# Understanding how Ideas Spread over Twitter using Epidemiological Models

Presentation

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# Outline

# Introduction

- **Model:** We will use a compartment model similar to the SEIZ model (Susceptibles Exposed Infectives Skeptics) in order to describe how stories spread on Twitter. We will divide the susceptible population into 2:
  - $S_1$: susceptible population which has not been infected by 'similar' topics in the past.
  - $S_2$: susceptible population which has been infected by 'similar' topics in the past.
- **Goal:** Determine to what extent having a good understanding of $S_2$ (size, contact rates, etc) can help us better model and potentially predict how an idea will spread on Twitter.
  - **Possible Applications:** Marketing analysis, rumor detection.

# Bettencourt et al.

- In their paper Bettencourt et al. developped the SEIZ model to describe the adoption of the Feynman diagrams by the scientific community around the world. This model introduced an exposed state and a skeptic state.
  - $Z$: The skeptic state describes a part of the population that does not believe in the the information and will not react to it.
  - $E$: The exposed state accounts for the part of the population which have been exposed to the information but takes some time before they begin to believe/react to it.

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  - $E$: The exposed state accounts for the part of the population which have been exposed to the information but takes some time before they begin to believe/react to it.
- In this paper, they showed that the SEIZ model was the one that was able to best capture the dynamics in the spread of the Feynmann diagrams across the scientific community. Out of the different epidemiological models they tested, this one yielded the best fits.

# Fang Jin et al.

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- Their results also allowed them to define a ratio $R_{SI}$, which they believe can measure how likely a story is to be a rumor or a true story.

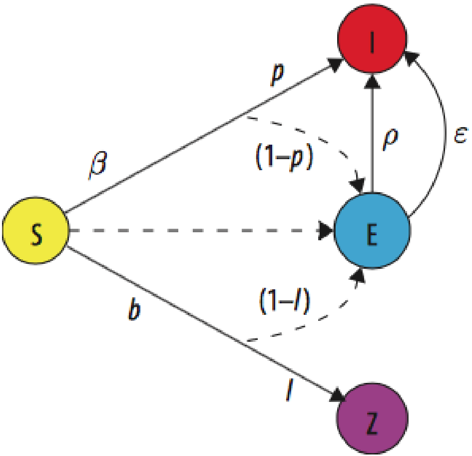
# SEIZ model (equations)

$$
\begin{aligned}
\frac{dS}{dt} &= -\beta S \frac{I}{N} - bS\frac{Z}{N} \\
\frac{dE}{dt} &= \beta(1-p)S\frac{I}{N} + b(1-l)S\frac{Z}{N} - \rho E\frac{I}{N} - \epsilon E \\
\frac{dI}{dt} &= \beta p S\frac{I}{N} + \epsilon E + \rho E\frac{I}{N} \\
\frac{dZ}{dt} &= blS\frac{Z}{N}
\end{aligned} \tag{1}
$$

$$N = S + E + Z + I \qquad 0 \leq m < p \leq 1$$

$$0 \leq l \leq 1 \qquad \frac{dN}{dt} = 0$$

# SEIZ model (graph)



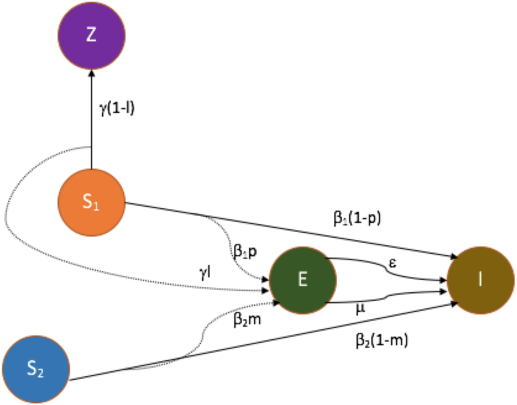
# Modified SEIZ (equations)

$$
\begin{aligned}
\frac{dS_1}{dt} &= -\beta_1 S_1 \frac{I}{N} - \gamma S_1 \frac{Z}{N} \\
\frac{dS_2}{dt} &= -\beta_2 S_2 \frac{I}{N} \\
\frac{dE}{dt} &= \beta_1 p S_1 \frac{I}{N} + \beta_2 m S_2 \frac{I}{N} + \gamma l S_1 \frac{Z}{N} - \mu E \frac{I}{N} - \epsilon E \\
\frac{dI}{dt} &= \beta_1 (1-p) S_1 \frac{I}{N} + \beta_2 (1-m) S_2 \frac{I}{N} + \epsilon E + \mu E \frac{I}{N} \\
\frac{dZ}{dt} &= \gamma (1-l) S_1 \frac{Z}{N}
\end{aligned}
\tag{2}
$$

with,

$$\frac{dN}{dt} = 0 \quad \text{and} \quad m, p, l \in [0,1] \quad \text{with} \quad m < p$$

# Modified SEIZ (graph)



# Blocks

### Block Title

You can also highlight sections of your presentation in a block, with it's own title

### Theorem

*There are separate environments for theorems, examples, definitions and proofs.*

### Example

Here is an example of an example block.

# Summary

- The first main message of your talk in one or two lines.
- The second main message of your talk in one or two lines.
- Perhaps a third message, but not more than that.

- Outlook
  - Something you haven't solved.
  - Something else you haven't solved.

# For Further Reading I

A. Author.
*Handbook of Everything*.
Some Press, 1990.

S. Someone.
On this and that.
*Journal of This and That*, 2(1):50–100, 2000.