MAT6-236 Differential Equations
Presentation Abstracts
March 4, 2014

Evolution of Euler's Method

JT Thompson, Mason Chow, Tabitha Schneider, John Srodulski

Abstract

Euler's method is a first-ordered numerical approximation that can be used to graph a solution to ordinary differential equations (ODEs). Since Euler's method is first order, the global error of the approximation, *O*(dx), is proportional to the step size. We will explore how other methods have enhanced the approximation without decreasing the step size. In comparison to Euler's methods, we will look at the Midpoint method (first-ordered), Heun's method (second-ordered) and Runge-Kutta's method (fourth-ordered), and understand how each increasing order truncates the global error. To show the rate at which these methods increase efficiency, we will also compare error sizes of each method qualitatively. Lastly, we will gain insight as to how these methods were derived by relating them to the Taylor series.

SARS as an SIRD

Natalie Powell, Chris Gonzales, and Julian Figueroa

Abstract

In 2003, Severe Acute Respiratory Syndrome, a contagious disease caused by a coronavirus, began in Asia and swiftly spread through more than two dozen countries. Normally, epidemic modeling uses three variables to represent the population involved: Susceptible, infected, and recovered. In the case of SARS, a fourth variable must be accounted for: Dead. In our project, we engineer an altered SIR model, based on previous work with the system, as an SIRD model in order to graphically and analytically explain how and why this particular disease spread so quickly and catastrophically. We will focus on creating equations that accurately model the progression of the disease in a population.

Zombies through the years

Eric Andow and Lainey Drevlow

Abstract

Modern culture has a fascination with the zombie apocalypse. In recent years, the most popular franchise on the subject has been Robert Kirkman's *The Walking Dead*. While others have opined on Kirkman's literary merits, we decided to look at how the Kirkman version of the apocalypse would look as a differential equation. Using the SIRZ model as a basis, we will investigate how the rules that govern zombie reproduction affect their population model. We'll compare Kirkman's zombies to other famous examples, like George Romero's ghouls from *Night of the Living Dead*, and Richard Matheson's vampires in *I Am Legend*. We will explain how each of these variations affects the differential equation that models the spread of the zombie plague, and what this means for the future of humanity.

Solow-Swan Economic Growth Model

Thao Nguyen, Shannon Rantala, Aeint Ngon

Abstract

Long-run economic growth has always been a subject of interest for economists and policy makers. Using differential equations, the Solow-Swan model attempts to model long-run economic growth using capital accumulation, labor growth and increases in productivity. We will intuitively and mathematically derive the model and show some of the model's implications on economic policies. Moreover, we will apply the model in analyzing two countries' economic growth.

Modelling an Oscillating Chemical Reaction

J.T. O'Connor and Laura Wetzel

Abstract

Oscillating reactions are to chemistry as perpetual motion machines are to physics. While a typical reaction follows a relatively direct path to equilibrium, oscillators switch back and forth between two or more paths, depending on the concentration of an intermediate. If the intermediate has excited electronic states within the range of visible light, the solution will be observed to change color periodically. Like their physical counterparts, however, oscillating reactions are doomed to eventually reach equilibrium—the oscillations will slow and cease. We will examine the Briggs-Rauscher reaction, a classic chemical oscillator in which the relative concentrations of I^- and I_2 cause the color of the solution to fluctuate from colorless to amber, to dark blue.

Chaos

Ji Zhao and Ji Zhang

Abstract

If a dynamical system is sensitive to initial conditions, is topologically mixing and if its periodic orbits are dense, we can classify this system to be chaotic. An example of chaos in our everyday life is the smoke of cigarettes. We will introduce three tools to examine chaos: bifurcation diagram, Poincare map, and Lyapunov exponent. We will also talk about the idea of Poincare recurrence.