OVERVIEW: To begin, you will pick a journal article that interests you and which explores a topic that is related to, but is not covered in, one or more of your math course(s). The paper will serve as a starting point for your explorations; you will then move beyond this paper using additional references. Your project will culminate with a paper and a half-hour presentation.

CHOOSING THE INITIAL JOURNAL ARTICLE

You may choose an article from any source you like, as long as it contains (at least) undergraduate-level mathematics (or, possibly, does not contain college-level mathematics but leads you immediately to something which *does*).

That being said, articles in Math Horizons, The College Math Journal or Mathematics Magazine are most likely to be aimed at the right level. The Journal of Recreational Mathematics may also be a good place to begin exploring. Articles from other sources have also worked quite well in the past, but it can be harder to judge early on how successful you will be reading a paper, whether it is aimed at the right level, and whether it will give you room to explore further once you've finished reading it.

There are no hard-and-fast rules for how to choose your initial article to guarantee a successful project. Based on a quick survey of past projects, I have compiled a list of guidelines you might want to follow, but for every one of them, we have had at least one successful project that didn't follow that guideline.

- The article is between 7 and 20 pages long.
- The bibliography contains neither too few nor too many references (perhaps 8-25 is a good range). Look also at what sorts of resources they cite: if they cite several books that sound beyond your knowledge level *and* the journals they cite are very specific and on advanced topics, then that paper may be too hard to read. In an ideal world, at least one paper cited will sound like it is also interesting and aimed at your level, or at least one book cited sounds like it is aimed at your level. If most of the works cited our not mathematical (for instance, all finance journals), then the paper is probably not going to work well.
- The article contains actual mathematics. Just a description of ideas, or the result of a data-gathering experiment with little math done besides plotting the data can lead to difficulties.
- On the one hand, the paper should describe a fairly specific situation – for instance, it usually should not be a literature review, as that tends to end up being way too broad a topic. On the other hand, the article shouldn't be so specific that there's no real place to go once you've finished that paper

Once you have a couple articles that you think are possibilities, skim through them quickly to see if you are interested in the larger question they address, and if you think you can manage to fill in the gaps of the mathematics.

AFTER YOU CHOOSE THE INITIAL ARTICLE:

Read the article carefully – you should understand every line. For instance, if the article says that a result is well-known, or cites a source for a previous result, look into it. You do not have to return to first principles for everything, but you want to understand as much as possible: if you find that you will be looking up too many previous results, then for some, you may just want to get a feel for why it is true, perhaps by looking at some specific cases.

Once you have made it through the first article, you will then follow that up with more reading – reading a related paper or excerpts from a book. Different people will follow different routes here: some

may choose to pursue something referred to in the paper in more detail by reading something from the bibliography. Others may choose to find a related paper by searching for papers that refer to their paper, or that refer to one of the sources in the bibliography. And still others may just pick up on a topic in their paper and find ways to sources that discuss that topic. The main point is to learn more about an aspect of what you've read that interests you. This process may be very linear – your initial article refers to another,which in turn refers to another (or your first article is referred to by another, etc), but often times it doesn't turn out to be quite so clear-cut. The reference that leads you on may be in a bibliography *or* you may find it by finding other papers that refer to yours, using a data base search. (Occasionally, a student may eventually start doing some work on their own (similar to mathematical research), but this should not be the main work of the semester.) Take advantage of there being a dedicated Math/Science library liaison (Peter Kirlew) – he can help you put your search for more to read into action.

Throughout this process, be looking for examples that illustrate the ideas you're reading about.

WEEKLY PREPARATION, PRESENTATION, AND PARTICIPATION:

You will work hard to make progress on your reading every week. Each week-end, you will look over what progress you've made, and prepare to present what you've learned to the rest of the class. It doesn't need to be a glossy formal presentation, and you don't need to practice it, but your thoughts *do* need to be organized. I also suggest you prepare a few slides (PowerPoint, Beemer) that (at least) contain equations, figures, matrices etc that would be too hard or take too long to write on the board. In addition to allowing your presentation to flow more smoothly, this will allow you to start learning how to type in the equations, matrices, figures etc that you are going to need in your final paper and presentation. The final slide should always be a bibliography of all sources used to date, both to avoid any appearance of plagiarism *and* so that by the time you write your paper, you already have a bibliography. See below for the form citations should take.

