

## Appendix 1

We made a comparison about thoracic surgical volume in our hospital after the COVID-19 epidemic broke out with the thoracic surgery volume in last year at the same time. By using regression fitting and modeling to research the influence that COVID-19 has made on thoracic surgical volume, besides, we use the model to predict how long it will take in our hospital that recover to the thoracic surgery volume's level in last year. (Clear the volume difference in 2019 and 2020).

Data was selected from the period which start at Jan 23<sup>th</sup>, 2020, which is the date that Wuhan blockaded the city, and end at Apr 8<sup>th</sup>, 2020, which is the date that Wuhan relieved the blocking state. We counted the thoracic surgical volume in our hospital during this period, then we divided this time period by 7 days and record how many thoracic surgeries are operated in each 7 days. We regard each 7 days as a manual week so assume the volume of manual week as variable  $x$ , identically we assume the volume of thoracic surgery in each manual week as variable  $y$ . We used software method to draw the cartesian coordinate system and fit the data by Last Squares to generate a linear function and a nonlinear function, which are what we will research for.

Besides, we fitted the data in 2019 to generate functions. It is because that in the same time period in 2019 there is no COVID-19 pandemic, so we can regard the data in 2019 as the normal data. Based on this assumption, we analyzed the functions that we fitted in 2020, predicted how long it will take that recover to the last year's level after Apr.8<sup>th</sup>, 2020.

The max weekly thoracic surgical volume was selected in 2019 as the max ability that the hospital can operate thoracic surgery. And we calculated the difference between the thoracic surgical volume during Jan 23<sup>th</sup> to Apr 8<sup>th</sup> in 2 years. And we discovered that the volume in 2019 is more than 2020 which means COVID-19 do influence the volume of thoracic surgery in this hospital.

### Research tools and environment

We used Microsoft Excel 2019 (Microsoft, Redmond, WA, USA) as the raw data processing software, and count the thoracic surgery volume in each manual week by Pivot table function in Excel.

After we got the processing data, we saved the data as csv file, which were named as 2019\_week.csv and 2020\_week.csv. The content in the files are divided in two columns, the first is the number of the manual week and the second was the thoracic surgery volume in this manual week.

As for the abnormal data (the 3 manual weeks which is Chinese Spring Festival), we used Linear interpolation formula to simulate the surgery volume (19,20). First, we calculate the linear function which satisfy the points on the both sides of the interpolation point, then we assume the interpolation point is on the linear function, calculate the dependent variable when the independent variable is the interpolation point. The dependent variable will be the interpolation volume to simulate.

We used Jupyter Notebook as the IDE to process the csv file under Python 3.7. In our python code, the matplotlib library is used to draw the graph and the Numpy library is used to process science calculation. Following is the core code of drawing graph:

```
plot1 = plt.plot(x, y, 's', label='original volumes')
plot2 = plt.plot(x, yvals, 'r', label='polyfit volumes')
plt.xlabel('x')
plt.ylabel('y')
```

```
plt.legend(loc=4)
plt.title('polyfitting')
plt.show()
```

We use Last Squares method to fit the data, following is the core data of fitting:

```
#nonlinear fitting
points = np.genfromtxt("E:/wrc/2019_week.csv", delimiter=",")
x = points[:,0]
y = points[:,1]
f1 = np.polyfit(x, y, 3)
p1 = np.poly1d(f1)
yvals = p1(x)
```

```
#linear fitting
M = len(points)
x_bar=np.mean(points[:,0])
sum_yx= 0
sum_x2=0
sum_delta =0
for i in range(M):
    x=points[i,0]
    y=points[i,1]
    sum_yx += y*(x-x_bar)
    sum_x2 += x**2
w = sum_yx/(sum_x2-M*(x_bar**2))

for i in range(M):
    x=points[i,0]
    y=points[i,1]
    sum_delta += (y-w*x)
b = sum_delta / M
return w,b
```

Then we use following code to calculate the difference between 2019 and 2020:

```
import csv
data_2020 = csv.reader(open("E:/wrc/final/2020_chest.csv", 'r'))
```

```

data = [1.331*i+52.242 for i in range(1,12)]
j = 0
data_result = [0]*11
for i in data_2020:
    data_result[j] = data[j]-int(i[1])
    j+=1
print(' '.join(str(num) for num in data_result))
print(sum(data_result))

