MATHEMATICAL MODELLING: EPIDEMIOLOGY SIR AND SEIR SYSTEMS

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WHY IS EPIDEMIOLOGICAL MODELLING IMPORTANT?

- Represents the knowledge and assumptions about disease transmission
- Statistical methods are endorsed to estimate key parameters from data, test hypotheses, and make predictions of epidemics
- Important during disease outbreaks, giving insight on transmission dynamic, which grants good control and preventative measures
- Modelling offers a mode of comparison, ultimately leading to critical decisions during outbreaks

SIR SYSTEMS

- An SIR model is an epidemiological model that computes, in theory, the number of people infected with a contagious in a closed population.
- $S = S(t)$, the number of susceptible individuals in a closed population
- $I = I(t)$, the number of infective individuals in a closed population
- $R = R(t)$, the number of recovered individuals in a closed population

SIR (CONT'D)

- SIR Models has associated compartments, representing the rate corresponding to each population/ group

$$\frac{dS}{dt} = -\beta SI$$

$$\frac{dI}{dt} = \beta SI - \gamma I$$

$$\frac{dR}{dt} = \gamma I$$

SEIR MODELS

- An SEIR Model is an epidemiological model, which is similar to SIR, however it introduces an ”exposed” state. In this model, an initially susceptible individual who succumbs to the disease is considered “exposed.”
- S= S(t), the number of susceptible individuals in a closed population
- E = E(t), the number of exposed individuals in a closed population
- I = I(t), the number of infective individuals in a closed population
- R = R(t), the number of recovered individuals in a closed population

SEIR MODEL (CONT'D)

- SEIR Compartments:

$$\dot{S}(t) = -\frac{\beta}{N} I(t) S(t)$$

$$\dot{E}(t) = \frac{\beta}{N} I(t) S(t) - \varepsilon E(t)$$

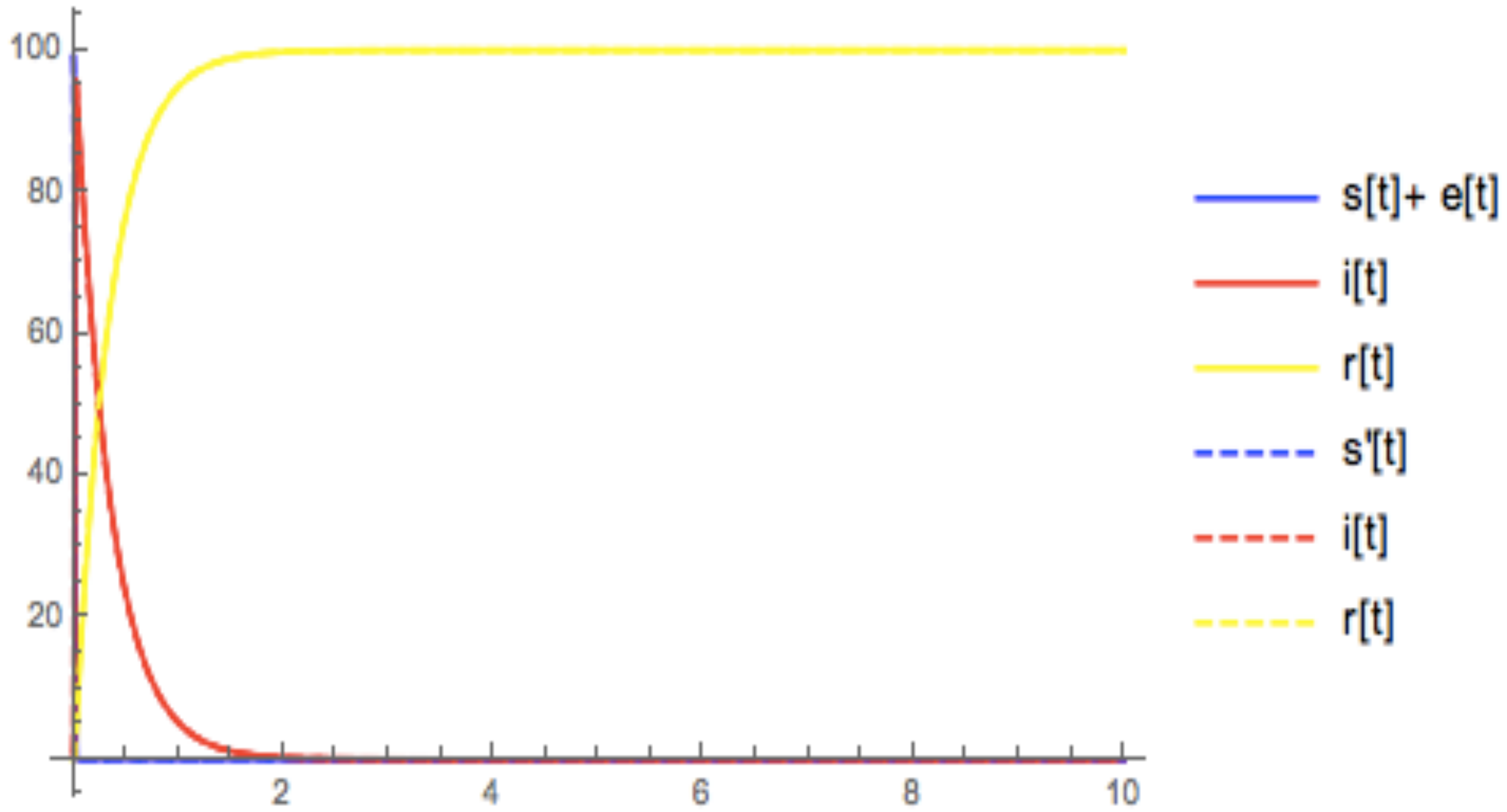
$$\dot{I}(t) = \varepsilon E(t) - \gamma I(t)$$

