CALCULUS I — POSTER PROJECT

Objective. The goal of this project is to give you chance to explore a topic of your interest that has some connection to calculus, and to share what you learn with your peers.

Description. On the last day of class, we'll have a poster session. In groups of 3–4, you'll prepare a handout and a digital poster about a topic of your choice related to calculus.

- The handout should be one typewritten page (front and back). It should give an introduction to the topic, and incorporate a detailed and substantial proof and/or example (at the level of a difficult homework problem or harder). It need not be original, but it should be fully explained *in your own words*. If you can incorporate computer calculations, that would be awesome! The handout should also include a list of works that you referenced, so that someone who wants to learn more about your topic knows where to start.
- The poster should convey the main ideas of your topic and some insightful examples. Pictures are always nice, if at all possible![1] All of the details do not need to appear on the poster (that's what the handout is for). We'll use the data visualization wall in the library to present posters, so you can prepare the poster digitally.

Keep in mind that the intended audience is one of your classmates: someone who knows something about calculus broadly speaking (specifically, the topics we've discussed in our class), but may not know anything specific about your topic.

Please make sure that everyone in your group understands everything on your group's poster and handout!

Poster session. The day of the poster session, we'll all wander around looking at the each other's posters, reading each other's handouts, and asking each other questions about anything we need help understanding. You should be prepared to explain your poster, and to answer any questions people might have about it.

Groups and topics. Your group and topic will need to be approved by me before 11:59pm on the third Tuesday. One person in each proposed group should send me an email letting me know who you'll be working with and what you'll be working on.

Grading. Your project score will be based on the following criteria.

- Content (out of 4 points). There should be correct and substantial mathematical content in your poster and/or handout.
- Clarity (out of 3 points). The topic should be clearly explained and logically organized, in a way that is appropriate for the intended audience.
- Participation (out of 3 points). The day of the poster session, each of you will be asked to explain your group's poster to some number of people outside of your group, and also to have some number of people outside of your group explain their group's poster to you.

[1] Remember that, if you don't make a picture yourself, you have to attribute it to whoever did.

Possible Topics. Here is a list of topics you might decide to pursue. Note that the "possible references" for many of the topics in the list below just indicate a single exercise in the textbook. *Solving a single exercise is not a project!* The exercise is meant to serve as a springboard for you to do your own research and flesh out a full project. For example, you might decide to look into the derivation of an equation, or find some data that justifies a model, or... You can be creative about what direction you go! ☺ Also, please remember to make a note of all of the references that you end up using and to cite all of them in your handout.

If you have another idea that's not on this list, let's discuss it!

If you like physics, thermodynamics, astronomy, chemistry...

- Newton's Law of Cooling. *Possible references.* You might look at [RA11, section 9.2].
- The Kirchoff, Fresnel, and Fraunhofer diffraction equations. *Possible references.* You might start with [RA11, 2.2, exercise 66].
- The relationship between Einstein's special relativity and Newtonian mechanics. *Possible references.* You might start with [RA11, 2.7, exercise 44].
- The Clausius-Clapeyron equation. *Possible references.* You might start with [RA11, 3.2, exercise 63].
- The Stefan-Boltzmann equation. *Possible references.* You might start with [RA11, 3.7, exercise 94].
- Snell's law of refraction. *Possible references.* You might start with [RA11, 4.7, exercise 54].
- The Hagen-Poiseuille equation in fluid dynamics. *Possible references.* You might start with [RA11, 4.7, exercise 55].
- The Beer-Lambert law in spectroscopy. *Possible references.* You might start with [RA11, 5.9, exercise 22].

If you like biology, biochemistry...

- The Michaelis-Menten equation. *Possible references.* You might start with [RA11, 2.7, exercise 33].
- The von Bertalanffy growth equation. *Possible references.* You might start with [RA11, 3.7, 80–82].
- The Hagen-Poiseuille equation in fluid dynamics. *Possible references.* You might start with [RA11, 4.7, exercise 55].
- The Gompertz function and its applications to the growth of tumors. *Possible references.* You might start with [RA11, chapter 4 review exercise 61].

If you like psychology...

- Stevens' Power Law. *Possible references.* You might start with [RA11, 3.4, exercise 47].

If you like computers...

- Sigmoidal correction in image processing. *Possible references.* You might start with [RA11, 4.4, exercise 65].
- Euler's method for solving differential equations. *Possible references.* You might look at [RA11, section 9.3].
- Algorithms for numerical integration. *Possible references.* You might look at [RA11, section 7.9].

If you like economics...

- Elasticity of demand. *Possible references.* You might start with [RA11, chapter 3 review exercises 115–117], or with [LGR17, section 6.3].
- Annuities. *Possible references.* You might look at [RA11, section 9.2], or [LGR17, 3.1, exercises 90–91].
- Marginal cost. *Possible references.* You might look at [RA11, section 3.4].
- Monopoly pricing. *Possible references.* You might start with Wikipedia.

If you like sports...

- The "Pythagorean theorem of baseball" (also called "Pythagorean expectation"). *Possible references.* You might look at [LGR17, 4.2, exercise 56], or at Wikipedia.

If you really like math...

- The Ham Sandwich Theorem. *Possible references.* You might start with [RA11, 2.8, exercise 34–35].
- Formal definition of a limit. *Possible references.* You might start with [RA11, section 2.9].

References

[LGR17] Margaret L. Lial, Raymond N. Greenwell, and Nathan P. Ritchey. *Calculus with Applications*. 11th edition, 2017.

[RA11] Jon Rogawski and Colin Adams. *Calculus: Early Transcendentals*. 3rd edition, 2011.