Abstract
Although infant mortality rates are falling in the United States, the U.S. still has higher infant mortality than comparable wealthy nations [1]. This study examined opinion formation regarding reproductive care for women to understand its effect on vulnerability to infant mortality. Using recent public opinion and health data, we found a compelling relationship between public opinion of reproductive health and infant mortality. Utilizing a Holmes and Newman network model, we used differential and bifurcation analysis to analyze changes in opinion and the rate at which opinion formation occurs in a social network. We concluded that the rate at which opinions change impacts opinion formation within a network and thus the vulnerability to infant mortality.

Dynamical System
We utilized the Holme and Newman model for opinion formation in networks when constructing our system of differential equations [4]. In this system [AA] = number of connections in the system between two nodes with opinion A, [BB] = number of connections in the system between two nodes with opinion B, and [AB] = number of connections in the system between a node with opinion A and a node with opinion B. Substituting \( u = ([AA] + [BB])/K, v = ([AA] - [BB])/K, \) and \( w = ([A] - [B])/N, \) with \( N \) number of nodes, \( K \) number of connections (edges), and \( \phi \) as the probability of changing opinion, we simplified the equations to be:

\[
\frac{du}{dt} = \frac{N}{K} (1 - v - \phi (1 - 2u + v^2))
\]

\[
\frac{dv}{dt} = \frac{K}{N} (1 - 2u) (1 - v - \phi (1 - 2u + v^2))
\]

\[
\frac{dw}{dt} = 2(1 - q) (1 - v - \phi (1 - 2u + v^2))
\]

Where we were able to find our set of critical points. The first set occurs when the probabilities of a node with opinion A becoming a node with opinion B, and vice versa, are equivalent. The final point occurs when there are no [AB] connections in the system, and [AB] = 0.

This system and critical points can be represented three dimensionally.

Assumptions
- N and K are constant values within the system
- No heterophily exists in the model (no connection formation with opposite node; Holmes-Newman model)

Motivation
Using data obtained from a CDC study that spanned from 2005 to 2016, we noticed that the rates of infant mortality varied greatly depending on the state and were higher than rates in peer countries [2]. We suspected that this may have been a result of the access to health care within communities across each state. To analyze this trend, we decided to look at the percentages of different opinions regarding the legality of abortion in each state because of the relationship between abortions, health care, and infant mortality found in a Religious Landscape study [3]. Plotting public opinion against infant mortality in the last two years, we saw there was a linear relationship between the two and used this relationship as the foundation of our vulnerability model.

Bifurcation
Eigenvalues corresponding to critical points (a) and (b):

\[ u = \frac{1}{2} (1 - 1)^2 + \frac{1}{2} (1 - 1)^2, \quad v = w, \]

\[ u = 1.0, \quad v = w \]

The curve is bounded by ±1 along the v = w axis. As shown by Figure 2, as \( u \rightarrow -1, \) fixed point (a) becomes a stable attractor. This indicates that all nodes converge to have the same opinion at this fixed point when \( y > 1. \) However, in Figure 3, when \( y < 1, \) fixed point (a) disappears within \( 0 \leq u \leq 1, \) and \( u \) converges at 1 while \( v \) and \( w \) do not change their values, and the point is unstable. This indicates that the network will split at this point distinctly into those with opinion A and those with opinion B, shown also by the fact that when \( u = 1, \) it is because \([AB] = 0.\)

Citations: