Technological and Higher Education Institute

of Hong Kong

Faculty of Design and Environment

DIT5406 - Advanced Topics in Information and

Communications Technology

Project Report

Covid-19 spread analysis and prediction

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TABLE OF CONTENTS

Introduction

In December 2019, Coronavirus disease 2019 (COVID-19) spread from Wuhan to global. As there were many travelers from Mainland China, Europe and America to Hong Kong, the number of confirmed cases increased. Hong Kong had a high risk of having a community outbreak.

We are going to find out the result of the following information:

1) The trend of COVID-19 and their confirmed date
2) The age distributions and gender of the confirmed cases
3) Residence of the confirmed patients
4) The source of infection of the confirmed cases
5) Travel history of the cases imported
6) Prediction of the future case and end date of COVID-19 in Hong Kong

This report will be divided into three main parts, Literature Research, Diagram, and Analysis.

Literature Research

Pei Wang et al. (2020) had collected the data of 1212 patients from Henan and had analyzed those data. They found that 55% of patients are male, although the percentage is similar, the number of male patients is higher than the female patients. They thought one of the reasons was males might have more social activity than females, therefore, they had a higher probability of infection.

In their research, it found that the age distributions of the patients were mainly 31-60 years old. 21% of patients were 31-40 years old, 22% were 41-50 years old, and 23% were 51-60 years old. It showed that these three age groups had a higher risk of infecting COVID-19. Besides, the patients of 21-30 years old also took up to 16%. Therefore, the risk of this age group was also not missing.

Wang also found that 55% of patients were male which was higher than the female patients. They had some speculation of why those groups had a higher infection rate than the other. As COVID-19 was a virus that easily infects people when they are in social activity. Wong thought that the person's age 21-60 were the main labor of the society and they had a larger social circle. Because of a higher chance to communicate with others, the virus had spread in them fast. Male also had larger social circles than females, due to the same reason, the risk of males infecting COVID-19 would be higher than females.

Viner (Viner, et al., 2020) had done research about whether there was a good effect of school closure during COVID-19. This research had compared with the similar situation of SARS in 2013. In 2013, SARS was widely spread in the world, even in Hong Kong. This report used population data and the school of England to do a simulation calculation to find out the effect if the school had not closed in the COVID-19. They found that the reach of the crowd of students

is double than their family members who were going to work. Therefore, there would be around 30% of the conditions that could be spreading in school.

On the other hand, they also simulated another situation, which was assuming all primary and secondary schools, 25% universities were closed during the period of the COVID-19, and the rate of family, that their kids were schoolmate, contact outside of school increased 50%, and the contact of the community during the closure of school increased 20%, The death rate of COVID-19 after the school close could decrease 2-4%. As a result, Viner (Viner, et al., 2020) thought the policy of school closure was a useful policy on controlling COVID19 spreading in the community.

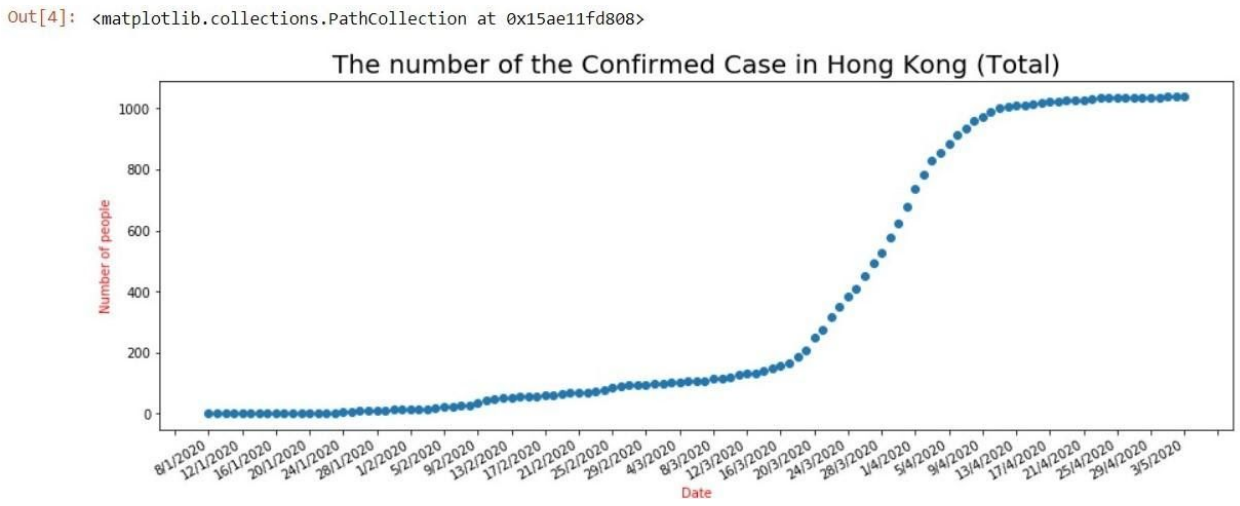
Mengyuan Li (Li, et al. 2020) had a prediction about the confirmed cases, new cases, and death cases of China and across the world. The report used the data of COVID-19 in China to build the model and use this model to predict the cases across the world.
In their result, they predicted that China's case would reach the top by the end of February, and would be over in the middle of May. This report found that the daily distribution of the confirmed cases was similar to China, so they estimated the situation of China and other places would be similar, but late about 32 days.