$$\dot{R}(t) = \gamma I(t)$$

RESULTS

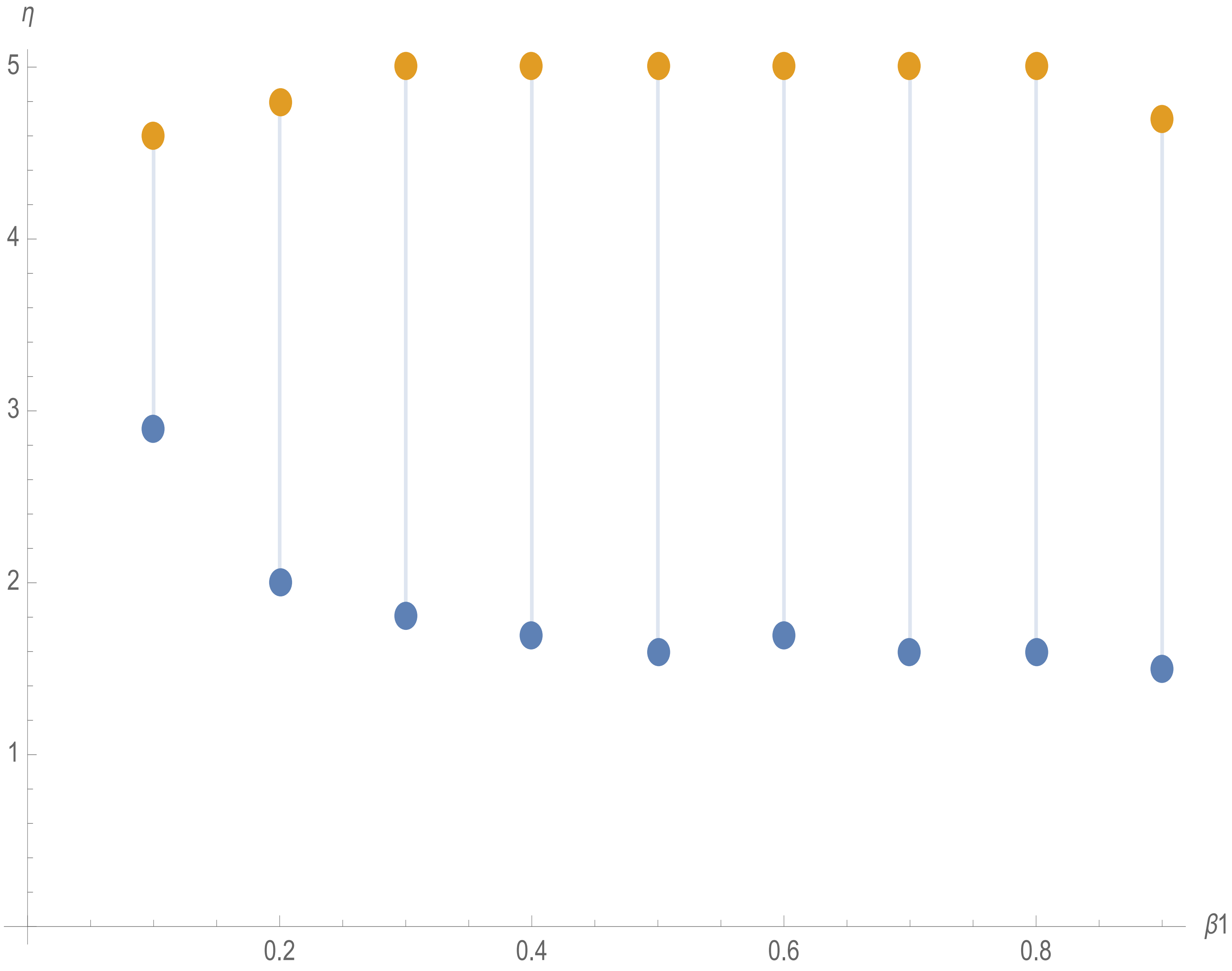
- Experimental analysis
- Eta is growing exponentially faster than beta values
- “E” (Exposed) population depletes

MyGraphsBoth[5.0, 3.0, 625.0, 10]



RESULTS:

- Highlights explicit Beta1 values, where both SIR and SEIR models look the same
- Beta for SIR Model was fixed at 0.1
- Beta1 and Eta values for SEIR was evaluated (Integrated) to give us an idea of when both systems are practically identical
- "For Loop Analysis"



SUMMARY:

- To study the outcome of SIR and SEIR Models
- Determine when their results (graphs, population) are indistinguishable
- Use a mathematical approach (integration, analysis) to find a best fit for both, SIR and SEIR Models
- Study the associated parameters of each system to find a correlation, which will ultimately contribute to the objective of the study

WORK CITED

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