Zombie Mathpocolypse

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Abstract

Do you watch zombie movies? Have you ever wondered what will be the climax? Now you can use mathematics to figure out who will win. In this work we consider a mathematical model for zombie infection from the literature. The model consists of three ordinary differential equations for three classes Susceptible, Zombie and Removed. We will solve the model using numerical techniques such as the Euler's method and the Runge-Kutta methods.

Background

Within the pop culture and entertainment of society today, zombies dominate television shows, movies, books, and video games. But how did this idea of zombies come about? According to historians, the word zombie dates all the way back to the eighth century and is said to have originated from the word *nzambi*. In African language of Kongo this means 'spirit of a dead person', or from the word *zonbi*, which in Haitian Creole represents a person who has died and was then has been "brought back to life without speech or free will" (History of Zombies). According to Voodoo folklore, a large part of the Haitian culture, Bokors, or Voodoo priests that were interested in the study and application of black magic, maintained the power to resurrect individuals from the dead through the administration coup padre. This was a powder issued orally with the primary ingredient as tetrodoxin, which is the deadly substance that is found in the puffer fish. When someone has been given coup padre, their heart rate would slow to a near stop, breathing patterns would decline, and body temperature would reduce significantly. Those who were unaware of the process that which the individual had just undergone would take him or her for dead and bury them. Once buried, the Bokor would then unearth the individual while he or she were still alive. Even though the individual was considerably alive physically, he or she would not be mentally present – which resulted mindless drones emerging from the individual. From that point on the now zombie would go on living under the power of the Bokor until the death of the Bokor (History of Zombies).

Evidence of such zombies emerges from archaeology in the form of discovered corpses with decapitated heads or missing brains. Furthermore, bones found with human teeth marks point towards the victims of the cannibalism associated with these zombies (History of Zombies).

Although they may share characteristics with the sort of zombies mentioned above, modern zombies that we find today in pop culture and entertainment today do not come in the same way. Modern forms of literature portray zombies as victims of airborne viruses or mutated diseases. These illnesses tend to be widespread and often result in a pandemic within literature. As the population of zombies increase, many literary works utilize this idea that the zombie infection can be spread if an unaffected individual is bitten by a zombie. In this work, we will focus on these sort of pop culture zombies found in literature and the mass infection and apocalyptic circumstances associated with them (Tchuenche and Christinah).

The Basic Model

In this work we consider a model from chapter four of *Infectious Disease Modelling Research Progress.*

- **Susceptible(S)**: Refers to the general population who have remained free of infection
- **Zombie(Z):** Refers to those who have been infected
- **Removed(R)**: Refers to either those susceptibles who have been infected by a zombie, died, and are awaiting to resurrect or zombies who have been defeated by a susceptible
- **δ** : Individuals of the susceptible group who become deceased by natural causes (non-zombie-related causes) (S → R)
- **ζ** : Individuals of the removed class who resurrect and become zombies (R→ Z)
- **β** : Individuals of the susceptible class who become zombies through transmission of infection from a zombie (S→Z)
- α : Individuals of the zombie class who are terminated by means of head removal or destroying of the brain (Z→R)
- **Π** : Birth rate constant
- **N** : Total population without infection

In this model we will consider the outbreak of infection to take place over a short time span (30 days) so we will consider the birth rate and death rate by natural causes to be negligible.

Constants and Supporting Functions

$S(1) = N = 50$
$Z(1) = 1$
$R(1) = 0$
$\alpha = 0.005$
$\beta = 0.0095$
$\delta = 0$
$\zeta = 0$

$\Pi = 0$

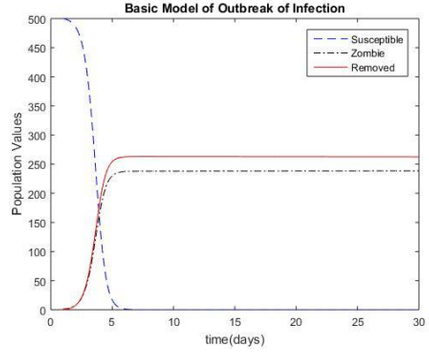
$$dS/dt = \Pi - \beta SZ - \delta S$$
$$dZ/dt = \beta SZ + \zeta R - \alpha SZ$$
$$dR/dt = \delta S - \zeta R + \alpha SZ$$

Numerical Method Used for Simulations

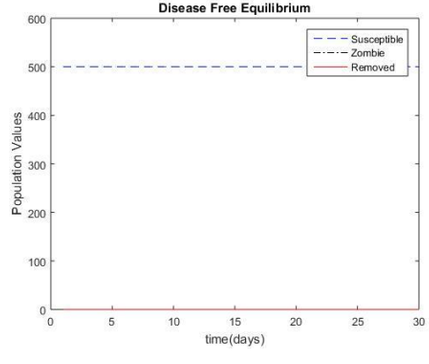
Euler's Method

n=0,1,2,3,..

- $Y_1 = Y_0 + h*f(x_0, y_0)$
- $Y_2 = Y_1 + h*f(x_1, y_1)$.
- $Y_{n+1} = Y_n + h*f(x_n, y_n)$



In this first graph, Basic Model of Outbreak of Infection, there are three different equations which can be looked at. First, the susceptible function, which represents the population of humans that are uninfected. Next, the zombie line, which represents those who have been infected and have turned into a zombie. Lastly, the removed line, which represents those who have been infected, turned into a zombie and defeated. As seen above, the population of susceptible people would last around six days before extinction. At this end point there would be approximately 238 zombies and 262 removed.



The graph above, Disease Free Equilibrium, shows the same scenario, but with a different initial condition. In the Outbreak of Infection graph, the initial condition of one infected zombie was used. However, in this graph, this condition was set to zero. As seen above, when there is no initial zombie, the populations will remain the same throughout the thirty day period.

References

1. Tchuenche, Jean Michel., and Christinah Chiyaka. Infectious Disease Modelling Research Progress. New York: Nova Science, 2009. Web.
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4. "Zombies, Vampires and Stockbrokers: New TV & Movies Available To Stream." *Screen Rant*. N.p., 01 Oct. 2015. Web. 12 Apr. 2016. <http://screenrant.com/zombies-vampires-stockbrokers-new-movies-tv-available-stream/?view=all>