Li used the model generated from China data to predict the confirmed cases, new cases, death cases, and end date of COVID-19 across the world. Based on the model, they found it would reach the top by the end of May and would be under control by the end of Aug.

Diagram and Analysis

1. The Number of The Confirmed Case In Hong Kong

1.1 Total Case



According to the chart of the number of confirmed cases in Hong Kong, it shows that until 3/5/2020 Hong Kong has around 1000 confirmed cases. The numbers kept rising starting from 20/1/2020 as the COVID-19 were appearing in Hong Kong at that time.

The numbers became more and more serious from 16/3/2020 which increased to treble as compared with the day before. From 16/3/2020 to 13/4/2020, it almost increased for 5 times (around 200 to 1000). It shows that something had happened and made the COVID-19 become severely.

Although Hong Kong had more than 1000 confirmed cases. But compared to the world, it was not serious (Li, et al. 2020). The reason was the number of visitors in 2019-2020. Starting from June, 2020, anti-government protests continued to rock the city. Many of the visitors, especially from mainland China were refusing to come to Hong Kong as they thought that Hong Kong was not safe to travel (SCMP,2019).

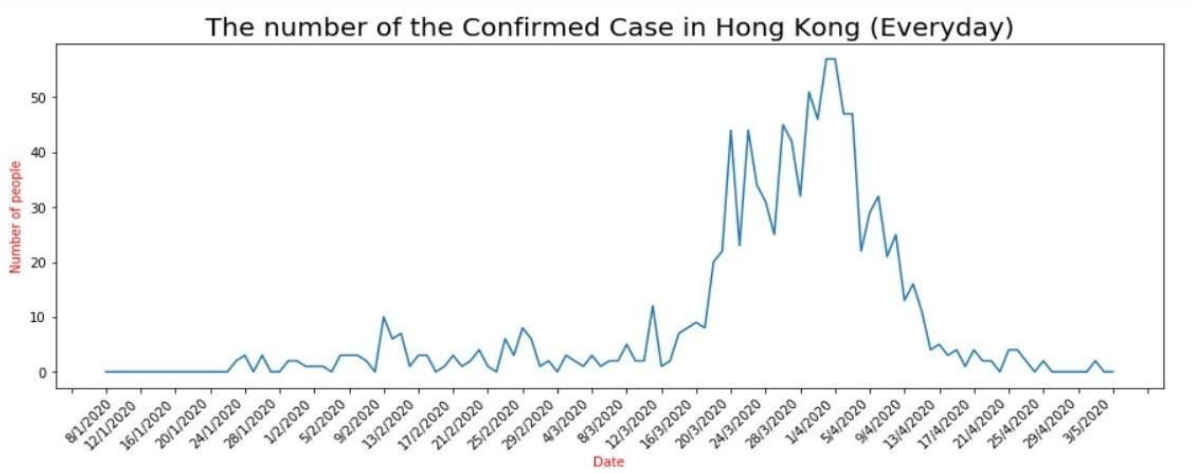
1. 訪港旅客人次撮要（按居住國家／地區計） **Total Visitor Arrivals by Country / Region of Residence**

居住國家／地區	Country / Region of Residence	2018 年 12 月 Dec 2018 人次 No.	2019 年 12 月 Dec 2019 人次 No.	增長率 % Growth	2018 年 1 至 12 月 Jan - Dec 2018 人次 No.	2019 年 1 至 12 月 Jan - Dec 2019 人次 No.	增長率 % Growth
合計	**TOTAL**	**6,586,268**	**3,191,466**	**- 51.5**	**65,147,555**	**55,912,609**	**- 14.2**
中國內地	**Mainland China**	**5,121,627**	**2,398,232**	**- 53.2**	**51,038,230**	**43,774,685**	**- 14.2**
非中國內地	**Non-Mainland China**	**1,464,641**	**793,234**	**- 45.8**	**14,109,325**	**12,137,924**	**- 14.0**
短途地區市場 (不包括中國內地)	**Short Haul Markets (Exclude Mainland China)**	**995,526**	**475,707**	**- 52.2**	**8,857,525**	**7,557,186**	**- 14.7**
澳門特區	Macau SAR	165,287	103,260	- 37.5	1,094,785	1,238,709	+ 13.1
短途地區市場 (不包括中國內地以及澳門特區)	**Short Haul Markets (Exclude Mainland China & Macau SAR)**	**830,239**	**372,447**	**- 55.1**	**7,762,740**	**6,318,477**	**- 18.6**

The number of visitors from China in December, 2019 was around 2,000,000 which was less than half from December, 2018 (around 5,000,000). (Hong Kong Tourism Board, 2020)

COVID-19 was happening from December, 2019 in China, Wuhan(Li, et al. 2020) and started to spread out to the world by traveling in 2020(Li, et al. 2020). That helped to show, Hong Kong was getting less affected on COVID-19 because of the decreasing number of visitors starting from June, 2019. Less visitors travelled to Hong Kong, less chances to get COVID-19 in the city.

