MAT5-236 Differential Equations
Application of Differential Equations Presentations
February 2018

Through the Grapevine

Brock Cecil, Brady Tobin, Sami Vetter

Abstract

In classrooms around the world, rumor spreading is an epidemic. There can be serious consequences if hurtful rumors make their way through a population. In order to avoid these ramifications, we must first attempt to understand the behaviour of the situation. Luckily, we can model the random process of the spread of a rumor through the use of logistic differential equations. We will first examine a model without stiflers (people who choose not to spread a given rumor). Then, we will move on to three variations of a model that examines the activity of Spreaders, Ignorants, and Stiflers (inspired by the traditional SIR model). As educators, we can use these models to advocate for preventing the spread of hurtful rumors.

How much longer do we really have?

Colin Pfeiffer

Abstract

Ever get curious on if or when zombies and humans would actually face off? Nowadays, zombies are seen as a popular figure of the media and they are usually portrayed as being these monsters that sort of appear with outbreak or infection. So what I would like to determine is, if humans would have enough time to leave before the sluggish zombie infection reached them. I will be working with the Bass Diffusion Model to help determine this. The Bass Diffusion model allows us to derive exact and approximate interaction times, leading to conclusions on how best to plan for the inevitable meeting. Interaction kinetics are added to the system and we consider under what conditions the system forms an infection wave.

AIDS: Modeling the Spread of HIV

Nicholas Bieno and Devan Clark

Abstract

The HIV epidemic in South Africa has caused life expectancy to significantly decrease since the 1990's. One major factor is the lack of knowledge on HIV and how to design control programs for it's spread. To compound this problem, new strains of HIV have appeared, even in the USA. We will be looking at the development of the AIDS epidemic in a homosexual population. We will focus on the progression and inevitable fatality rates of the HIV positive population.

Sexual Cannibalism

Eli Hartman, Kasper Kittredge, Orgho Neogi

Abstract

Female praying mantises have a reputation for eating the males after mating, an interesting phenomenon similarly observed in Black Widows and King Cobras. As the male is not always eaten, he has the opportunity to mate with other females. However, it has been observed that when the female does eat the male, she lays more than twice as many eggs than when she does not. Our goal is to model how this practice affects mantis populations, as well as determining which mating outcome, if any, is preferable.

Pressure on a star at different radii

Marshall Hobson-Ritz, Avery Lemons, Jay Marshall, Qingbao Wang

Abstract

A star requires pressure to keep from collapsing, which is generated by fusion in the star's core. When the star is at hydrostatic equilibrium, the pressure at a given radius will be constant, and will be zero at the surface. We will be examining a star that is at hydrostatic equilibrium, and we will need three differential equations to solve for the pressure within the star at a given radius.

Briggs- Rauscher reaction

Madeline Smith and Brendan Langmack

Abstract

Of the multitude of chemical reactions that can occur, rate laws to determine their reaction speed are based on differential equations and assumptions such as the law of mass action. Most reactions follow a 'direct' path in order to reach equilibrium, while other reactions oscillate and alternate between different paths en route to equilibrium. These oscillating reactions dependent on the initial concentrations present, which constitute an initial value problem in a mathematical model that is governed by the reaction mechanism.

These oscillating reactions, such as the Briggs- Rauscher reaction, have implications to understanding 'biological clocks' that are akin to human circadian rhythm or the chemical impulses in cardiac tissue that regulate heartbeat. In order to model reactions in chemistry, mathematicians often simplify differential models to make them more manageable. We will adopt this approach when analyzing the Briggs-Rauscher reaction. In the Briggs-Rauscher reaction oscillations in the concentrations of Iodine, Iodide, and I3- in complex with cause a periodic change in the color of the solution, which is visible by going from colorless to amber to dark blue. Then, we will look at different mathematical models used to model this reaction that are more complex to better understand the reaction.

Forced Mass on a Spring with Magnets

Brendan Conkle

Abstract

Based off of Lab 4.1 in Blanchard, Devaney, and Hall, I will be discussing a forced harmonic situation involving a mass hanging from a spring with two nearby magnets influencing it. In addition, there will be a forcing function represented by wind on the mass. I will numerically analyze this situation comparing it to when it is unforced and changing the influence and distance of the magnets from the mass.

Modeling A and H Stock Prices

Anna Stuiber, YuZhe Zheng, Yudong Zhang

Abstract

Investors are always looking for new, more accurate ways to predict future stock prices and determine which stocks are a good investment. The financial market is a place where mathematical theory and economic theory combine. The predator and prey model leads us to the simplest differential equation for predicting stock price in two markets, like in the Chinese stock markets. We will consider one company published in both A stock market and H stock market, we will compare the two different stock prices from different markets, and can use this to determine how much to buy and sell.