

**Directed Reading Program, Fall 2018**  
**Information Sheet for Students**

**Expectations**

1. Participate in a semester-long reading course under the guidance of your mentor.
2. At the end of the semester, you will present a twenty-minute talk about your reading to participants and mentors of the DRP. This will happen during reading week, exact dates will be announced later in the semester (mostly like Monday, December 10th or 11th). You are encouraged to attend any other talks as well.
3. Under the direction of your mentor, help draft a plan that will help you achieve the goals for the semester. Your mentor will submit this plan by **Friday, September 28th**. See the next page for information about the semester plan.
4. Dedicate four hours of independent reading each week.
5. Have approximately an hour-long meeting with your mentor each week. This meeting is meant to be a discussion about your reading, your mentor will not lecture.
6. We will have a variety of social events this semester. Please look for further information in your emails and consider joining us!
7. With your mentor, submit a tentative talk title by **Monday, November 26th**.
8. You should give a full timed run-through of your talk to your mentor before the seminar day.
9. If at any point you have issues with the above expectations, or you have any questions or concerns, please email one of the organizers as soon as possible. If you are not comfortable with this, you may also email our faculty adviser, Kathryn Mann, at [kathryn\\_mann@brown.edu](mailto:kathryn_mann@brown.edu).
10. Most important of all enjoy the experience and learn a lot!

Thanks,  
Shamil Asgarli  
Kyle Ferendo  
Ashley Weber  
Jiahua Zou

## Semester Plan

Your semester plan plays the same role that an outline does in writing a paper: it helps you see what goals are attainable and acts as a frame that you can use to expand into a weekly schedule. Your plan should include

- The names of the mentor and student(s).
- The title and author of the book (or other resource, but probably book) you want to use.
- The *specific* goals of your project. Many projects begin and are inspired by a desire to learn a general field of mathematics (and this is fine!), but what we want to see is a specific theorem or application towards which you're driving, and the specific methods and theorems that you'll need along the way. These goals can evolve over the course of the semester as you need.

## Example Plans

Books: *An Elementary Introduction to Mathematical Finance*, by Sheldon Ross. After a brief introduction to probability theory, we will develop several foundational ideas of mathematical finance. These include results derived from standard no arbitrage arguments, including put-call parity. The goal of the project is to derive the famous Black-Scholes option pricing formula.

Statistical Models for Pattern Recognition

Possible text: Hastie, Tibshirani, Friedman, *Elements of Statistical Learning*

We will investigate statistical models -- both classical and modern -- with a focus on classification. We will first lay some theoretical groundwork for ordinary least squares, and later discuss extensions such as shrinkage methods, discriminant analysis, and other state-of-the-art modeling techniques. We will utilize these methods to see how they perform on real data, focusing on the problem of handwritten digit recognition.

Spivak's *Calculus* is basically an idiosyncratic undergraduate analysis textbook, but the clarity of focus and the extraordinary breadth of exercises make it an excellent place to learn what a proof is and how mathematicians think about math. Our goal is to get to a rigorous proof of the extreme value theorem, one of the first serious uses of the existence of least upper bounds in the real numbers. Along the way, we'll work with the axioms for an ordered field, discuss limits and continuity in a serious way, and develop intuition for the least upper bound axiom. If time permits after we've accomplished this goal, the book continues to give an excellent treatment of derivatives and tangency.

We want to learn some Riemannian geometry -- our plan is to work through Chapters 5 and 6 of Callahan's *Geometry of Spacetime*. Chapter 5 is a computation-and-picture-heavy description of the metric and curvature on a surface embedded in Euclidean space, and Chapter 6 discusses intrinsic definitions -- the theorem egregium, geodesics, and tensors. This overlaps somewhat with a standard intro Riemannian course, but those have a tendency to be overwhelmingly formal -- the plan here is to build a good collection of concrete examples. If we have more time at the end of the semester, we can of course talk a bit about connections.