1.2 Everyday



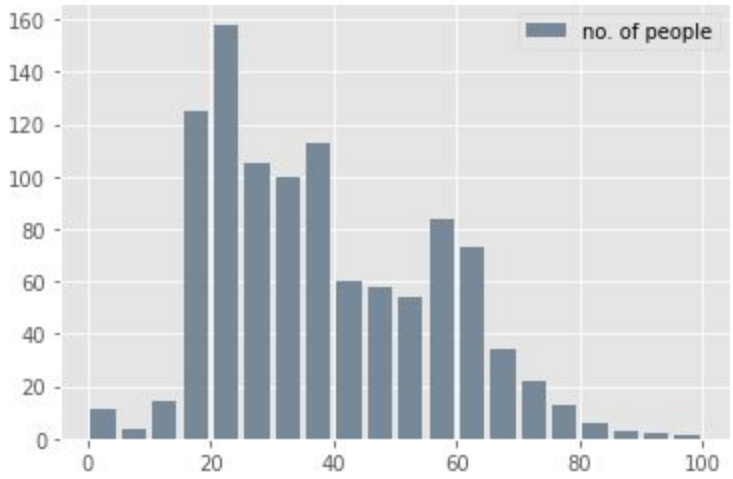
The figure above is showing the number of confirmed cases in Hong Kong per date. From the data, it finds out that the highest number of confirmed cases was in 31/3/2020 to 1/4/2020 which was more than 50 people.

The number of confirmed cases started to increase from 16/3/2020, it happened because the Hong Kong government was doing quarantine measures strengthened. From midnight on March 19, people arriving in Hong Kong who had been to Egypt, the US, the UK and Ireland in the past 14 days, the compulsory home quarantine would be issued by the department's Port Health Division (Hong Kong Government, 2020). More people were having the COVID-19 checking test and many of the Hong Kong citizens who lived or studied overseas were worried about the epidemic situation of the world so it caused a high increase in the confirmed cases.

The confirmed cases were started to decrease from 2/4/2020. It decreased because the government was announcing to close some of the places temporarily to prevent the spreading of COVID-19 by taking a risk-based approach when deciding (Hong Kong Government, 2020).

On around 12/4/2020, the data had a great drop to less than 10 and it had been kept until now. It shows that COVID-19 was already in control in Hong Kong and 0 cases were starting to appear.

2. Age Distribution of The Confirmed Cases



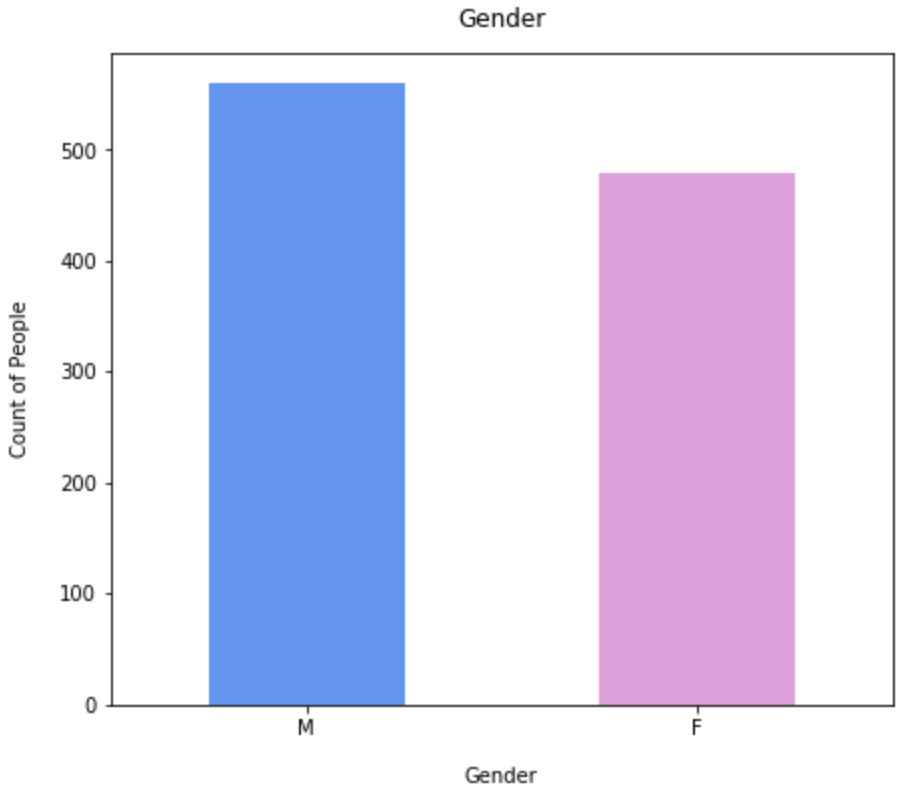
The above figure is the age distribution of the confirmed cases of Hong Kong. In the figure, we can clearly see the confirmed cases were mainly distributed in age 15-40 and 55-65, and the highest age group was age 20-25. The age group of 0-15 and 75-100 were the only group the lower than 20 confirmed cases.

