AN ALTERNATIVE MODEL HITTING THE RUNWAY

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SCUDEM IV Problem A

Background

- People tend to allocate themselves into certain schemes and sects.
- All subgroups of the entire population tend to intermingle and conform to some sort of ideal that encompasses their values.
- One example of such a subgroup would be the hipsters with how they tend to dress and act like one another.

The Problem

- The problem at hand is to examine the propensity of a person in an established group to alter their appearance and conform to expectations over time.
- How long does it take for this change to occur?
- How many people will change and how uniform will the group begin to appear?

Goals

- Describe which factors are being changed within the test group.
- Describe the transfer of information within the test group.
- Describe how the model imitates true human interaction.
- Fully describe the changed factors and how their numerical counterparts are interrelated.

Idea

- Fashion trends most likely spread through the population mimicking an infectious disease.
- The reasoning behind this is that both circumstances tend to operate on the same time scale and are greatly influenced by an individual's interaction with others.

The SIR Model[1]

Differential Equations

- $\frac{dS}{dt} = -\beta SI$
- $\frac{dI}{dt} = \beta SI - \gamma I$
- $\frac{dR}{dt} = \gamma I$
- $N = S + I + R$

Variable Definitions

- N – entire population
- S – susceptible individuals
- I – infected individuals
- R – infected individuals that recovered
- β – contraction probability rate
- γ – recovery rate

Updated Model Assumptions

- N instead represents the population of the specified subgroup alone.
- The changing rate β depends on four predetermined factors:

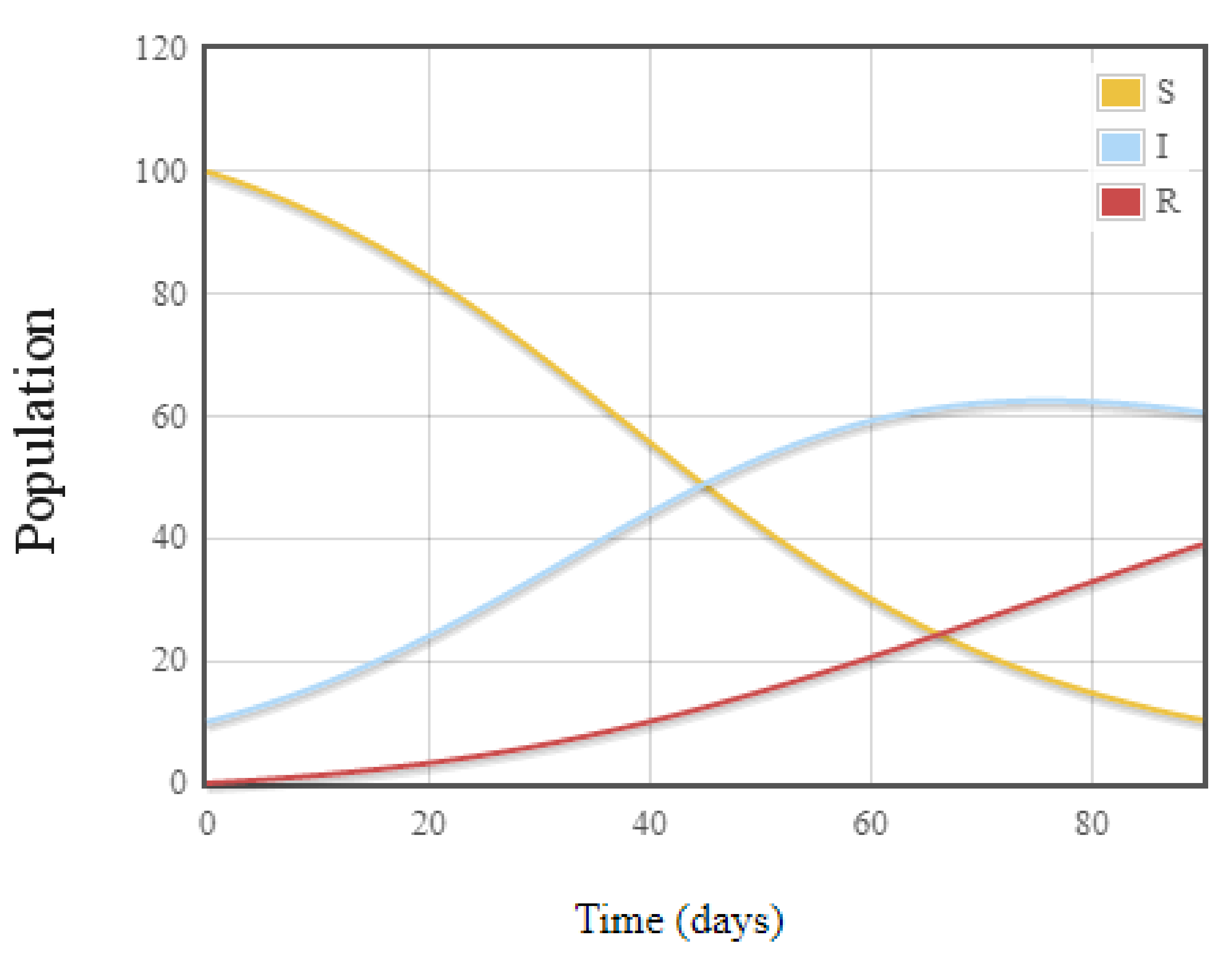
1. Age (*a*)
2. Social Class (*s*)
3. Personality (*p*)
4. Popularity (*pop*)

