Data Model Prediction of the Air Travel's Recovery in Beijing Capital Airport

The TechThinker

Executive Summary

Data Collection	Collect data of monthly passenger volume and its change of rate in Beijing Capital Airport
Model	Construct a Holt-Winters seasonal forecasting model using python
Prediction	Consider three situations: 1) no rebound; 2)rebound in late August; 3)rebound in winter
Insights	International flights will take a longer time to be recovered than domestic flights
Recommendation	Three turning points: 1)Take off inflection point; 2)Profit turning point; 3)Profit elasticity inflection point

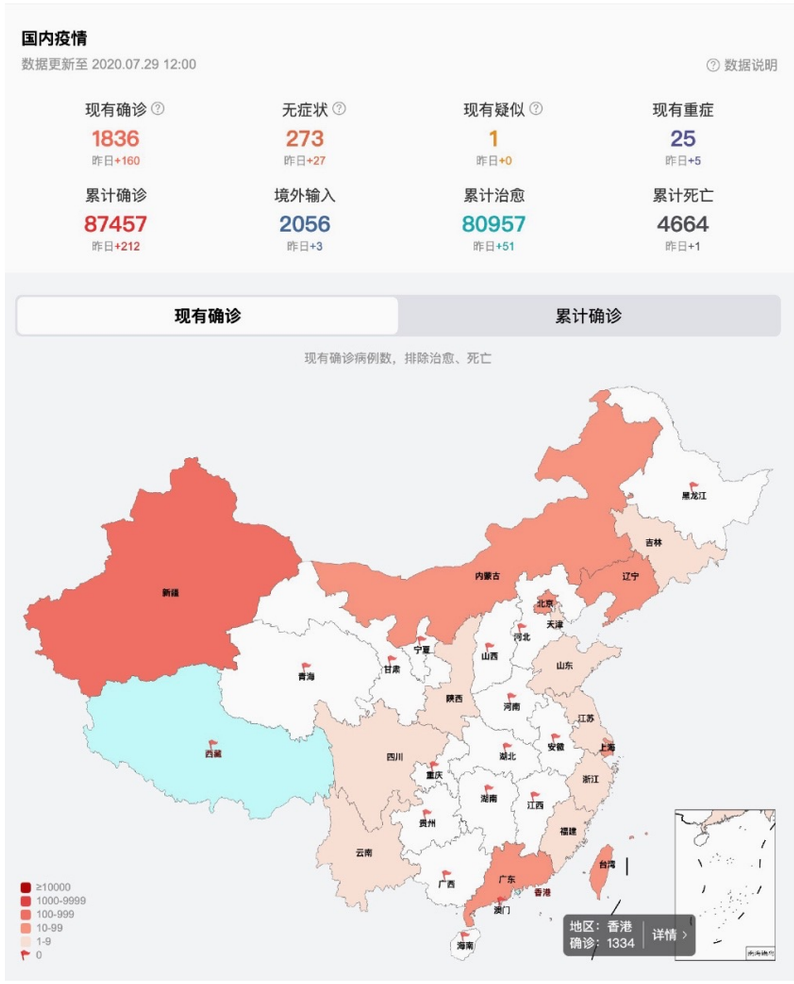
Covid-19 Outbreak

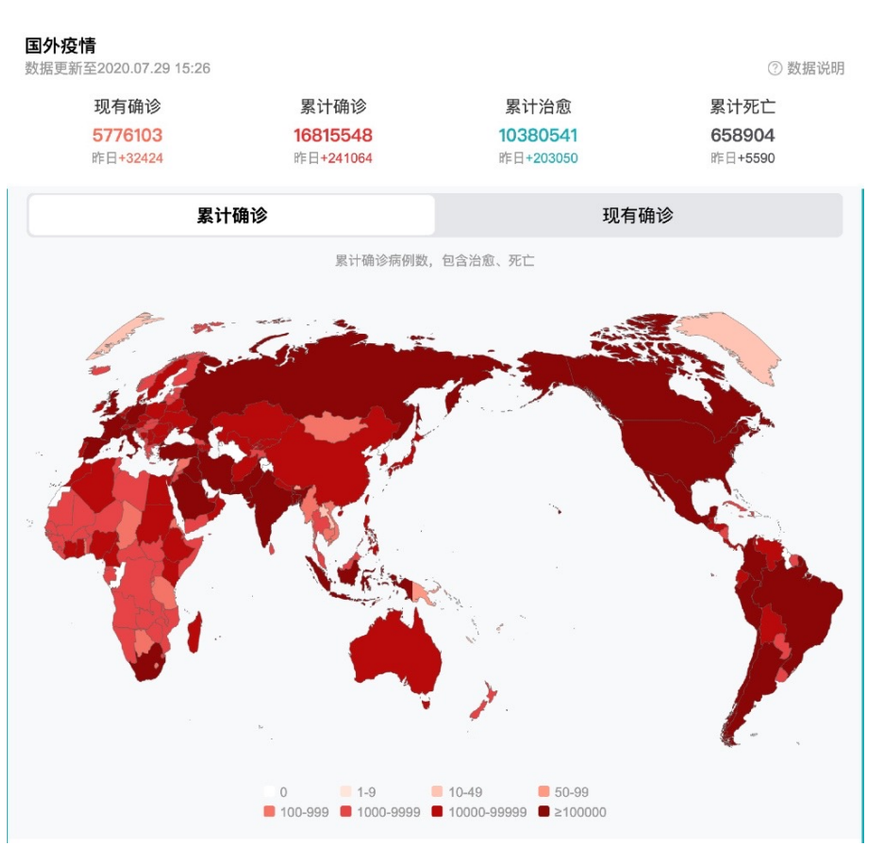
Domestic Situation:

Until July 29th, 2020, **China mainland** currently has **1836** confirmed Covid-19 cases.

Beijing gradually recovered from the centre of second round epidemic, Beijing now has **27** confirmed cases.

Xinjiang Province and Dalian gradually become the centres of the third round epidemic.

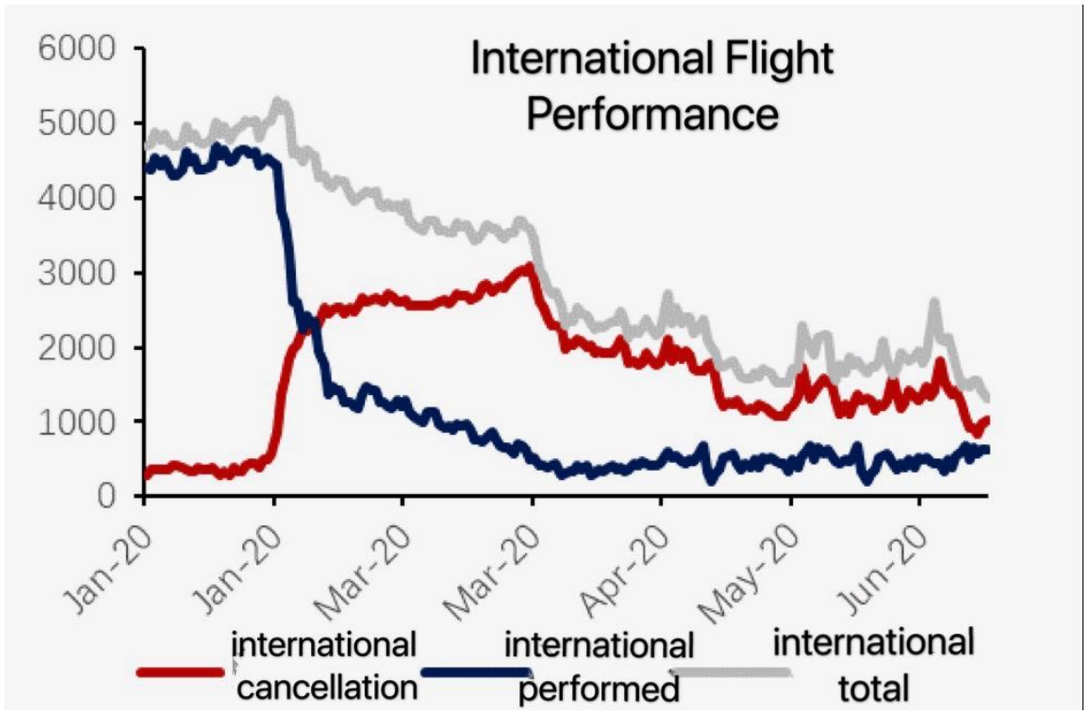


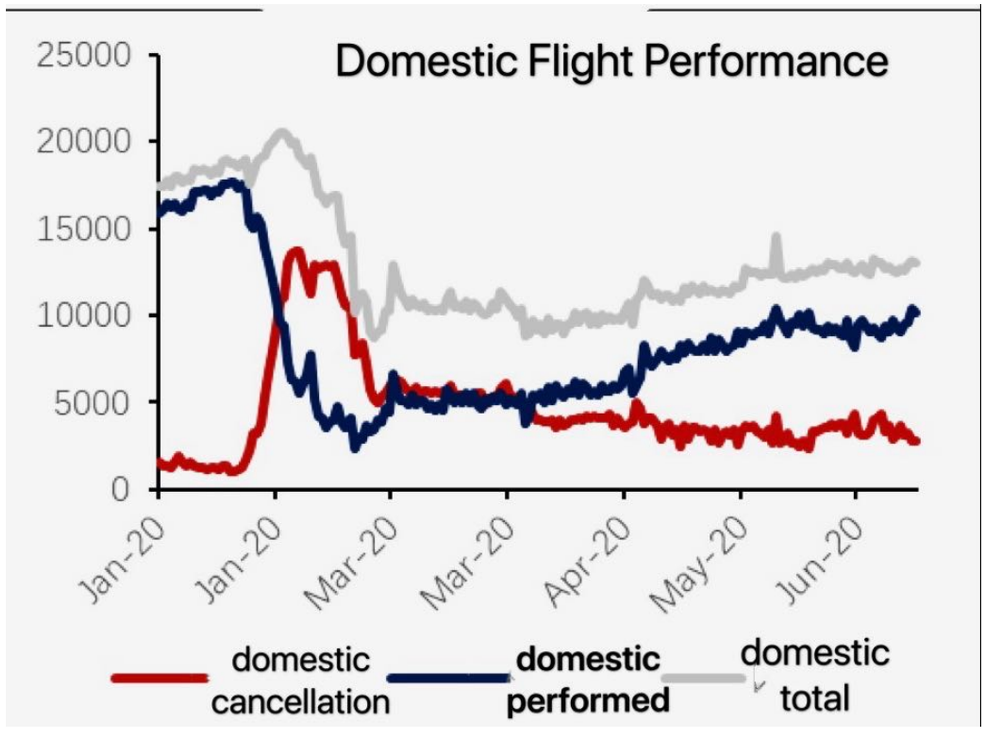


International Situation:

The world currently has over **5.8 million** confirmed Covid-19 cases, which including all continents.