For the age group of 15-40, most of them are students and the main workforce in Hong Kong. As the report of Pei Wang et al. (2020), we found that Hong Kong had a similar situation with China. For the same reason, It showed that the age group who had more social activity would have a high risk of infection.

We could also find that the confirmed cases for the age 0-15 were not higher than 20 people for each group, It might be because the schools were closed during the COVID-19 outbreak, which showed that the school closure had a good effect on prevention of COVID-19. The result of Hong Kong was the same as the research of Viner (Viner, et al., 2020)

3. Gender Distribution of The Confirmed Cases

```
M    560
F    480
Name: Gender, dtype: int64
```



From the above figure, we can see the gender of the COVID-19 confirmed cases in Hong Kong, there are 560 male patients and 480 female patients. It shows that male patients are higher than females.

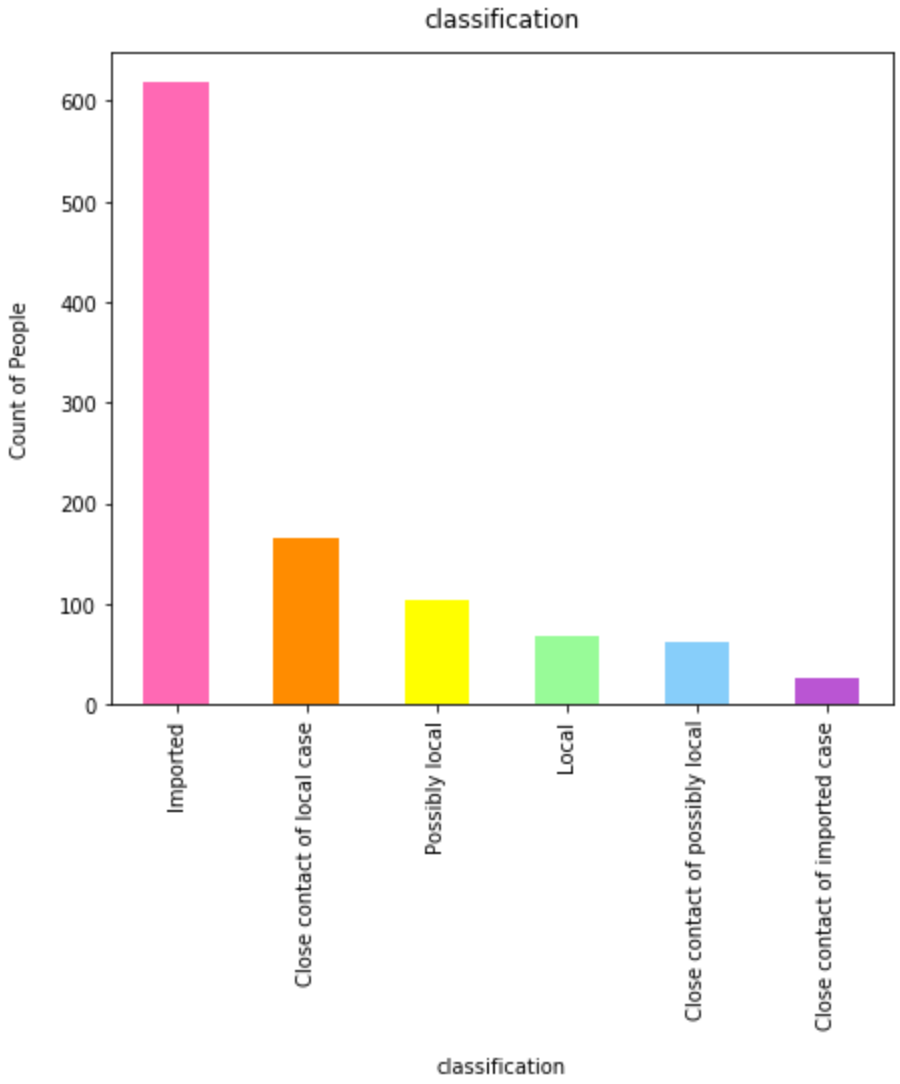
The above result is the same as that of Pei Wang's research. Both showing males had a high risk of infected COVID-19. They thought the reason is that males were the main labor so that they had large social groups and had more social activity than females.

However, from the Table from the Census and Statistics Department (Census and Statistics Department 2020) about the Hong Kong labor force by gender, female labor was a little bit more than male. It seemed that the social activities of females were likely higher than males. Therefore, we thought there may be another reason that male had a higher infection rate than females.

