Final project proposal: Covid-19 infection rate simulation

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Project Github:
https://github.com/kentchen831213/2022Spring_Finals

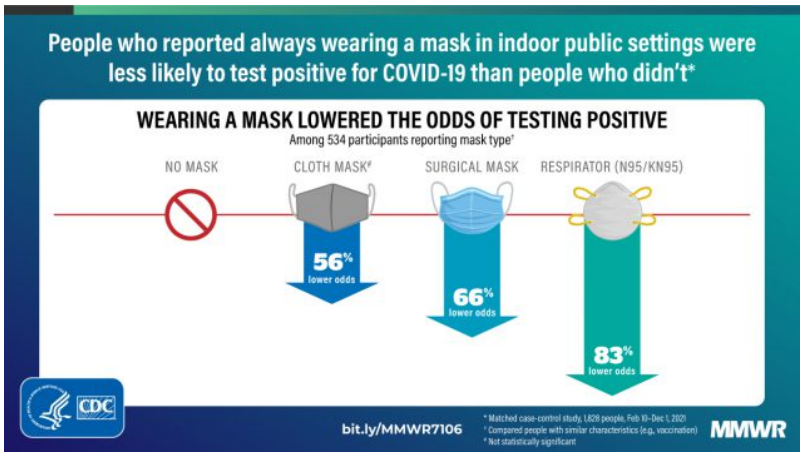
Project type: Type I

In week 7's introduction to the Monte Carlo simulation, we are asked to think of how the simulation created by Washinton Post can be improved. (https://www.washingtonpost.com/graphics/2020/world/corona-simulator/)

Originality-wise, we found another similar simulation adding facemask as an additional variable. (https://www.healthdata.org/acting-data/why-we-must-continue-wearing-masks-and-social-distancing)

Despite the previous attempt are trying to improve the accuracy of simulation, we still consider there is still room for improvement. Our final project intends to extend the efforts based on the previous 2 examples and tried to add more variables to the simulation model. We plan to add a probability of protection by wearing a facemask or receiving the vaccination. Another configuration we attempt to realize is a delayed infection based on the fact that people getting infected will not show symptoms after a few days.

- The probability of wearing different masks to block infection



Source: https://www.cdc.gov/mmwr/volumes/71/wr/mm7106e1.htm
* Only single mask probability available, cannot add the factor of double-masked, graphically displayed data only.

- Taking the vaccinated population into consideration given the current vaccination rate, especially the vaccine's effectiveness against Covid variants:

	Effectiveness at preventing											
	Ancestral		Alpha		Beta		Gamma		Delta		Omicron	
Vaccine	Severe disease	Infection	Severe disease	Infection	Severe disease	Infection	Severe disease	Infection	Severe disease	Infection	Severe disease	Infection
AstraZeneca	94%	63%	94%	63%	94%	69%	94%	69%	94%	69%	71%	36%
CanSino	66%	62%	66%	62%	64%	61%	64%	61%	64%	61%	48%	32%
CoronaVac	50%	47%	50%	47%	49%	46%	49%	46%	49%	46%	37%	24%
Covaxin	78%	73%	78%	73%	76%	72%	76%	72%	76%	72%	57%	38%
Johnson & Johnson	86%	72%	86%	72%	76%	64%	76%	64%	76%	64%	57%	33%
Moderna	97%	92%	97%	92%	97%	91%	97%	91%	97%	91%	73%	48%
Novavax	89%	83%	89%	83%	86%	82%	86%	82%	86%	82%	65%	43%
Pfizer/BioNTech	95%	86%	95%	86%	95%	84%	95%	84%	95%	84%	72%	44%
Sinopharm	73%	68%	73%	68%	71%	67%	71%	67%	71%	67%	53%	35%
Sputnik-V	92%	86%	92%	86%	89%	85%	89%	85%	89%	85%	67%	44%
Other vaccines	75%	70%	75%	70%	73%	69%	73%	69%	73%	69%	55%	36%
Other vaccines (mRNA)	91%	86%	91%	86%	88%	85%	88%	85%	88%	85%	67%	45%

  Source:
  https://www.healthdata.org/covid/covid-19-vaccine-efficacy-summary
  Details of how data aggregated:
  https://www.healthdata.org/special-analysis/omicron-and-waning-immunity
  *A manually converted CSV is now available on Github project page
  https://github.com/kentchen831213/2022Spring_Finals

- A delayed infection
  This is to reflect the fact that the infection symptom will not show immediately after contact. A timer to simulate an incubation period of infection.

Hypothesis 1:
Assume wearing a facemask is mandated, a sweet spot for vaccination coverage rate exists

Hypothesis 2:
Assume a fixed infection rate and the vaccination coverage rate, the minimum number ratio for the population to wear a mask

Hypothesis 3:
Travel bans help mitigate the spread of infection

Hypothesis 4:
Will vaccine effectiveness degradation effect curve-flattening?

Other known technical challenges:

Simulation times:
If we choose graphical simulation, the estimated simulated time would be stretched to the unacceptable waiting time when we scale up the simulation cycles.

Protection probability for both facemask and vaccination:
Though we know having both measures increases protection from viruses, the probability can neither be additive nor multiplicative for evaluating the effectiveness of both. It is a dilemma for us to think of both as an independent event.