Air Industry Outlook





Since the outbreak of Covid-19 in January, air industry in China has experienced huge loss in 2020. Daily international flight execution rate has decreased over 75%, now with less than 1,000 flights each day.

Domestic flight execution rate has decreased over 50%, now daily flight execution rate is around 10,000 each day.

Data Collection

• Monthly passenger volume and its change of rate in Beijing Capital Airport (2000.1-2020.6), which includes total passenger volume, domestic passenger volume and international passenger volume

• Domestic flight execution rate (2020.1-2020.6),

• International flight execution rate (2020.1-2020.6),

• Month-on-month change of domestic and international passenger volume in Beijing Capital Airport (2020.1 - 2020.7)

• Resumption of the Beijing-Hongqiao Shanghai route (2020.1-2020.7),

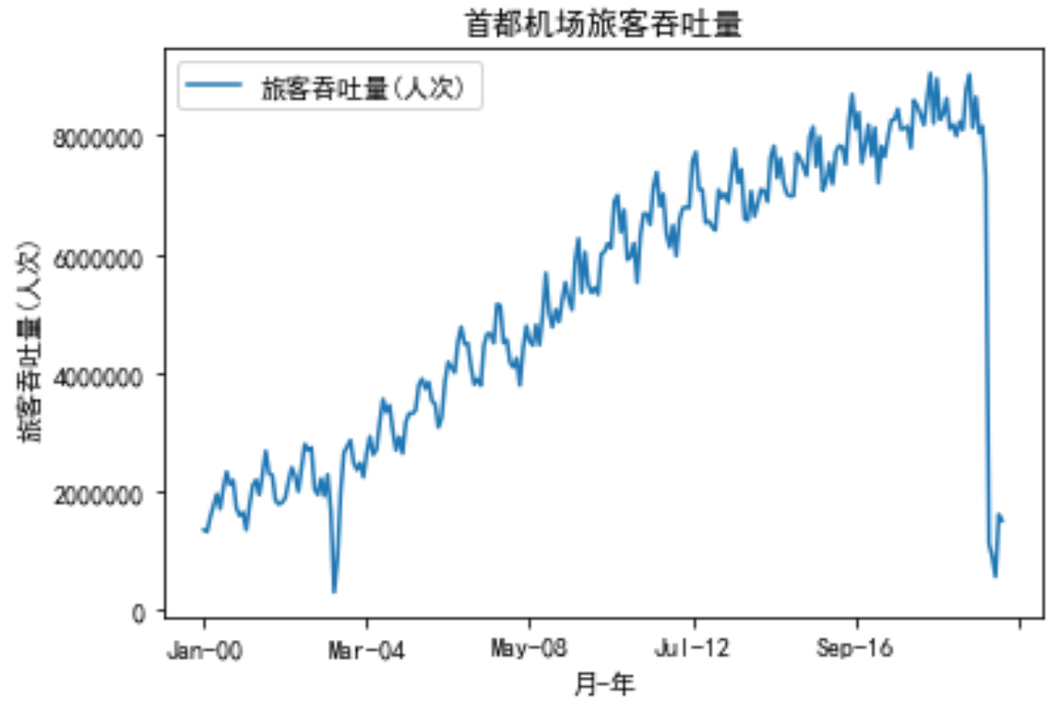
• Daily passenger volume in Beijing Capital Airport during SARS (2003.1-2003.7)

• Daily passenger volume in Beijing Capital Airport after SARS (2003.8-2004.8)

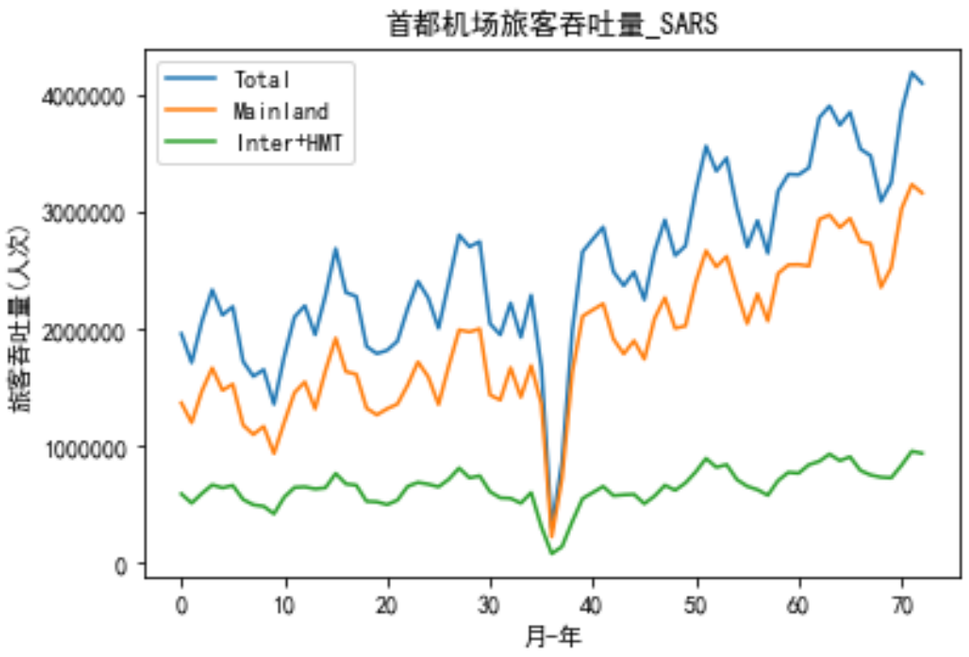
• *Data Source: Beijing Capital Airport Officials, National Bureau of Statistics, Civil Aviation Administration, Industrial Securities Research Institute of Economics and Finance*