It might be because females were more considerate of the protection of COVID-19 so that the risk of COVID-19 infection in females decreased.

4. Classification of The Confirmed Cases

```
Imported                          618
Close contact of local case       165
Possibly local                    103
Local                              67
Close contact of possibly local    62
Close contact of imported case     25
Name: classification, dtype: int64
```



This figure is showing the classification of Hong Kong confirmed cases. It is divided into six groups, those are Imported, local, possibly local, close contact of the local case, close contact of the Imported case and close contact of possibly local case.

We can see that the imported case is in the majority, there were over 600 cases, and 16 May 2020 was the date that had the highest imported cases.

Although the imported cases were huge, there were only 25 close contacts of import cases, which was the lowest one in the above groups. It is because the Hong Kong government had quarantine measures to all inbound travelers from overseas since 15 Mar 2020(Hong Kong Government, 2020), that they needed to have 14 days quarantine after returning to Hong Kong. Based on these measures, the virus did not spread rapidly from the imported case to the local.

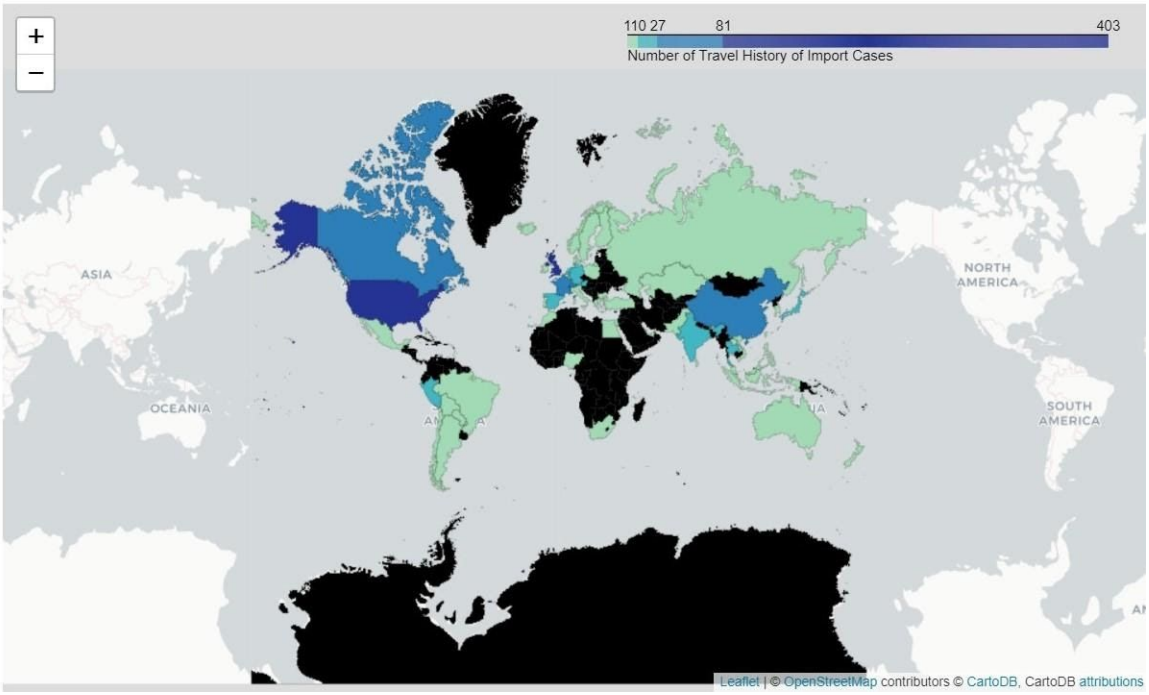
On the other hand, as the local cases which could not easily prevent, the virus had spread of their close contact, therefore, the number of the close contact of the local case was the second higher group.

5. Travel History of Confirmed Case

```
Out[21]: [<matplotlib.lines.Line2D at 0x1cfe30c7d48>]
```

Hong Kong People loved to travel or study everywhere. The above picture shows where the confirmed cases were going before they were infected with COVID-19. It could show that most of the travel history was in Europe which like the UK, France, Switzerland. The second frequency was Asia like Japan, China.

Out[18]:



