Math 181: Research Essay Project

Jesse Kass

Winter 2022

The assignment

For the essay (10% of your grade), pick a topic in math history that (1) you find interesting, (2) is original (in particular, has not been covered in class), and (3) is documented by at least two primary sources. Then learn about the topic and write a description of what you learned.

Your essay should be between 1,000 to 2,500 words (roughly two to five pages). The essay must include a complete bibliography which does not count towards the word count. The essay must be submitted in class as a typed, printed, and stapled document. Please use an 11-12 point font and a serifed font (e.g. Times New Roman, in MS Word).

How to pick a topic

Both the Katz textbook and the book by Stedall do a good job of displaying the range of topics one can study in the history of mathematics: people (e.g. mathematicians), research ideas (e.g. theorem), teaching (e.g. how was calculus taught), and institutions (e.g. universities). Does anything strike your fancy? If not, look at the suggestions below on how to find primary sources, and try find something that interests you.

Here are some topics that we've seen in class so far that would work well for an essay:

1. Biography. Is there a mathematician that you'd like to learn about? We discussed T. E. Hart, and the lecture notes from January 12, 2024 describe a number of primary sources that contain information about him. Can you find similar sources for another mathematician?

2. Institutions. A natural type of institution to study is university or school. The Branch Normal College in Arkansas during the late nineteenth century is discussed in the lectures notes from January 24, 2024. Is there another college that you are interested in studying? Can you find out what textbooks were used? Who the math instructors were? Who the students were? What math research was being done? Was there a math club at the university? Some primary sources are the university catalogues we looked at as well as the textbooks that were used at the university.

You can also be creative and study other types of institutions, for example a research lab like Bell Labs or a government agency like the National Science Foundation.

3. Texts. Take a close look at a written text. In class, we spent several classes doing a deep dive into Archimedes' *The Sand Reckoner*. In addition to working through Archimedes' derivation of the number of grains of sand that fit into the "universe,"' we also discussed the Greek numerical system (to motivate Archimedes's numerical system), the book *The Archimedes Codex* described the work that goes into recovering an Archimedes's work, and and in a homework exercise, I had you compare translations. There was a lot more we could have done. For example, we could have looked more closely at the astronomy computations and contextualized them.

   Is there a historical mathematics text that you would like to delve into? Primary sources could be the texts themselves.

4. A mathematical idea. We traced the history of Descartes' Rule of Signs in the lecture notes for January 20, 2024. We studied what the rule says, how it was presented in 19th century textbooks, and how it was originally presented by Descartes. If had time, there is more we could have done. I did not give a full proof that the rule holds, and neither did Descartes. In fact, tracking down a valid proof is challenging. The purported "proofs" in the textbooks were looked have errors. A worthwhile exercise is tracking down the first complete proof.

   Are there mathematical ideas that you would like to study? Primary sources could be papers describing the idea.

5. Other ideas. Be creative and come up with other ideas. For example, one of the primary sources that some people looked at on the first day of class was a patent application for mechanical calculator. Can you explain how the calculator worked? What it did? Whether any models were built and sold?

If there is a topic that you are really interested in but people have already written about it, can you change the focus? For example, suppose that you are interested in Gauss. Many people have already written about Gauss, but maybe you can instead write about a result Gauss proved? Or you can write about the mathematical environment at the university Gauss taught at.

How find primary sources

Wikipedia says that a primary source is "an artifact, document, diary, manuscript, autobiography, recording, or any other source of information that was created at the time under study. It serves as an original source of information about the topic." We've seen several types of primary sources in the class and in the readings already.

I encourage you to be creative and find a topic that interests you.

For some topics, there are no extant primary sources (e.g., many of the Greek mathematicians from the 3th century BC), and for others, there are primary sources,

but they are written in a foreign language that you don't understand (e.g., Gauss's dissertation which is written in Latin). In that case, please take "primary source" to mean the accessible source closest to the original source (eg, use an English translation of Gauss's dissertation) and use that source as a basis for reconstructing the original source.

In addition to primary sources, you are encouraged to also use secondary sources. Here a secondary source means a scholarly analysis or interpretation later than the original topic you are studying. However, please use scholarly sources. Blogs and wiki article can be used, but please do not use them directly and instead track down the sources that are being used.

Some places where you might be able to find sources:

1. the "References and Notes" section of the Katz textook;

2. read the "Further reading" section at the end of the Stendall book and bibliography of the Wardhaugh book;

3. look at the resources on the course website;

4. look at the library guides (`https://guides.library.ucsc.edu/`) or ask a reference librarian for help;

5. google-fo can work well since a lot of material has been digitized.

Cite your sources

Make sure to list all the sources you use in your bibliography, and in your essay, give credit whenever you use another person's ideas. Using someone else's words or ideas is plagiarism, a serious break of academic integrity that may raise honor code concerns.

When writing the bibliography, the easiest thing is to follow a standard style guide (`https://guides.library.ucsc.edu/citesources`). For guidance on how to properly credit others and avoid plagiarism, see `https://guides.library.ucsc.edu/citesources/plagiarism`.

Timeline

- submit at least two primary sources that you will use as part of the homework on Friday February 21.

- submit a polished draft of your essay as part of the homework due on Wednesday March 13. We will spend one class doing a peer review of drafts.

- the final version of your essay is due on the last day of class, March 15.