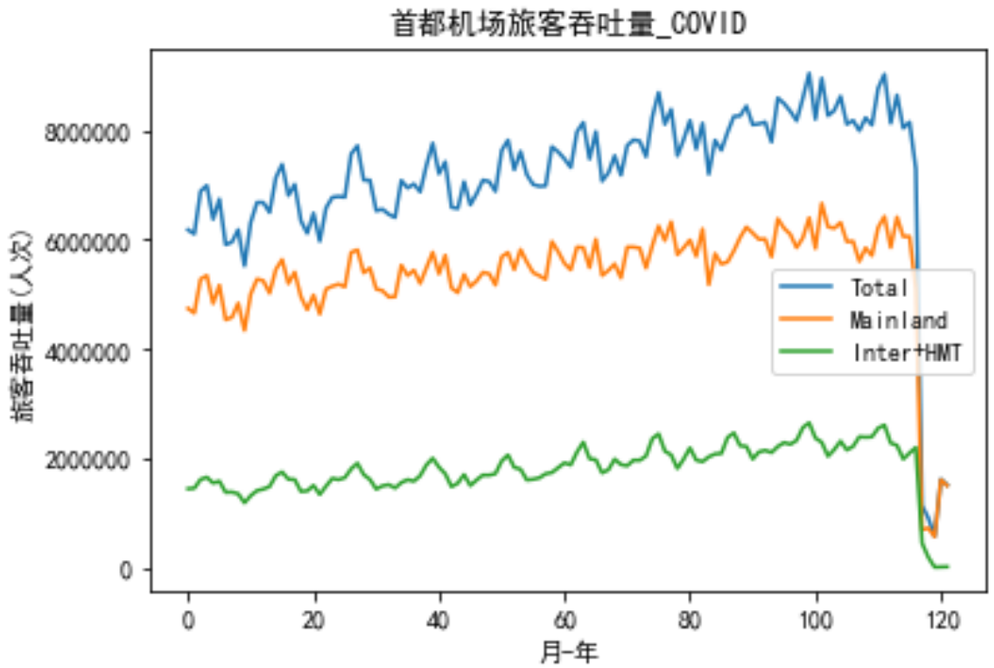
Data Preprocessing

- To get a perspective, Monthly Total Passenger Volume in Beijing Capital Airport (BCA) was plotted, as well as Domestic Volume and International Volume



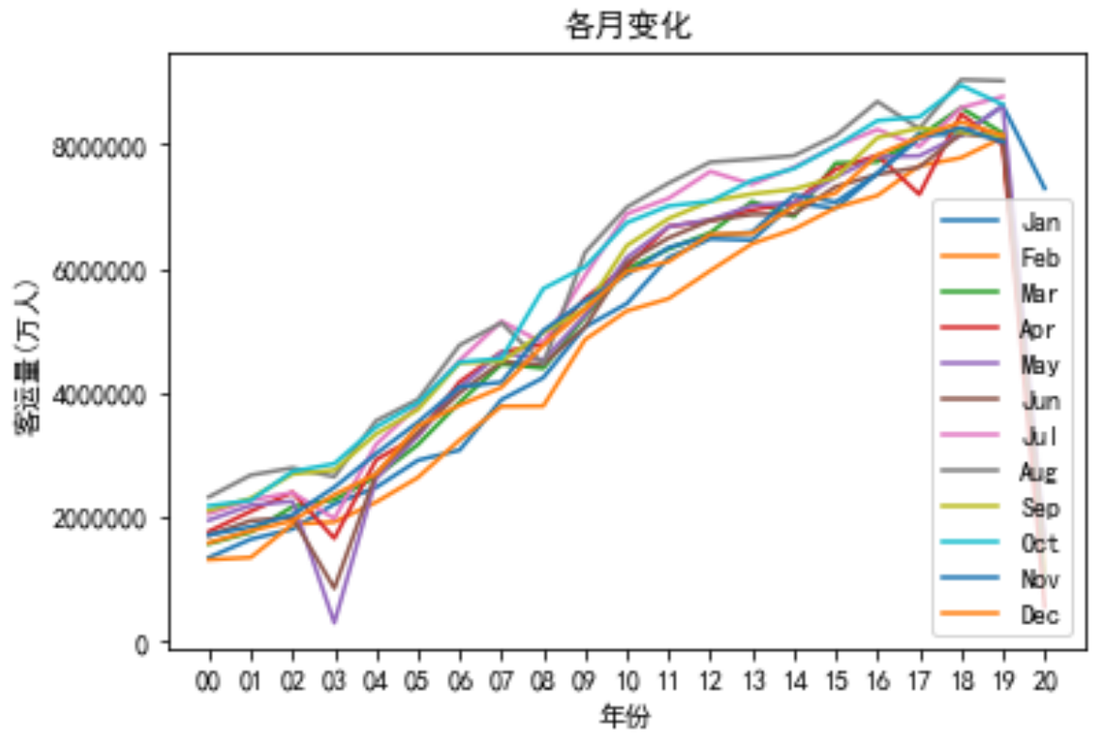
- We focused on the change of Total/Domestic/International Passenger Volume in BCA during SARS and COVID respectively