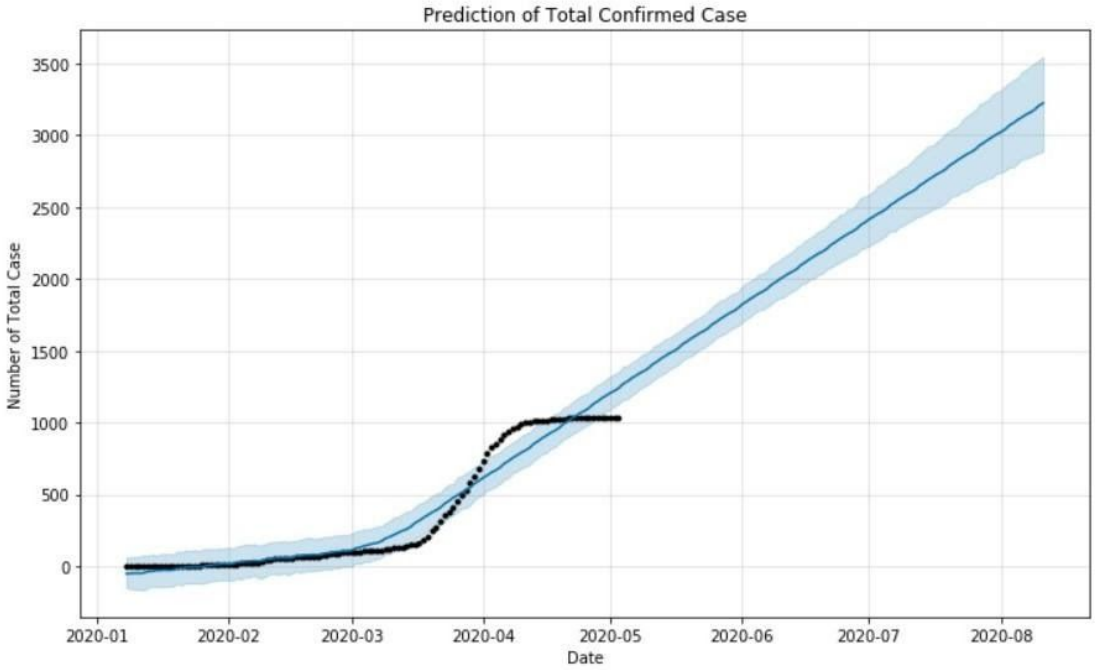
After knowing the places the confirmed cases went, numbers are also important data that affected the saturation of nowadays. In the map, there are a lot of different colors that show different numbers that the confirmed cases might cause COVID-19 by checking on their travel history.

According to the figure above, the UK had the most number of the travel history of the import cases which was more than 400. The reason why it happened was because more and more children were going overseas for their studies. “According to data from UNESCO, 36,442 Hong Kong students are studying abroad at present. Those in the UK account for the largest number with 16,580, followed by Australia (9,186), the US (7,508) and Canada (2,037).” (The PIE News, 2019) It showed that half of the Hong Kong students who were studying overseas were going to the UK. That was why the number of the import cases mostly came from the UK when the government was setting the 14 days compulsory quarantine at designated places (home or other accommodation) of health quarantine arrangements on inbound travelers from overseas.

6. Prediction of Future Case

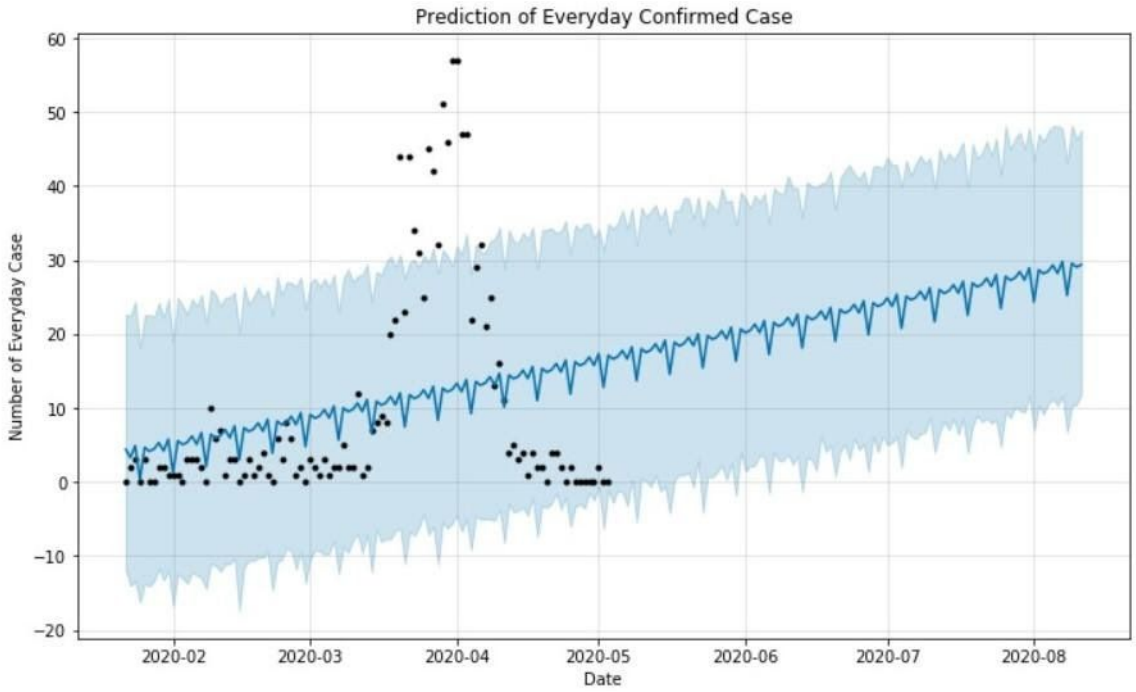
6.1 Prediction of Total Confirmed Case

```
Out[12]: Text(0.5, 1, 'Prediction of Total Confirmed Case')
```