Numerical Signage

Factors	Low Risk (0 – 0.6]	Medium Risk [0.7 – 1.2]	High Risk [1.3 – 2)
Age (years)	41-60	0-20	21-40
Social Class	Indigent	Middle Class	Wealthy
Personality	Introvert	Extrovert	Ambivert
Popularity	1-3 close friends	4-6 close friends	7-9 close friends

Application of Updates

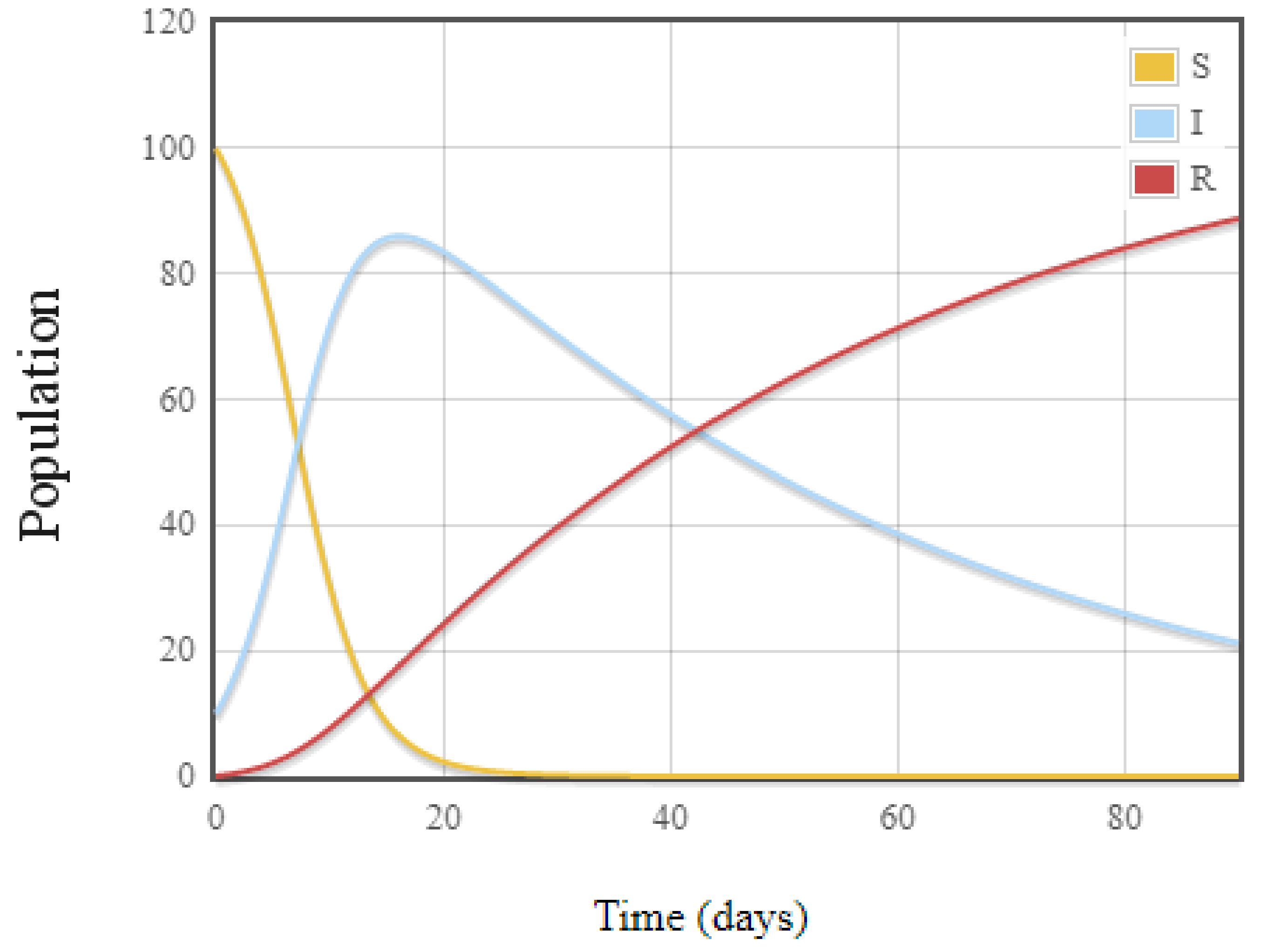
- $\beta = a^{1/2} * s * p * pop^{1/2}$; $a < 1,\ pop < 1$
- $\beta = a^{2} * s * p * pop^{2}$; $a > 1,\ pop > 1$
- $\gamma = \beta^{-1}$; $\beta > 1$
- $\gamma = \beta\ * 20\%; \beta < 1$
- Age and popularity were altered due to how they were considered to hold more significance over the outcome of the model.



ANALYSIS OF EXAMPLE DATA FOR LOW RISK INDIVIDUALS [2]

