MAPPADEMICS

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To what extent are we able to use a computer model to determine an optimum response to epidemics?

3 GOOD HEALTH AND WELL-BEING

Aims and Objectives

✅ **Localisation**

Malaysian-specific statistics for added relevance and accuracy, promoting SDG 3 (Good Health and Wellbeing) within the country

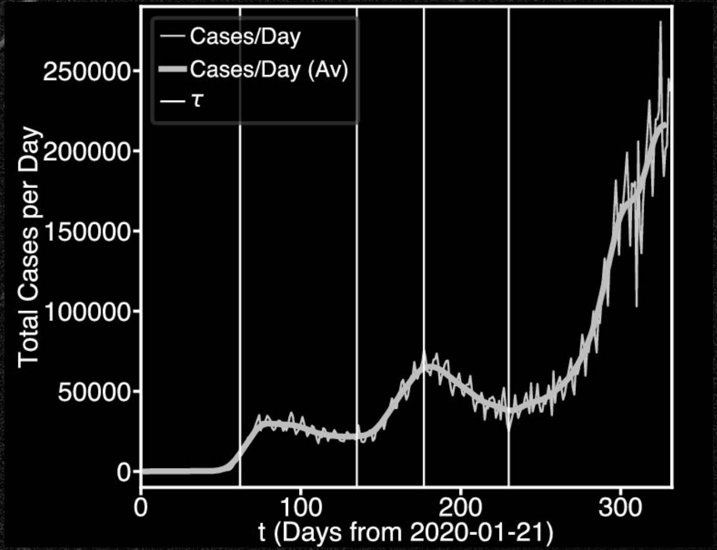
✅ **Real-World Applications**

Model can be used to track/model a variety of different diseases in different areas, improving SDG 3 all over the world

✅ **Easily Accessible and Useful**

To show how epidemics come to be and to provide a visually engaging and easy-to-understand way and for people to understand how to stop them

Existing Models



Limitations

❌ Lack of interactivity and visual elements

❌ Mathematically challenging to understand

❌ Created with a more generalised perspective, as compared to a specialised “by country” perspective

https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.nature.com%2Farticles%2Fs41598-022-07487-8&psig=AOvVaw3TyBfKIhqC_n6iQAbiLesw&ust=1731076693123000&source=images&cd=vfe&opi=89978449&ved=0CBcQjhxqFwoTCKiP1Ky5yokDFQAAAAAdAAAAABAE

Inspirations

Simulating a Pandemic - a video by 3Blue1Brown

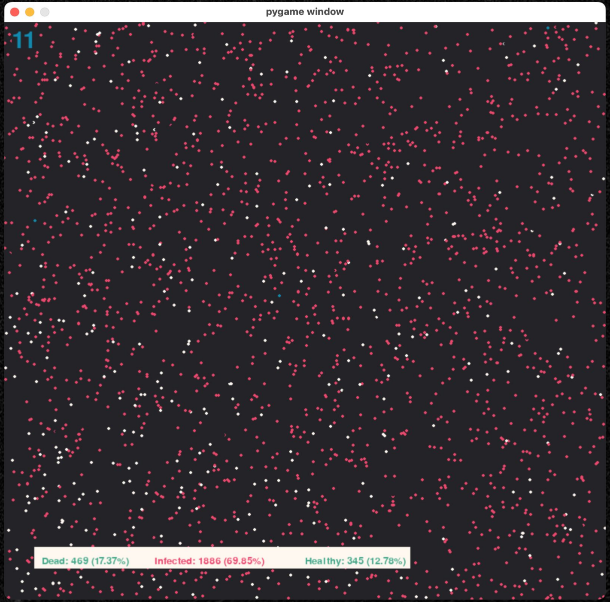
An abandoned project based off a YouTube tutorial