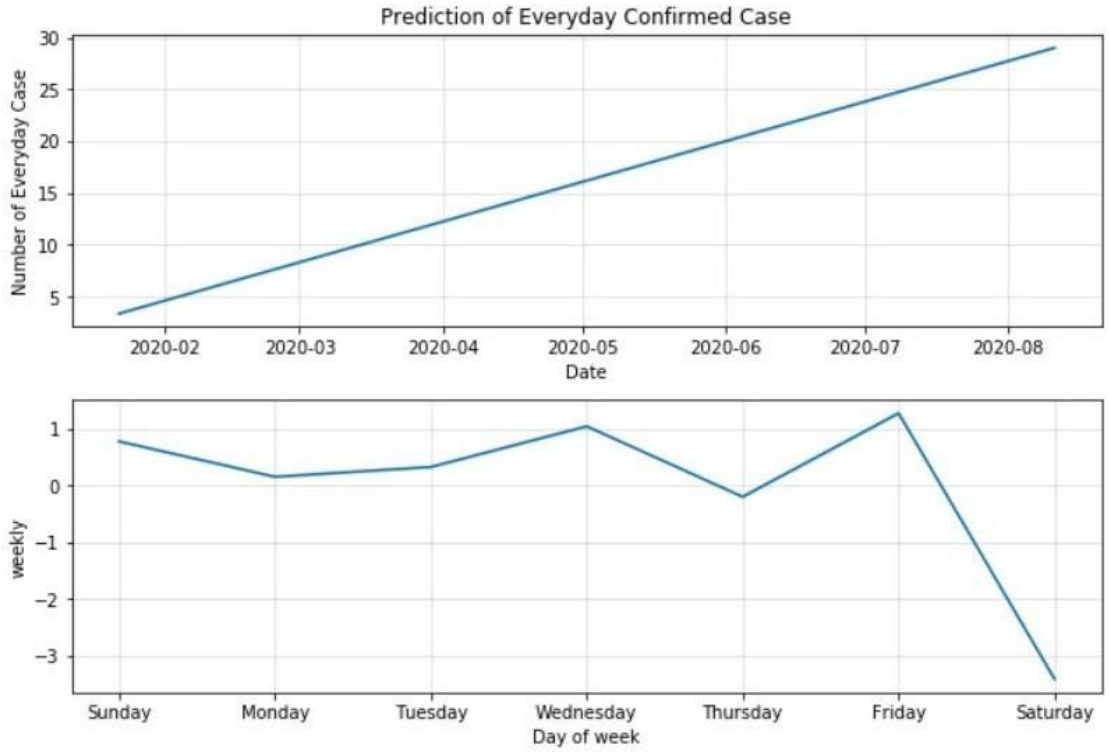


For the prediction of the total cases, although the confirmed cases were starting to decrease, the predictions are still increasing. There were a few 0 cases per date but it was not in a continuation which means there may still have confirmed cases afterward. The total cases will keep increasing if there are still cases in the future. However, the predicted numbers are already lower than before as the confirmed cases of Hong Kong are in control. If the number of the confirmed cases are kept low or even continue on 0 cases, the prediction will have a great decrease afterward.