You will present on either Monday or Wednesday (come prepared to present on Monday; I will choose who is going on which day each week). The rest of the students in the class, and I, will have a copy of whatever article or excerpt of a book you are currently working on, and you will discuss your progress in detail.

When it is someone else's turn to present, you will listen carefully. If you don't follow anything, ask them to clarify it – don't feel like you're just missing something; it will help them to explain. This is a seminar class – discussion is good!

I will be paying attention to how much work you seem to have accomplished, how well you prepared for the week's presentation, and how much you participate while other students are presenting, and will give you weekly feedback, in the form of a score out of 10 points. (I tried not doing this the first time I taught the course, and it meant that students had no grade in the class until the end of the semester, and no feedback on whether they were putting enough effort in or not – I am adding this to help, not hinder!)

PAPER:

Your paper will address a topic in as much detail as possible. It should *not* include false starts, or side trips you made that ended up not going anywhere.

In your paper, be sure to discuss why we should care about this topic: does it have an application? Is it fundamentally interesting in some way? In short – why did it grab *you*?

You will begin organizing your thoughts for the paper about midway through the semester, with an outline (with current bibliography). Several weeks later, you will turn in a rough draft (with bibliography),

to me. I will read this paper only for structure (organization) and mathematical correctness.

You will make refinements to the paper as well as following up on my comments (and adding anything new you've learned that fits in), and hand a second draft of your paper (of course, still with bibliography) to a peer in your class. After you have all had a chance to read each other's papers, you will meet to discuss constructive comments you have to make.

The final draft will be due the Monday of finals week.

A few thoughts on format: Include a title page and an abstract. While you don't have to include every single step in a calculation or proof, there should be enough work or explanation so that your audience (other senior math majors) can follow (and I know you not only know it's true but *why* it's true). Include concrete examples of theorems or ideas in action. As for notation: equations don't have to be numbered unless you refer back to them. in a sentence of words, mathematical symbols shouldn't be used to replace single words as a shortcut – "Given that P_i = the probability of event i occurring" should be replaced with "Given that P_i *is* the probability of event i occurring". Similarly $\exists$ and $\forall$ should not be used in a sentence of words.

For the format of citations and your bibliography, see CITATIONS, below.

PRESENTATION:

As for the slides: You should begin with a *Title* slide and end with a *References* slide. (You should also verbally give attribution while presenting.)

CITATIONS:

Everything (ideas, equations, diagrams and other figures) must be attributed!

Your bibliography should begin on a new page. The heading (which should read **References**) should be in a heading-sized typeface, and follow whatever convention for headings you used throughout your paper (if you centered them, center this; if you left-justified them, continue that trend). List works cited in alphabetical order (first author), and enumerate them. When citing a work, simply enclose the number of the referenced work in brackets.

Modifying an example taken from the guide to AMSrefs, you might say in the main body of your paper:

Alan Sokal [3] recommends Bourbaki's text [2] for a gentle introduction to set theory.

On your end-page, you would then have:

References

1. E.F. Assmus Jr. and J.D. Key, *Designs and their Codes*, Cambridge University Press, Cambridge, UK, 1992.

2. N. Bourbaki, *Théorie des Ensembles*, Hermann, Paris, 1970.

3. A. Sokal, Transgressing the Boundaries: Toward a Transformative Hermeneutics of Quantum Gravity, *Social Text*, 46/47, (1996), 217-252.

4. J. Weeks, *Torus Games*, available at `http://www.geometrygames.org/TorusGames/`, accessed 1/23/2012

SOME IMPORTANT DATES:

2/1/12	Class in the Woolley Room; start looking for your first article
2/6/12	First article should be selected (e-mail me the pdf file)
3/26/12	Outline of Paper due
4/4/12	Outline of Presentation due
4/13/12	Rough draft of Paper due, 3:30pm
4/16-4/22/12	Prepare Presentation. Give, receive reviews of practice talk(s).
4/20/12	Abstract of Presentation due (e-mail it to me)
4/23/12	Feedback due - peer reviewed presentations
4/25/12	2nd draft of Paper due for peer review
4/30, 5/1/12	Final Presentations
5/2/12	Feedback due, Peer-Reviewed Paper
5/7/12	Final Paper due, 5pm (e-mail it to me. pdf file if possible; .doc if not)