The effects of the COVID-19 pandemic

The hope for improved healthcare for all

Improvements to our Model

Our model is inspired by the simulation of disease spreading, except it is modified to a Malaysian specific context. We also include the use of masks and vaccines.



```python
def infect_people(self):
    for c in self.grid.cells:
        states = [p.state for p in c.people]
        if states.count("infected") == 0:
            continue
        people_in_area = []
        for index in c.get_neighboring_cells(self.grid.n_rows, self.grid.n_cols):
            people_in_area += self.grid.cells[index].people
            infected_people = [p for p in people_in_area if p.state == "infected"]
            healthy_people = [p for p in people_in_area if p.state == "healthy"]

            if len(healthy_people) == 0:
                continue
            for i in infected_people:
                for h in healthy_people:
                    dist = math.sqrt((i.x-h.x)**2 + (i.y-h.y)**2)
                    if dist < self.infect_dist:
                        if random.uniform(0,1) < self.prob_catch:
                            h.get_infected(self.recover_time)

def summarize(self):
    time_index = range(1,len(self.record)+1)
    infected = [r[0] for r in self.record]
    dead = [r[1] for r in self.record]

    newly_dead = [0]
    for i in range(1,len(dead)):
        newly_dead.append(dead[i] - dead[i-1])
    newly_dead = moving_average(newly_dead, 20)
    newly_dead = newly_dead[:len(time_index)]

    fig, ax = pyplot.subplots()
    ax.plot(time_index, infected, color = "red")
    ax.set_xlabel("Period")
    ax.set_ylabel("People currently infected", color = "red")

    ax2 = ax.twinx()
    ax2.plot(time_index, newly_dead, color = "black")
    ax2.set_ylabel("20 period moving average of fatalities", color = "black")
    pyplot.show()
```

How It Works: Our Code

- Uses grids to minimise processing
- Summarises the process to create a graph
- Can be run on any computer

Selection of Regions

Kuala Lumpur

Population density: 8500 people per km^2

https://jknselangor.moh.gov.my/hsis/images/covid19/Panduan-Pesakit-Covid19-di-HSDG-BM/Kit Covid-19_EN.pdf

Kuching

Population density: 750 people per km^2

Georgetown

Population density: 2600 people per km^2

A wide range of data...

Diseases Selected

Influenza A

Tracking common epidemics

COVID-19

Tracking newly discovered diseases

Measles

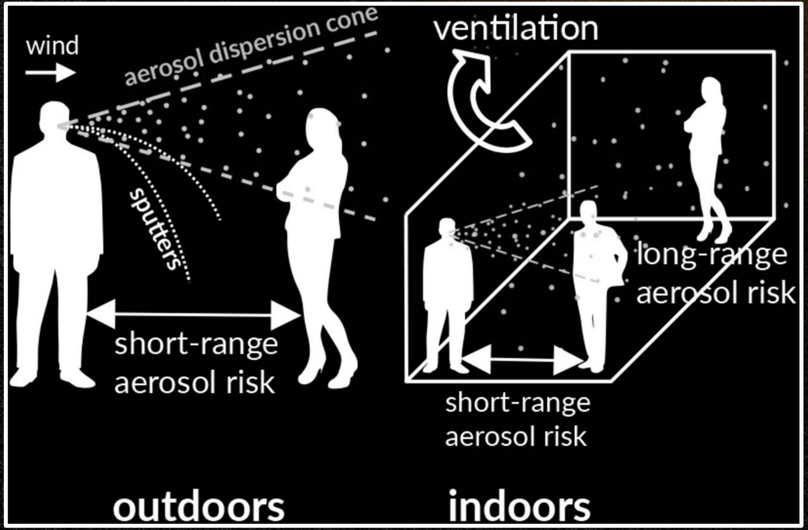
A case study on the crucial role of vaccines

Plague

Worst-case scenario (biosecurity!)

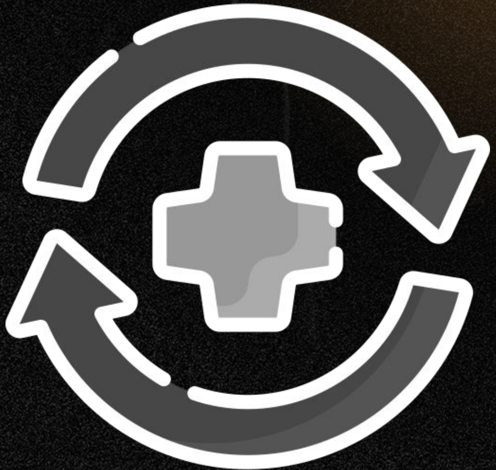
Variable: Infection Distance

How far a disease can spread from the first infected person; can travel through air droplets from coughing and sneezing