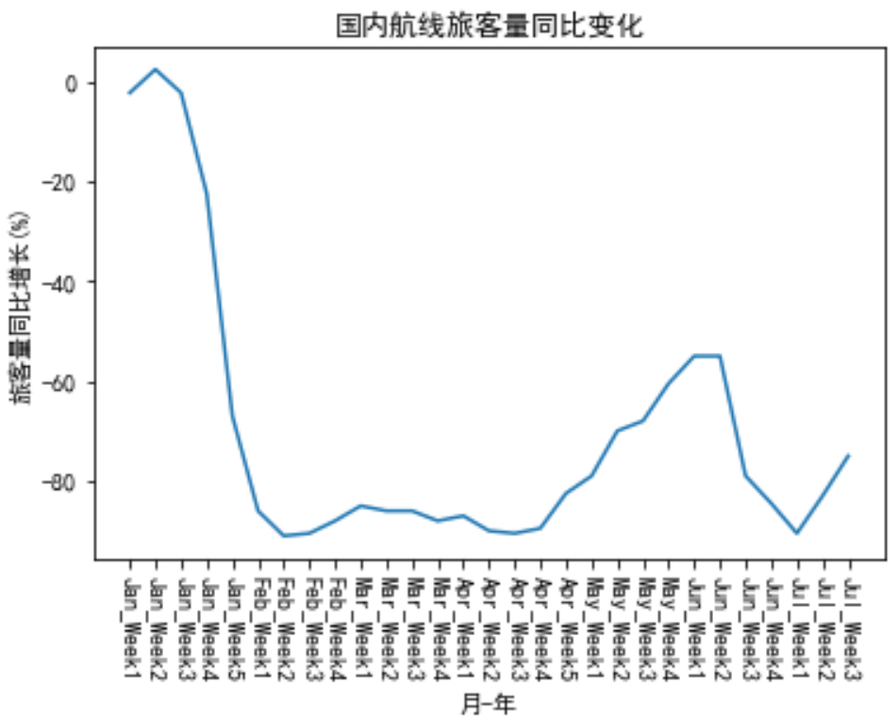


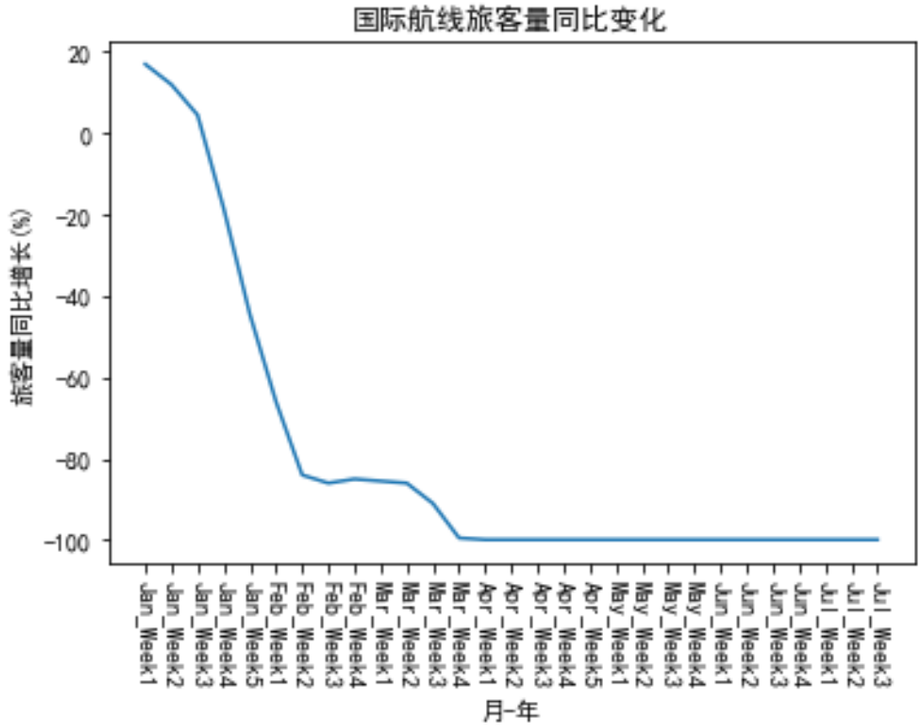
Data Preprocessing

- We plotted the change of Total Passenger Volume in BCA in terms of 12 months in every year to find the difference from month to month



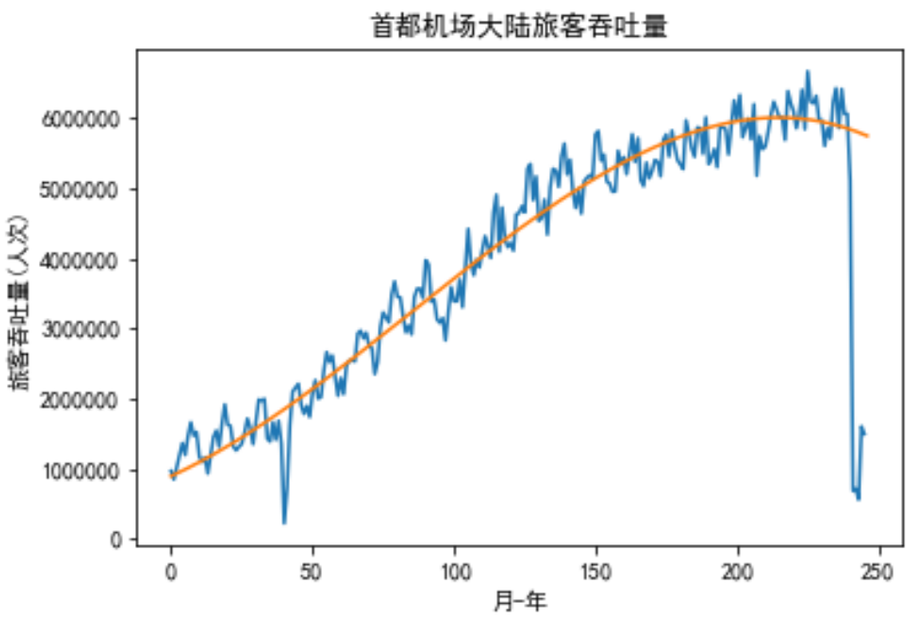
- We plotted the month-on-month change of domestic and international passenger volume from Jan, 2020 to Jul, 2020 to have a view of recent recovery of air industry



