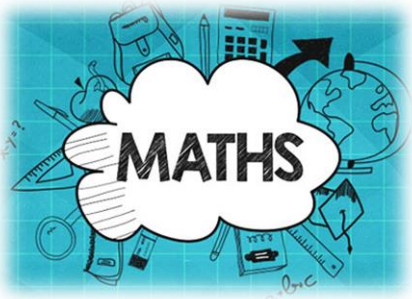
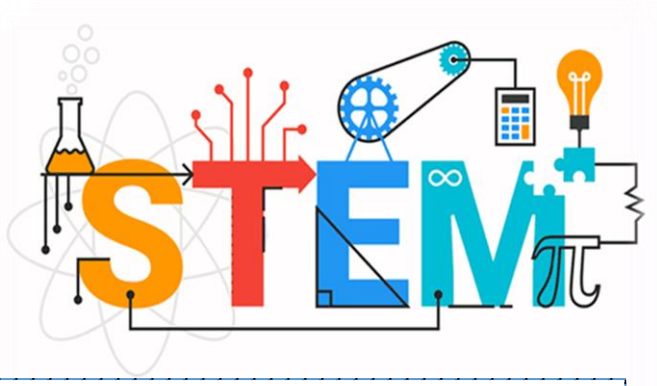




TWGHs Lo Kon Ting Memorial College
Mathematics
STEM Education

S3 Chapter 11

Probability

Infectious disease model

Name: _____

Class: _____ ( )

Group: _____

Contents

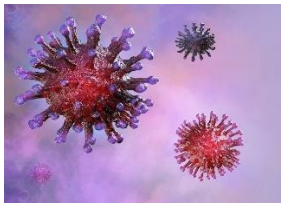
Interesting Trivia: Masked society

Figure 1 – A masked society

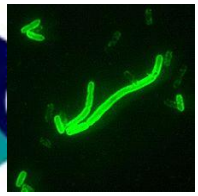
Annually Infectious disease

The continuous outbreak of infectious diseases has had a tremendous impact on human health survival and economic development. Since the 1970s, new infectious viruses that are constantly mutating have quietly coming to human beings and at least one new infectious disease has been discovered every year.

As the flow of human populations continues to increase, creating favorable conditions for the spread of infectious diseases, human beings are facing the growing threat of infectious diseases. Therefore, in-depth study of effective monitoring methods for infectious diseases, the establishment and development timeline and accurate infectious disease prediction, prevention and control technologies by using analysis model, has important theoretical significances and realistic values for improving the public health level of citizens. Model fitting, data simulation and experimental comparison analysis are mainly adopted.



Timeline of Infectious diseases

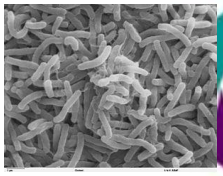


Black Death(Plague) ,1346

Disease caused by the bacterium Yersinia pestis, resulted in the deaths up to 75-200 million

Cholera, 1817

Small intestine infection by some strains of the bacterium Vibrio cholera, affect an estimated 3-5 million people worldwide

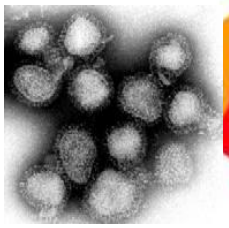


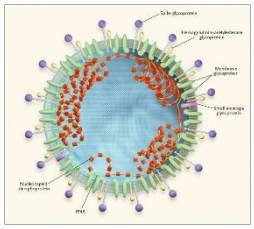
Malaria, 1880

A mosquito-borne infectious disease, around 290 million case of malaria worldwide

Hong Kong flu, 1968

Caused by an H3N2 strain of influenza A virus, the virus killed 1 million people worldwide



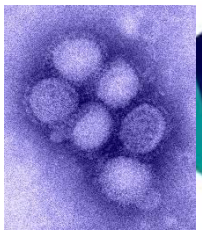


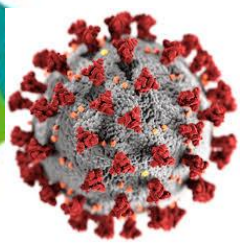
SARS, 2003

Respiratory disease of zoonotic origin caused by severe acute respiratory syndrome coronavirus, with a case fatality rate 11%

