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Examination of the Appropriate Time of Movement Restriction of People in COVID-19

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1. Introduction

COVID-19 is spreading worldwide, in major cities in Japan, the government set up a countermeasures headquarter from March 25, 2020, issued an emergency declaration from April 8, and canceled it on May 25. The declaration of emergency restricted The movement of people and temporarily stopped the spread of infection. In this study, we examine when the govermment shoud limit the movement of people to minimize the spread of virus.

2. Proposed method and conditions

The target of analysis is Tokyo (population 13 million), and the SEIR model, which is often used for infectious disease analysis, used for the expanded analysis of COVID-19. The SEIR model divides the total population into four groups (non-infected, exposed, infected, cured) and shows increase or decrease in each groups. The transition rate from non-infected to exposed is $\alpha = 0.1$, and the infectious rate $\beta = 0.1$. We applied the SEIR model by multiplying α and β by the ratio of the amount of movement published by apple[1]. Since the movement limit is likely to be high during the period from March 25 to June 20, use only the values for that period, and set the movement ratio to 1 for the other periods (Fig1). Here, we consider the time when the Japanese government started to work on movement restrictions (March 25) as the time of substantial movement restrictions, and examined the difference in the number of infected people when changing the start time of movement restrictions.

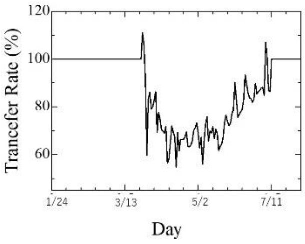

Figure 1: Change in the amount of movement.

3. Simulation results

The cumulative number of infected persons obtained from the SEIR model is shown in Fig. 2. It can be seen that the cumulative number of infected people will eventually increase to about 5,200 if the movement restrictions are entered on March 25.

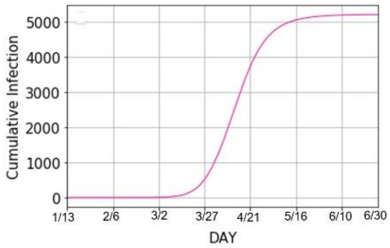

Figure 2: Changes in the cumulative number of infected people.

Figure 3 shows the change in the cumulative number of infected people due to the difference of the start date of movement restrictions. The vertical axis shows the ratio based on the cumulative number of infected people when the movement was restricted on March 25. The horizontal axis shows the movement restriction start date.

Figure 3: Changes in the cumulative number of infected people due to different movement control start dates.

From Figure 3, it can be seen that the start date of movement restriction is March 28, the number of infected people is the smallest, and if the movement restriction start time is too late or too early, the damage will increase about 5%.

4. Conclusion

In this study, we examined the optimal timing of movement regulation to prevent the spread of COVID-19 infection using SEIR model. As a result of the analysis, it was found that the number of infected people could be minimized by having restricted movement on March 28.

5. Reference

1) Mobility Trend Report (apple)
https://www.apple.com/covid19/mobility