```

Following code is how we predict how long it will take to recover:

```

import math
count = 20
total = 0
while(True):
    minus = 0
    print(count)
    max = 129*1
    predict = 1.331*count+52.242
    if(max>=predict):
        minus = max - predict
    else:
        print("error")
        break
    total = total + minus
    count += 1
    if(math.floor(total)>=201):
        break

```

## References

19. Least squares. Available online: [https://en.wikipedia.org/wiki/Least\\_squares](https://en.wikipedia.org/wiki/Least_squares)
20. Linear interpolation. Available online: [https://en.wikipedia.org/wiki/Linear\\_interpolation](https://en.wikipedia.org/wiki/Linear_interpolation)

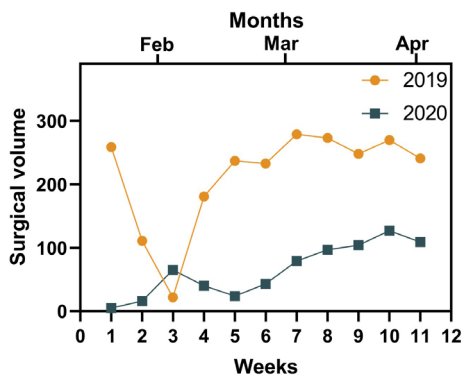


Figure S1 Changes in elective surgical volumes.

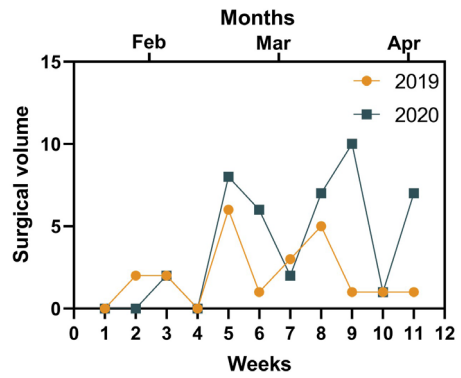


Figure S2 Changes in emergency surgical volumes.

