www.simiode.org
SIMIODE A SYSTEMIC INITIATIVE FOR MODELING INVESTIGATIONS & OPPORTUNITIES WITH DIFFERENTIAL EQUATIONS

STUDENT VERSION

Stopping Fake News

Blain Patterson | Sarah Patterson
Applied Mathematics
Virginia Military Institute
319 Letcher Avenue
Lexington, VA 24450 USA

Abstract: In modern society, creating and disseminating information is easier than ever. While this allows access to information on unprecedented scales, the validity of the information can be difficult to determine. Clickbait, propaganda, misleading headlines, biased news outlets, and social media posts all have the potential to fuel the wildfire of fake news [1]. In this project, you will model the spread of fake news and investigate ways to deter distributing misinformation.

Keywords: Fake news, SIR model, systems

Tags: Fake news, SIR model, SIS model, systems, sensitivity analysis, equilibrium, spreadsheets, MATLAB

STATEMENT

In modern society, creating and disseminating information is easier than ever. While this allows access to information on unprecedented scales, the validity of the information can be difficult to determine. In this project, you will model the spread of fake news and investigate ways to deter distributing misinformation.

One way to model the spread of disease is the SIR model. This models the flow of people between three states: susceptible (*S*), infected (*I*), and resistant (*R*), where *S*, *I*, and *R* each represent the number of people in each of those states. However, we can also model the spread of information using this same model. In this context susceptible would represent those who have not been exposed to fake news but are willing to believe it, infected would represent those who currently believe fake news, and resistant would represent those who are not willing to believe fake news. This latter case could be because they learned that the information was a hoax.

We can model the flow of people between these three states with the following system of differential equations.

$$\frac{dS}{dt} = -aSI \qquad (1)$$
$$\frac{dI}{dt} = aSI - bI$$
$$\frac{dR}{dt} = bI$$
$S(0) = S_0$; $I(0) = I_0$; $R(0) = R_0$

1. Interpret the meaning of each differential equation in this system.

2. What effect does each parameter (*a* and *b*) have on the model?

3. Research previous hoaxes to determine how they spread, the rate at which they spread, and how long before people realized it was a hoax. Choose the fake news you plan to model and determine appropriate parameters (*a* and *b*) and constants (S_0, I_0, and R_0) to model the spread of this news.

4. For a reasonable set of parameters, solve this system of differential equations (1) numerically using software of your choice (MATLAB, Excel, etc.) and include a graph showing the behavior of each population over time.
5. Based on the graph you created for Question 4, does this system appear to have any equilibrium values? What does that mean about the spread of fake news?

6. According to this model, is it possible for everyone in the population to believe this fake news?

Extension

What if after people realized something was a hoax, they were once again susceptible to being convinced that it was true? What would this mean about the population of resistant (R) people? Write a system of differential equations that models this interaction. We will call this the SIS model. Solve this system of differential equations numerically using software of your choice (MATLAB, Excel, etc.) to determine the behavior of each population over time. Which model, SIR or SIS, best describes how misinformation spreads?

Homework

Based on your results above, what do you think can be done to prevent or minimize the spread of misinformation? Write a one-page memo to the CEO of a particular social media or news outlet recommending changes that could be made to help stop or slow the spread of fake news.

REFERENCES

1. Vosoughi, Souroush, Db Roy, and Sinan Aral. 2018. The spread of true and false news online. *Science*. 359(6380): 1146-1151.