



DRP, Math Application Overview

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Seminar Description

This seminar will be an exploratory introduction to different applications of math, from biology and physics to image compression and disease modeling. If you have taken your lower division math courses and want to learn about how different topics you've learned about are used in the real world, this is for you! Each week we will focus on a different topic, and we will blend each meeting with lecture and group work style format.

Prerequisites

1. Calculus Sequence (MAT 21A-D)
2. Linear Algebra (MAT 22A)
3. Differential Equations (MAT 22B)
4. Some coding experience preferred, but not necessary.

No upper division courses required.

Texts

Varies each week. See the week by week breakdown for details. Seminar notes and readings will also be provided via Google Drive (link: https://drive.google.com/drive/folders/1Es59AwKEcKREeiaHqJYJ_f6h8--o7g2n?usp=sharing).

Meeting Format and Expectations

We plan to meet for **60 minute** sessions once a week and we will try to pick a time that works for everyone! Each session will begin with a mini 15-20 lecture to introduce the application, show some examples of how the application is used, and introduce any new math needed. We will then work collaboratively on a mini applied problem in groups. Before each class there will be some reading and/or videos to familiarize yourself with the topic material.

Learning Goals

Students will have a broader understanding of different math modeling techniques and existing applications of math. Students be introduced to several different applications and will learn how to apply skills to mini-projects. Finally, students will get experience working on hands-on projects in groups and gain coding experience.

Tentative Seminar Schedule

- Week 1: Introductions and Math Modeling Crash Course
 - No reading material
- Week 2: Numerical Methods Overview and Coding Crash Course
 - Reading: Set up MATLAB or Python on computer and watch a basic getting started video on Youtube of your choice
- Week 3: The Logistic Equation
 - Reading: Sections 2.1-2.4 of *Nonlinear Dynamics and Chaos* by Steven Strogatz
- Week 4: Markov Chains and Presidential Elections
 - Reading: Watch Video - <https://www.youtube.com/watch?v=i3AkT09HLXo&t=139s>
- Week 5: Singular Value Decomposition and Image Compression
 - Reading: Section 8.7 of *Applied Linear Algebra* by Peter J. Olver
- Week 6: The SIR Model
 - Reading: Notes in Google Drive
- Week 7: Fitting the SIR Model using Least Squares
 - Reading: Sections 5.1-5.5 of *Applied Linear Algebra* by Peter J. Olver
- Week 8: Astrophysics - Kepler's Laws
 - Reading: https://astro.unl.edu/naap/pos/pos_background1.html
- Week 9: Fluid Dynamics - Torricelli's Law
 - Reading: <https://pressbooks.online.ucf.edu/osuniversityphysics/chapter/14-6-bernoullis-equation>