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Executive Summary
Problem A: Group Affinity and Fashion Sense

Introduction:

We often find that societies influence behavior, and how we style our appearance is one such behavior that can change based on the people we interact with. For example, the style of fashion that characterizes the appearance of a typical hipster originated as an attempt to oppose mainstream fashion but was quickly adopted by similar minded people and those who enjoyed the aesthetics of the emerging new style to become as widespread and popular as it is today. Inspired by this prompting scenario, we focused on creating a model for the prevalence of some style of appearance or fashion trend that changes within a population over time as people choose to adopt or abandon the style. We determined what the eventual general outcome would be for any fashion trends, as well as the outcomes of three hypothetical scenarios.

Assumptions:

When determining our model, we thought about how the spread of fashion styles within a population can act similarly to the spread of a contagious disease. Those who conform to the style in question are “infected” with that fashion style, and those who do not conform to that style are susceptible to adopting that style (thus catching the infection) after interacting with someone who does wear the style. Since appearance is a visual characteristic, we’ll define an interaction to be when one person with the style and another without the style see each other in person or when the person without the style sees images of the other via social media. We shall assume that each individual has the same number of interactions per month and that the likelihood of adopting the style is the same for each individual.

It is also possible for someone who is infected with the fashion style to abandon the style, removing them from the infected population, but it does not make them immune to ever adopting the style again in the future. Thus, we will also make the assumptions that the likelihood of abandoning the style is the same for each individual and there is no limit to the amount of changes in style an individual can undergo. Some additional assumptions are that there is no time delay in changes and the total population is constant.

The Model:

Because we have decided to model the spread of fashion styles similar to the spread of diseases, we will base it on the SIS compartmental model:

$$\frac{ds}{dt} = -\beta si + \gamma i$$
$$\frac{di}{dt} = \beta si - \gamma i$$

where s is the proportion of the total population that is susceptible to adopting the style of fashion in question ($0 \le s \le 1$), i is the proportion of the total population who have the fashion style ($0 \le i \le 1$), β is the average rate at which an interaction between a susceptible individual and an individual with the style results in the susceptible individual adopting the style $(0 \le \beta \le 1)$, γ is the average rate at which those with the style abandon and stop wearing it $(0 \le \gamma \le 1)$, and $s + i = 1$ is the total population.

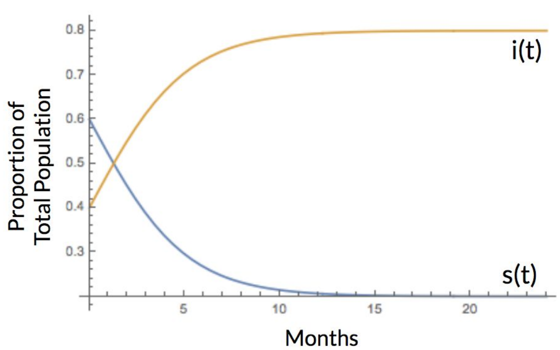
In general, this model will approach the steady state of $s(t) = \frac{\gamma}{\beta}$ and $i(t) = 1 - \frac{\gamma}{\beta}$. When $\gamma \ge \beta$, this steady state is $s(t) = 1$ and $i(t) = 0$ which represents the fashion style completely dying out. Note that this steady state depends only on γ and β, the rates at which the style is abandoned and adopted, respectively. Thus, for any particular γ and β, the system will always reach the same steady state no matter what the starting population proportions are, though it may just take longer to reach the equilibria if the starting proportions are quite different from the equilibria.

Results:

Applying our model to three hypothetical scenarios, we saw the following results.

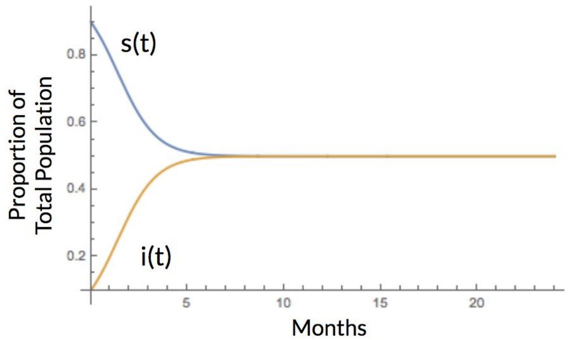
Scenario 1: $\beta = 0.5$, $\gamma = 0.1$, $s(0) = 0.6$, and $i(0) = 0.4$

We can see from the plot of this scenario below that the population of those with the fashion style overtakes the population not conforming to the style to approach equilibria of $s(t) = 0.2$ and $i(t) = 0.8$, and it takes about 10 months to get near the equilibria. Such a scenario represents a fashion style that is already fairly popular and is adopted much more often than it is abandoned.



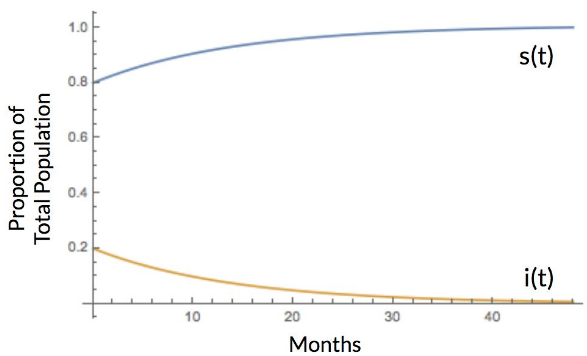
Scenario 2: $\beta = 0.4$, $\gamma = 0.2$, $s(0) = 0.9$, and $i(0) = 0.1$

We can see from the plot of this scenario below that the population of those with the fashion style and the population not conforming to the style approach the same equilibria of $s(t) = 0.5$ and $i(t) = 0.5$, and it takes about 7 months to get near the equilibria. Such a scenario represents a fashion style that starts with a more obscure presence but gains popularity at a slower growth in popularity than before, but it still ends up infecting half the total population with the style fairly quickly.



Scenario 3: $\beta = 0.01$, $\gamma = 0.083$, $s(0) = 0.8$, and $i(0) = 0.2$

We can see from the plot of this scenario below that the population of those with the fashion style dies out over time and approaches equilibria of $s(t) = 1$ and $i(t) = 0$, and it takes about 30 months to get near the equilibria. This scenario represents a fashion style that is a bit more popular to start with than the style in the previous scenario, but it is losing popularity over time to eventually die out completely.



Discussion:

There are some aspects of the spread of fashion styles that we would have liked to investigate further and incorporate into our model if we were given more time to do so. One aspect is how external influence can convince a person to adopt a style such as advertisements or popular media like television. Another thing we'd like to research further is what the rate of adoption is for specific fashion styles based on empirical data.

References:

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