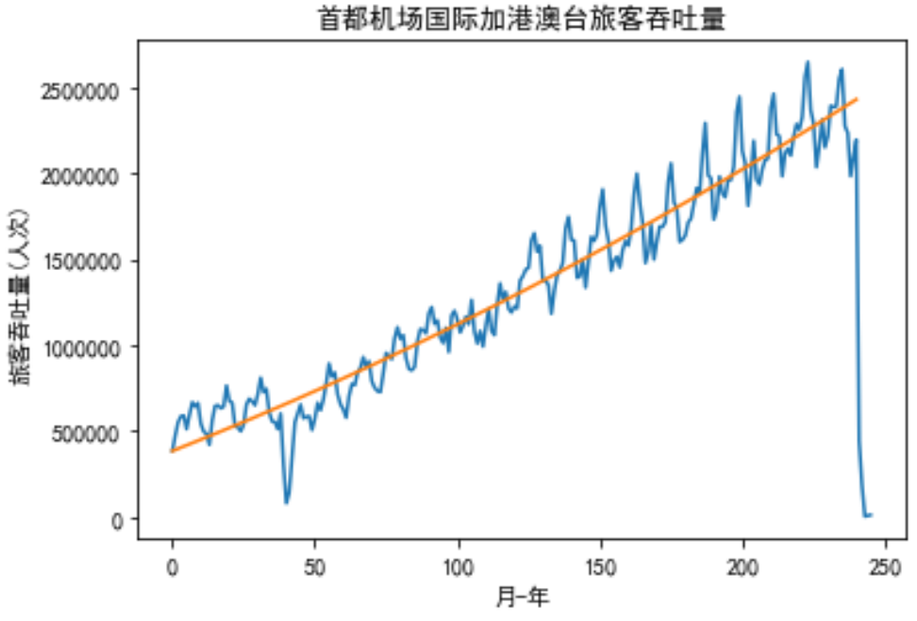


Data Analysis/Model

- First, we used polynomial-basis linear regression to find the trend of the change of monthly passenger volume (without outliers i.e. COVID), applied cross-validation and bootstrapping during training



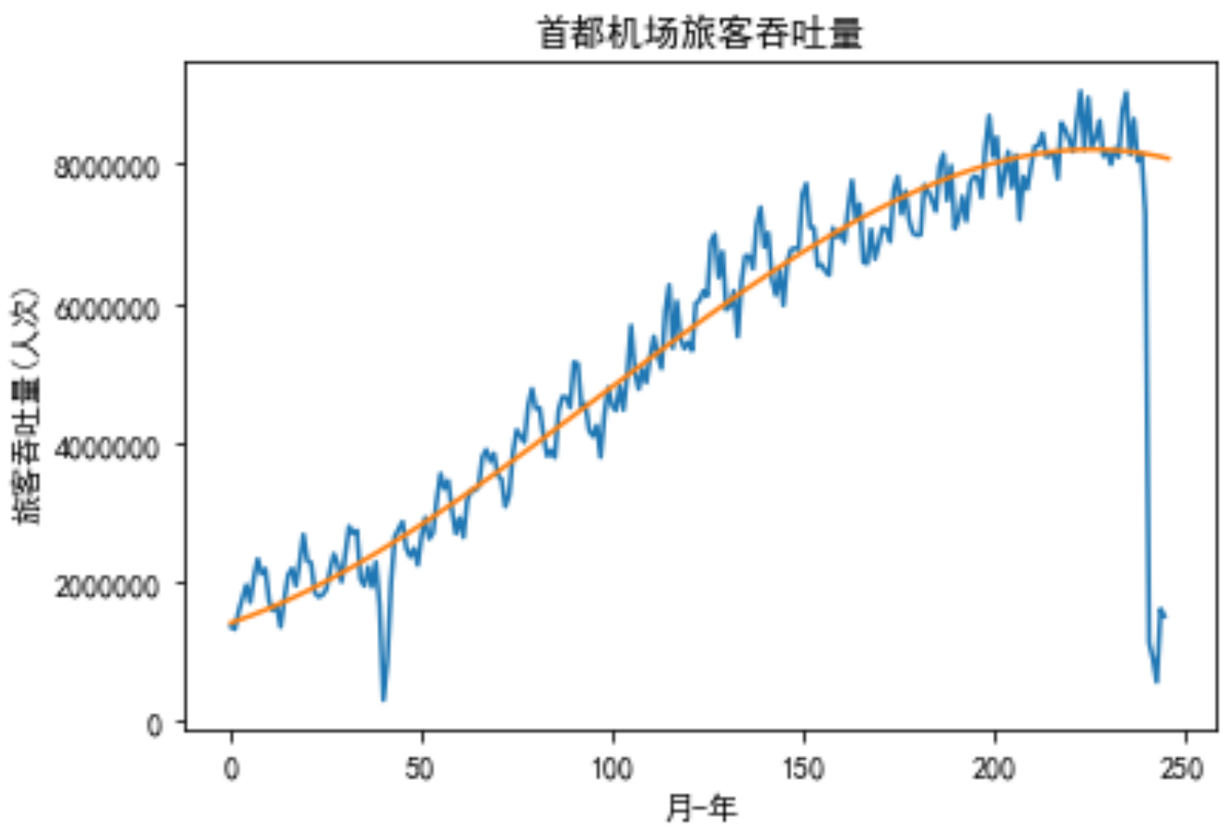
Degree-of-3 polynomial gives the lowest mean of squared error