H1N1, 2009

Mixtures of swine flu, bird flu and human flu viruses, over 18,138 deaths



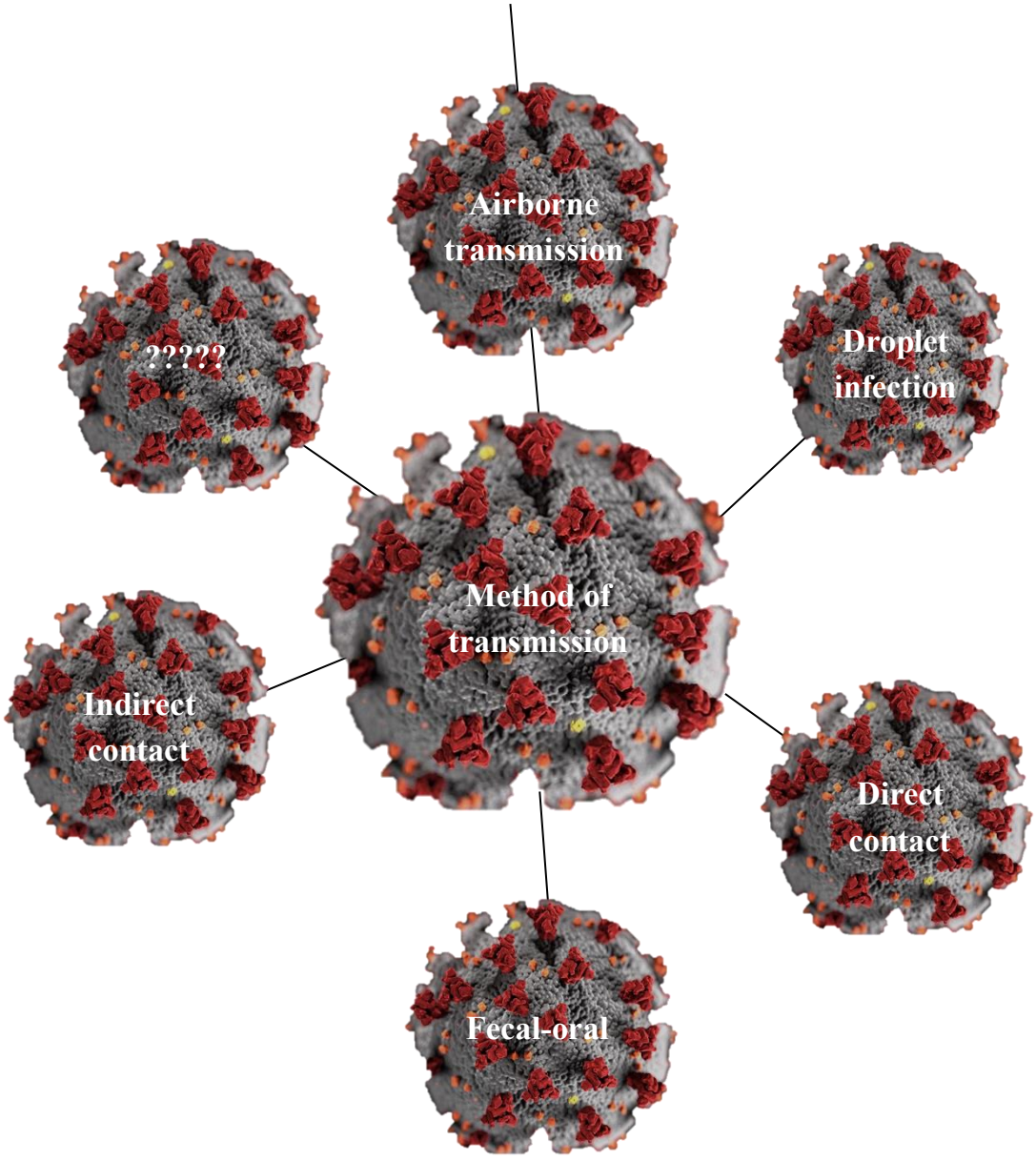


COVID-19, 2019

Infectious disease caused by SARS-COV2, more than 32 million cases have been reported across 188 countries and territories

Brainstorm

Try to discuss different transmission method and which one will have the highest probability and how can we avoid them



Discussion

Why we use mathematical model to simulate the outbreak of infection?

How can we reduce the probability of suffering infectious diseases?

What is the limitation of the model? How can we improve it?

Game activity

Your class will be divided into 2 groups and 8 teams, 4 teams for infected group, the remaining 4 teams for healthy group.

Step 1 You may either choose your own team, or an opponent team as the answerer

Step2 Choose a team representative and throw a dice, take the action with corresponding number

Number	Action
⚀	Fundamental question
⚁	Intermediate question
⚂	Intermediate question
⚃	Quick Response question
⚄	Quick Response question
⚅	Challenging question

Step3 After answering the question, please follow the following rules according to your rightness

	Rightness	
Group(chosen team)	**Correct**	**Wrong**
Healthy (self)	Recue an opponent team	Infected
Healthy (opponent)	Nothing happen	Disqualified (dead)
Sufferer (self)	Recover	Disqualified (dead)
Sufferer (opponent)	Nothing happen	Infected

For quick response question, your team need to have a battle with the team you chose in Step1. The team which have a faster response (correct) will capture the opponent team as your group.

The game is ended when either one of the group is eliminated
OR
30 minutes pass/all questions are asked.

After the game.....