Variable: Recovery Time

Average length of time between a person getting infected and the body fighting off the disease



Variable: Immunity Time

Average length of times antibodies specific to the disease remain in the body, preventing one from further illness

Variable: Infection Probability

Likelihood of catching a disease when one is exposed to an infected person

Variable: Probability of Death

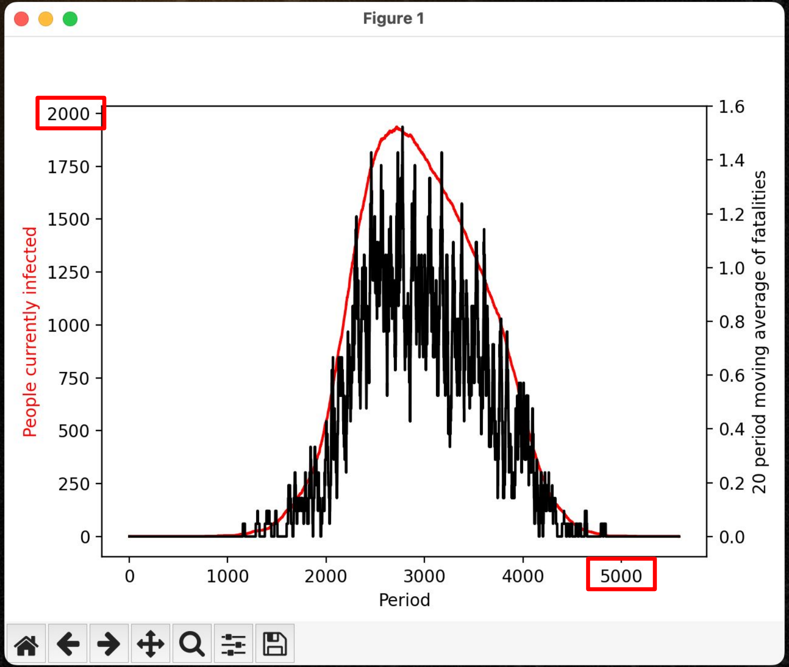
Probability for an infection to become fatal for the infected

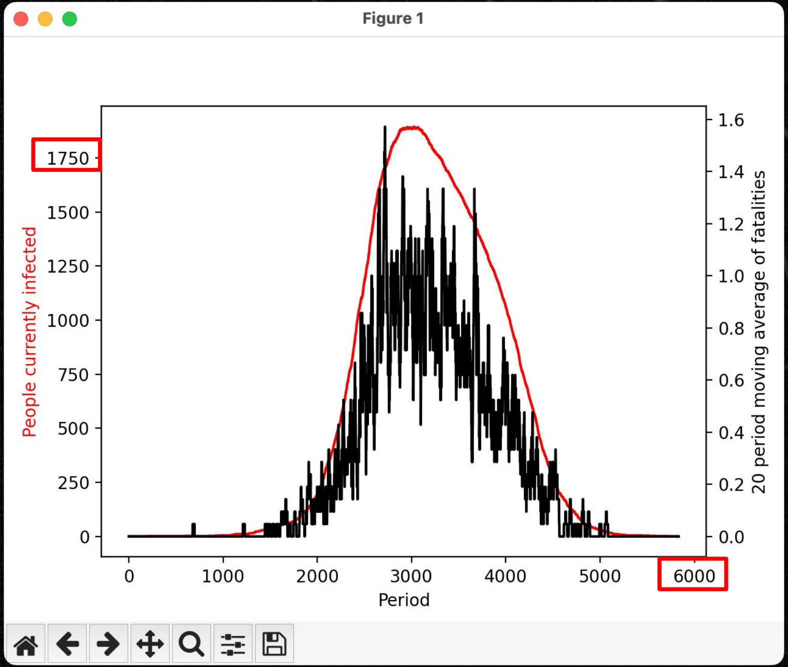
Statistics

	Influenza A	COVID-19	Pre-Vaccine Measles	Post-Vaccine Measles	Plague
Recovery Time	10 days (1750 frames)	20 days (3500 frames)	20 days (3500 frames)	12 days (2100 frames)	20 days (3500 frames)
Immune Time	18 months (94500 frames)	4 months (21000 frames)	Lifelong	Lifelong	~1 year (80000 frames)
Infection Probability	0.2	0.2	0.9	0.7	0.9
Death Probability	0.0005	0.001	0.0025	0.001	0.0015

https://www.webmd.com/cold-and-flu/flu-statistics
https://www.webmd.com/covid/covid-recovery-overview
https://www.who.int/news-room/fact-sheets/detail/measles
https://my.clevelandclinic.org/health/diseases/4335-influenza-flu