Degree-of-2 polynomial gives the lowest mean of squared error

Data Analysis/Model

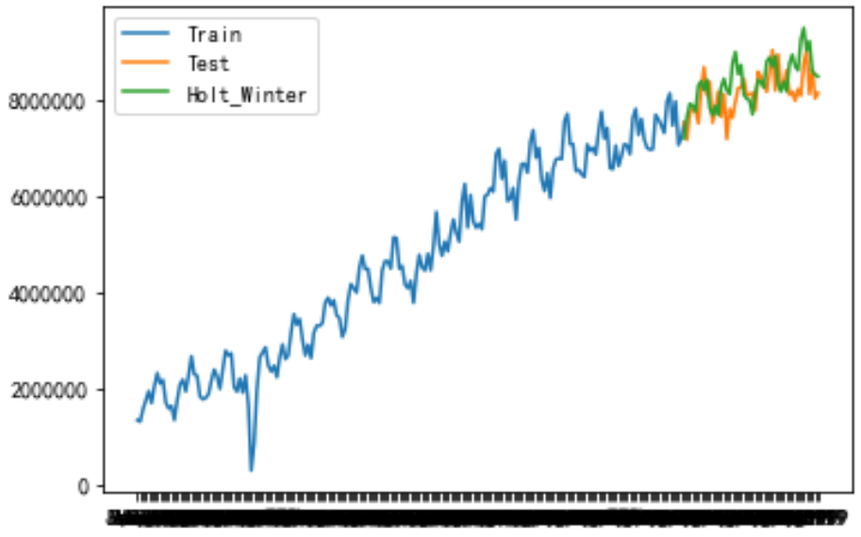
- It suggests that domestic volume is converging to a ceiling while international volume is still increasing linearly. Based on the current international situation, it's reasonable to say that the passenger volume cannot recover to the level before COVID in the next 12 months, and the recovery of domestic would not be huge like after SARS since the capacity of BCA converges to its saturation.



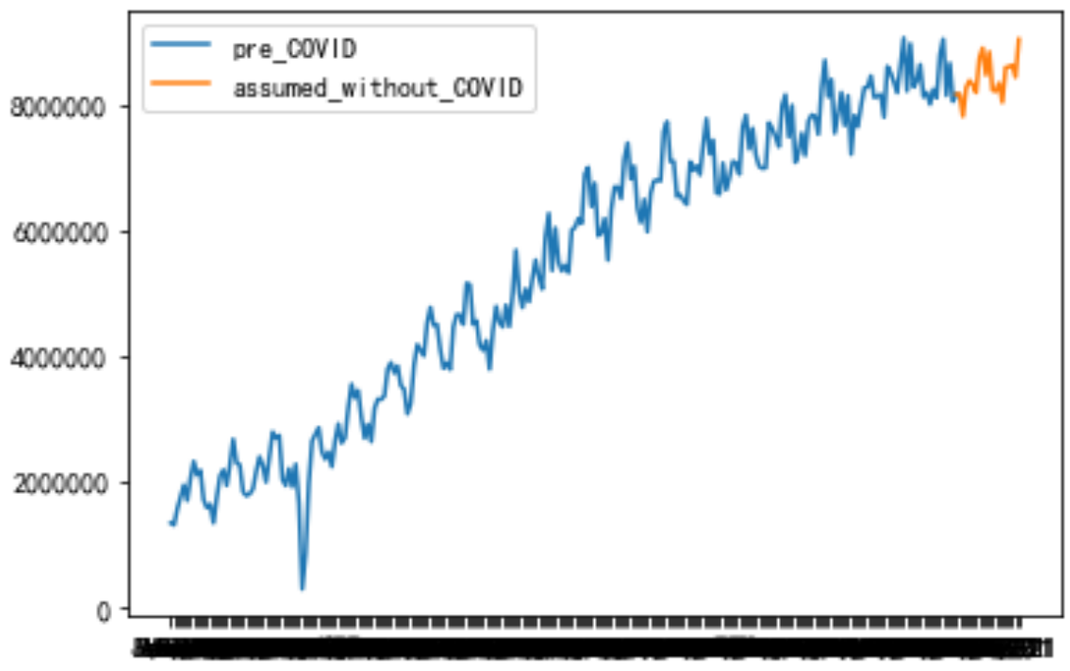
Degree-of-3 polynomial gives the lowest mean of squared error

Data Analysis/Model

- Consider to the seasonality and tendency of air industry shown in the plot, we decided to use Holt-Winters seasonal forecasting model, to make a predation of passenger volume without the affects of COVID.



We trained multiple seasonal_periods and found that period of 24-month with ‘additive trend and seasonal’ gives the lowest validation error



- Based on the best-fitting model, we constructed a prediction of passenger volume in the next 12 months without the affects of COVID. We applied this as our base line later on.