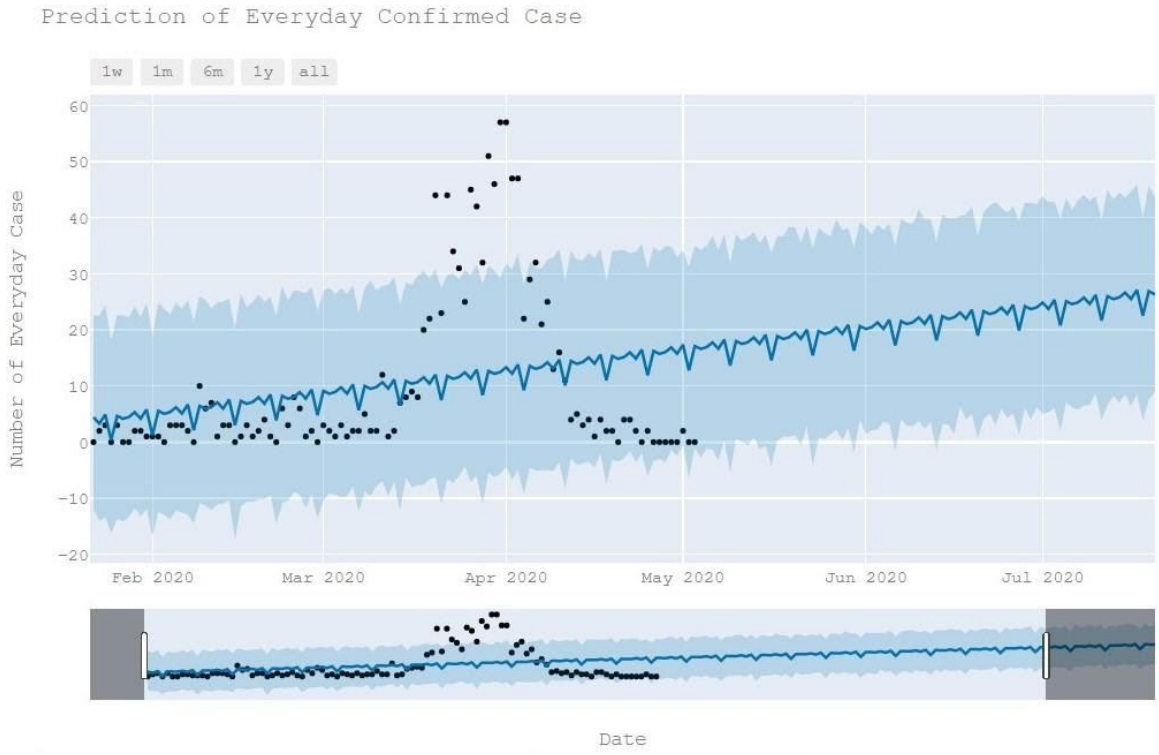
6.2 Prediction of Confirm Case Everyday



For the prediction of everyday cases, it is still in the increasing number. However, the above figure can show that it is not increased fast which means the COVID-19 is in control in Hong Kong.



The prediction of the highest number of every day confirmed cases is less than 30 which is lower than the highest number of the previous every day confirmed cases (50). It can show that the serious time of the COVID-19 in Hong Kong had already passed. There might be an increased number but it would not be having any sharp changes any more if nothing special happened. The situation would become better and better if the confirmed cases are kept stable in the future.


Prediction of Everyday Confirmed Case
1w
1m
6m
1y
all
Number of Everyday Case
60
50
40
30
20
10
0
−10
−20
Feb 2020
Mar 2020
Apr 2020
May 2020
Jun 2020
Jul 2020
Date

Conclusion

To conclude, COVID-19 outbreak in Hong Kong since 8 Jan 2020. After analysis of the data, we found that male have a higher infection rate than females. And the confirmed cases are mainly focused on the people in age 20-65, which may be because they have more social activity. For the cases in Hong Kong, most of them are imported cases, which means the pandemic is under control locally in Hong Kong. The majority of the imported cases are from the UK, the reason for it might be the UK has numerous Hong Kong oversea students.

According to the prediction figure, the growth of cases is slowing down, and have 0 confirmed cases in the last few days. It shows that the Hong Kong pandemic is mitigating.

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Appendix

Appendix 1: Labour Force and Labour Force Participation Rate - By Sex

Labour Force

Overview | Publications and Tables | Statistics in Other Sites | Concepts and Methods

Mobile Version

Table 007 : Labour Force and Labour Force Participation Rate - By Sex

	Male		Female		Both sexes	
Period	No. ('000)	LFPR (%)	No. ('000)	LFPR (%)	No. ('000)	LFPR (%)
2017	1 994.4	68.3	1 952.2	55.1	3 946.6	61.1
2018	2 006.8	68.5	1 972.2	55.1	3 979.0	61.2
2019	1 979.6	67.5	1 986.6	55.0	3 966.2	60.6
11/2018 - 1/2019	1 996.8	68.0	1 977.6	55.0	3 974.4	60.8
12/2018 - 2/2019	1 992.6	67.9	1 976.6	54.9	3 969.2	60.7
1/2019 - 3/2019	1 987.7	67.7	1 983.1	55.0	3 970.8	60.7
2/2019 - 4/2019	1 983.3	67.4	1 994.0	55.2	3 977.3	60.7
3/2019 - 5/2019	1 986.5	67.5	1 996.8	55.2	3 983.3	60.7
4/2019 - 6/2019	1 988.1	67.5	1 996.8	55.1	3 985.0	60.7
5/2019 - 7/2019	1 985.1	67.4	2 000.7	55.2	3 985.8	60.7
6/2019 - 8/2019	1 982.5	67.3	2 001.7	55.2	3 984.2	60.6
7/2019 - 9/2019	1 976.6	67.1	1 999.2	55.1	3 975.7	60.5
8/2019 - 10/2019	1 974.4	67.1	1 994.9	55.0	3 969.3	60.4
9/2019 - 11/2019	1 973.6	67.1	1 982.4	54.6	3 956.0	60.2
10/2019 - 12/2019	1 967.3	67.0	1 974.5	54.5	3 941.8	60.1
11/2019 - 1/2020	1 960.9	66.9	1 964.5	54.3	3 925.5	60.0
12/2019 - 2/2020	1 939.6	66.3	1 963.4	54.3	3 903.0	59.7
1/2020 - 3/2020 #	1 923.7	65.9	1 958.5	54.3	3 882.2	59.5