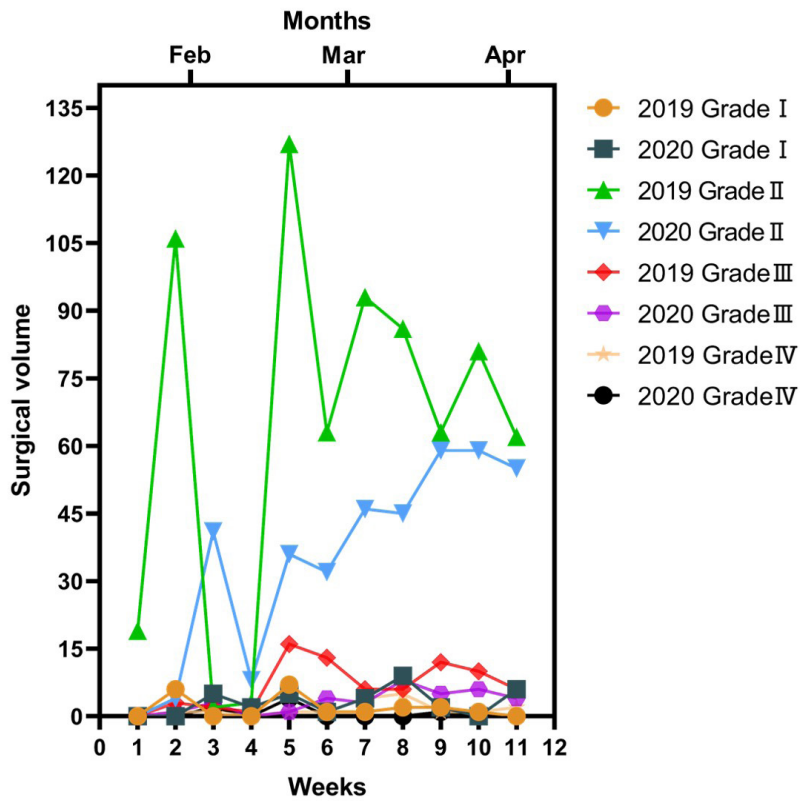
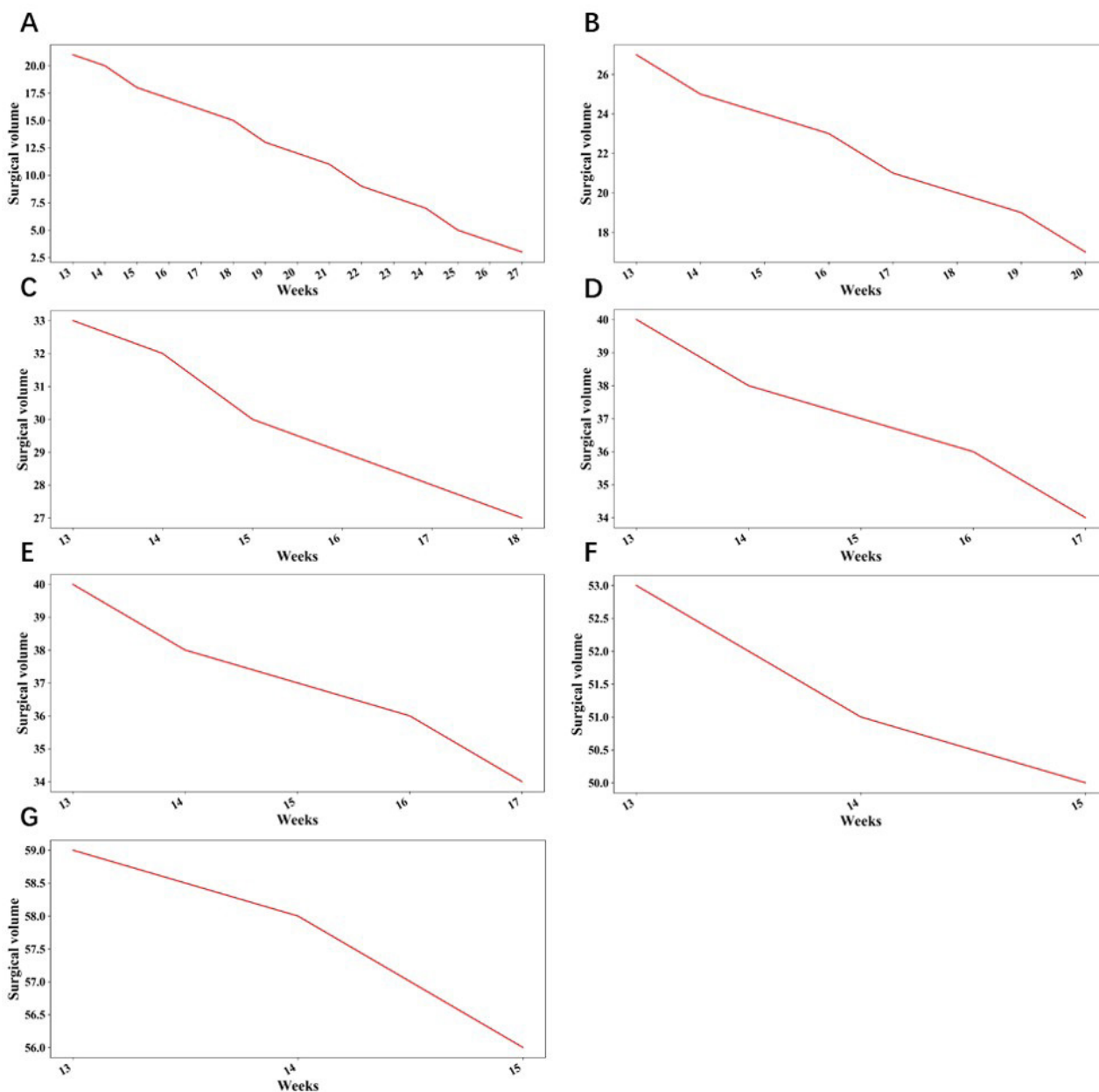


Figure S3 Changes in surgical volumes according to ASA grades.



**Figure S4** Time required to solve the backlog volume during the COVID-19 under the different workload in the department of surgery. (A) Time required when  $p=0.70$ ; (B) time required when  $p=0.75$ ; (C) time required when  $p=0.80$ ; (D) time required when  $p=0.85$ ; (E) time required when  $p=0.90$ ; (F) time required when  $p=0.95$ ; (G) time required when  $p=0.1$ . #, Horizontal axis represents the number of weeks needed from the 13<sup>th</sup> week and vertical axis represents the backlog volume. \*,  $p$  represents the proportional coefficients that the department's current surgical volume to the maximum load. COVID-19, coronavirus disease 2019.