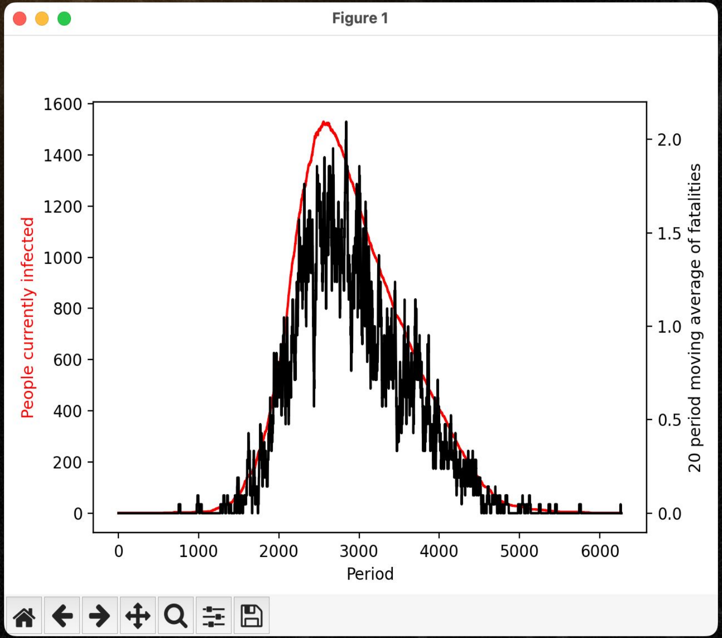
Mask Feature

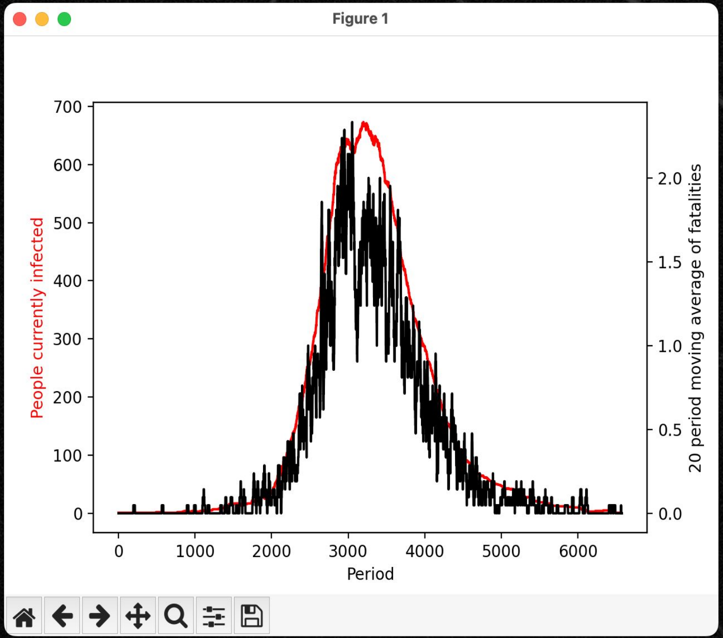




Flattening the curve works (with and without masks enabled)

Vaccinations





Flattening the curve works (pre-vaccine and post-vaccine)

Limitations and Future Developments

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Other Variables

Increase in population, viral mutation, quarantine, vaccinations, and other government-related responses are not included in the model

Assumptions

Masks being enabled assumes that 100% of the population wears masks correctly

Proportionalities

City size, population density and R_0 values could all be made more realistic and mathematically accurate

Community-Community Interaction

City size, population density and R_0 values could all be made more realistic and mathematically accurate

Thank You

The Mappademics Team

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