Thinking

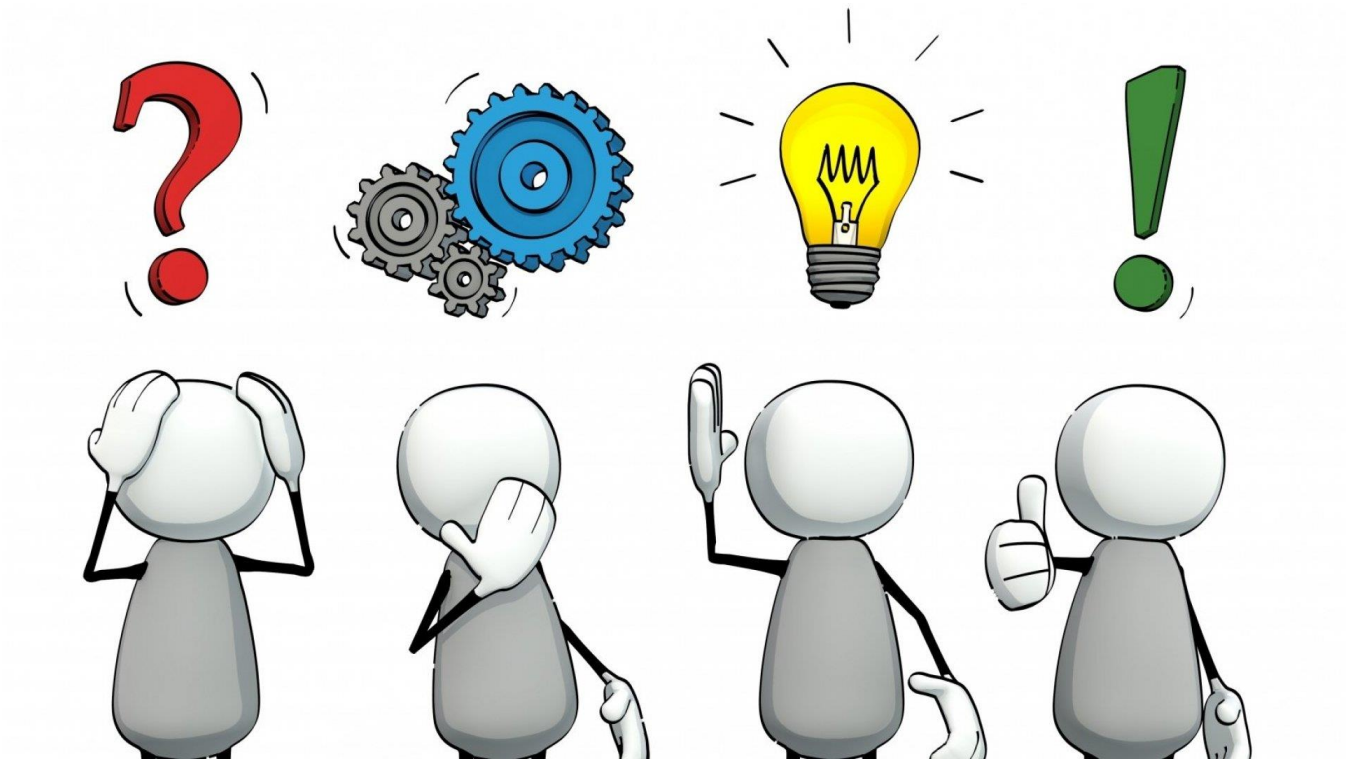
Calculate ability = immunity

More sufferer = higher probability for suffering the infectious disease

More non-sufferer = higher probability for recuing (by inventing vaccine)

Dice = different conditions you cannot controlled by yourself
when you are facing an infectious disease

What else….?



A vaccine is really important to provide active acquired immunity to a particular infectious disease!!!!

Activity

- A vaccine is invented and the recovery rate is depend on three fair mystical coins as followed. Finish the tree diagram and then answer the table below.

Results	Number of people recovered	Probabilities
3 Heads	0	
2 Heads and 1 Tail	1000	
2 Tails and 1 Head	2000	
3 Tails	3000	

Table : Probabilities of the recovery rate after the invention of vaccine

- Draw a tree diagram to list the possible outcomes as Table 3

1. A constant transmission rate of an infectious disease is 500 people per day. Assume the above vaccine is used with fairly distributed result. Is it possible to curb the spreading of the disease? Try to explain your answer by using expected value.

2. City A have a population of 1,000,000 and 100,000 of them have suffered from infectious disease with the same condition mentioned in Question 1. Assume the population remain constant and the infection will not cause lethal. Is it possible to recue all the sufferer someday? How long does it take to recue all the citizen OR spread over the whole City A?

3. It is known that the probability of n mystical coins get **ALL HEAD OR ALL TAIL** has an equation of $\frac{2}{2^n}$. 4 fair mystical coins are used this time and all the patients will be rescued if the throwing result is **ALL HEAD OR ALL TAIL**. What is the probability of this condition?