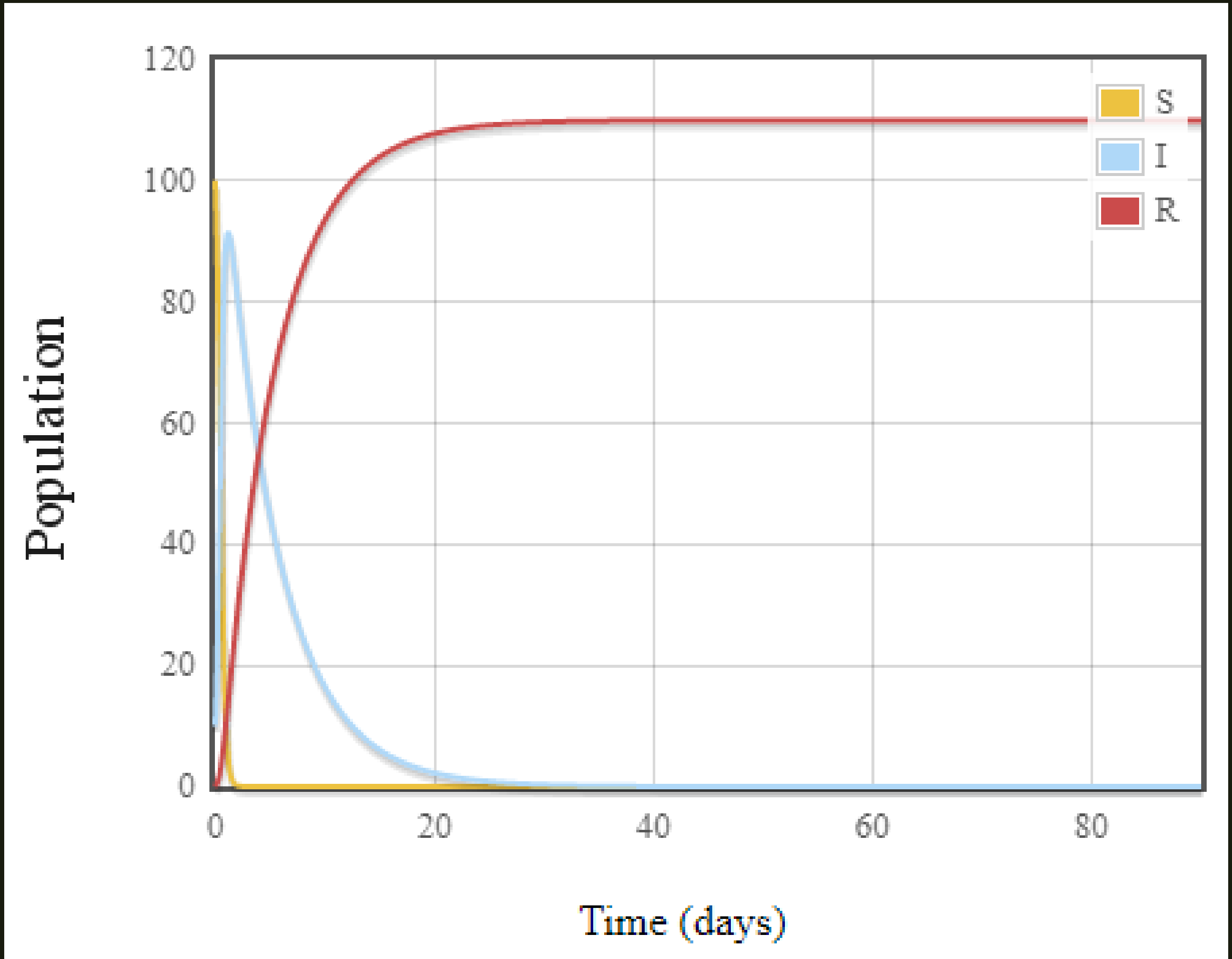
- In this example, all parameters were set to 0.4, which corresponds to an individual group of people who are at low risk for changing subgroups.

- $\beta = 0.4^{1/2} * 0.4 * 0.4 * 0.4^{1/2} = 0.064$
- γ = 0.064 ∗ 20% = 0.001



ANALYSIS OF EXAMPLE DATA FOR MEDIUM RISK INDIVIDUALS [2]

- In this example, all parameters were set to 0.7, which corresponds to an individual group of people who are at medium risk for changing subgroups.
- $\beta = 0.7^{1/2} * 0.7 * 0.7 * 0.7^{1/2} = 0.343$
- γ = 0.343 ∗ 20% = 0.01



ANALYSIS OF EXAMPLE DATA FOR HIGH RISK INDIVIDUALS [2]

- ❑ In this example, all parameters were set to 1.3, which corresponds to an individual group of people who are at high risk for changing subgroups.

- ❑ $\beta = 1.3^2 * 1.3 * 1.3 * 1.3^2 = 4.83$
- ❑ $\gamma = 4.83^{-1} = 0.21$

Conclusions

- Under a given set of parameters the number of "infected" individuals always spikes before leveling off when the trend fades away.
- This mirrors the original idea/hypothesis that the spread of fashion trends amongst the population often spread much like an illness through contact.

Limitations

- The model's assumptions and generalizations may work for the majority, but not necessarily for the individual.
- However, likening the spread of an illness to the spread of a fashion trend is an adequate start.
- Further development and research is needed to acquire practical data for realistic applications.

References

- [1] Keeling and Rohani. Introduction to simple epidemic models.
- [2] http://www.public.asu.edu/~hnesse/classes/sir.html, accessed November 2019.

QUESTIONS?