely want to choose something you like!) You might get an idea for a topic from some of the readings you're doing, both in the assigned readings and the extramural readings. Or perhaps you'll get an idea from a discussion with a classmate, or from something of interest in another class.[1] And of course you should feel free to talk to me about topics.

Here are some possible topics I've thought of:

- Music theory, as well as other applications of mathematical thinking to music.
- Social Choice Theory and Mechanism Design: the way that voting systems (in elections, in sports voting) and other matching systems (e.g., housing assignments, or hospital residency assignments) are designed.
- Benford's law (with implications, e.g., in forensic accounting). Also, related laws like Zipf's law.
- Theoretical Linguistics. There are a whole range of topics in different directions, ranging from theoretical syntax and semantics (like what we did/are doing) to language change, sociolinguistics, and dialect variation.
- Computer science and algorithms. How algorithms work in the real world. Why healthcare.gov didn't work. How specific algorithms (e.g., quicksort) work.

[1] You're not allowed to submit the same work for two classes—this is an important university regulation—but it's certainly fine to choose a topic that complements something you're learning in another class. For example, maybe you're interested in music theory and are studying tonal harmony. This could certainly serve as the topic of a paper for this course. Or perhaps you're taking a computer science class and have gotten really interested in algorithms; definitely you should feel free to choose a paper topic that will let you study this more closely.

- Machine Learning (with applications to Netflix, Facebook, and machine-grading of essays, and so many other areas). Related: big data.
- Game Theory (with applications to many areas not just in economics but in sports and elsewhere in society)
- Kahneman and Tversky's research into human "irrationality"
- Negotiation (building off of game theory)
- Economic Theory (with so many applications in so many areas)
- Probability and Statistics (with applications to medicine, science, sports, elections, weather, finance, and so many other areas)
- Information Theory
- Cryptography
- Finance (e.g., the corporate asset pricing model, how hedge funds work, arguments about the efficient market hypothesis, arguments for index funds, etc.)
- More about logic (e.g., modal logic, the P vs NP problem, Godel's Theorem)
- Natural Language Processing (e.g., how an iPhone autocorrects spelling, or machine translation)
- "Digital Humanities": applications of computers to understanding literature or history.
- Math Education (e.g., discussing the content in secondary curricula)
- Law (e.g., the logic of legal reasoning, the use of probability in the courtroom)
- Statistics and Education (debates over psychometrics, testing in schools, etc.)
- Grades (e.g., what does grade inflation mean—for one take see Ellenberg; perhaps tie in Spence's theory of education and signaling?)
- Other topics of your choice!

As you can see, there's a really wide range of topics that would work well, covering many different fields.

Over the next week or so, you should explore a few topics and see what interests you.[2] You should definitely be in contact with me

[2] You can include readings researching for your final project as part of your extramural readings.

(in person before/after class and in office hours, and by email), to discuss what possible projects interest you and to get suggestions from me of sources to consult. Once you settle on a project, you'll spend more time learning about the topic. Once again, I'll be there to help you, and you'll have all of the resources of the university. (Also, your classmates are your friends! I'd definitely encourage you to discuss things—to help each other if there are things that are confusing as you learn the material and to test whether your explanations are clear as you write.)

Then you'll write your paper. Your task is to write a stand-alone exposition of your topic to a general audience. This will be a more substantial paper, probably on the order of 3-6 pages single-spaced.[3] It's up to you how exactly you frame and discuss your material. You might chose to focus just on exposition, or you might choose also to discuss some of the societal or implications of your topic (in addition to your exposition). Because these decisions will depend a lot on the topic you choose, you should be consulting me along the way as you plan your project.

[3] As always, what matters most is that the length is appropriate for the paper.

Timeline

Narrowing Down Topics/Project Proposal

Over the next week and half, start reading about topics and thinking about possibilities. Email me at the latest by Friday, November 22, at 5pm, with a formal proposal of what topic you want to write about. You *should not* put this off to the last minute, and you should be in communication with me before that deadline as you consider possible topics.

Research/Outline

Over the next week, you should be doing research about your project. By Monday, December 2, you should send me an outline of your paper. The outline can take whatever form is most useful to you, but should give a sense of the order/structure of your paper. You should also list the main resources you have been using for research.[4]

[4] Of course, it's fine if you find more resources after this.

Polished Rough Draft

Your polished rough draft is due in class on Monday, December 9. Please bring *three* hard copies to class. Please also email me a copy. We will do peer review in class that day. You should email your partner(s) with your peer review comments by Wednesday, December 11, at 2:30pm.

Optional Oral Presentation

To give you the opportunity to practice oral presentations, you have the *option* of giving a 5-minute oral presentation about your topic before or during finals week. If you choose to do this, approximately a third of your final paper grade (and therefore about 8% of your overall grade) can be based on your presentation.[5] If you want to do this, please let me know via email by class on Monday, December 9.

[5] To incentivize you to try doing this, I will make it completely risk-free. If your paper grade is higher than your presentation grade, you will get the paper grade for the entire portion of the final project grade. In other words, you won't be penalized if your presentation isn't as good as your paper.

Final Draft

The final draft is due by Thursday, December 19, at 10:30am. (Please note that this is the scheduled final exam time for the course. Because I will have to submit grades shortly after this date, you will *not* be able to use your late days for this assignment, barring extenuating circumstances.) Please email me a copy and also submit a hard-copy in my office mailbox. If you are going to be out of town and cannot hand in a paper copy, please let me know ahead of time by email.

Instructions for Your Final Draft

Your assignment should be typed, in 12-point font and *single-spaced*. Your main paper should be approximately 3-6 pages. After your main paper, you should include a reflective paragraph about the assignment and an acknowledgments/sources paragraph. Please use the same sourcing approach as in previous papers: in the text of your paper, you can use casual citations as in journalism; at the bottom of your paper, please include a paragraph listing all sources you used and explaining in detail how you used them.