Factors

Domestic Epidemic Rebound

- Beijing, Dalian, Urumchi second round epidemic

Government Support

– Exemption of civil aviation development fund
– Subsidize airline company

Vaccine

- Actively estimate come in March 2021

Trade War

-Trade War between America and China intensified

Air Travel Restriction

- ACCA restricts flight seat occupancy rate <=75%
- Foreigners entry bans
- Flight suspensions—“Five one policy”

World Epidemic Unstable

- American countries (US, Brazil) now are the centre of epidemic
- Europe, Japan occur the second round epidemic

Recovery of tourism

– Consumer sentiment in tourism is 13.8
– Consumer sentiment in tourism for future is 63.4 (still a low state), the recovery of tourism is more likely to be a Curvilinear gradual process

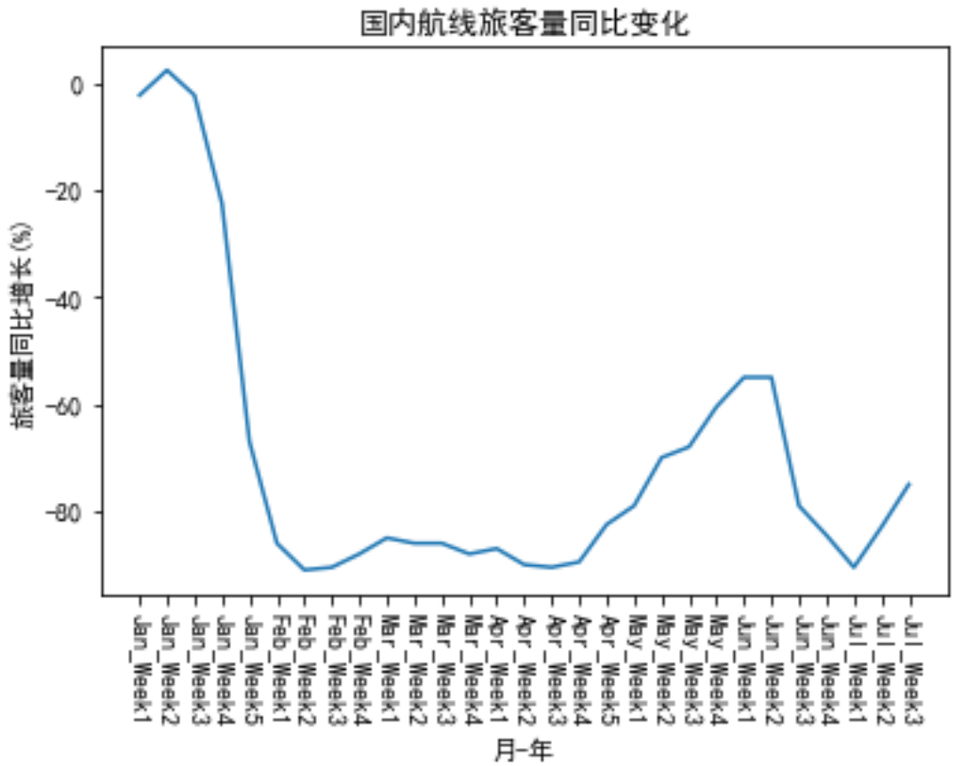
Consumer Confidence

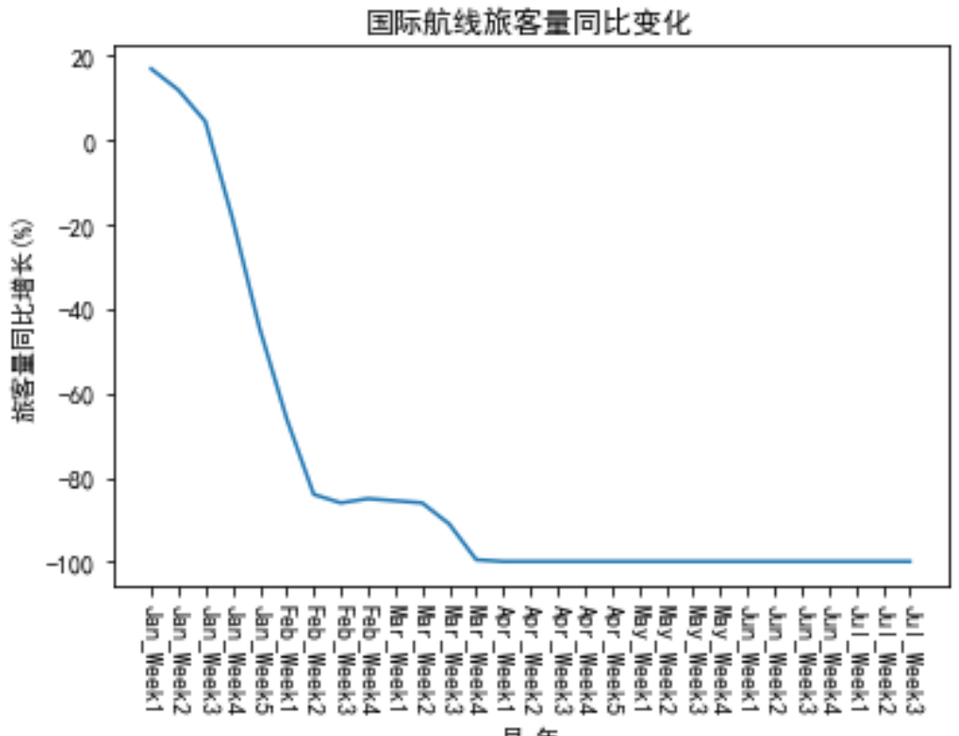
Airline self-help

- Some airlines release "Fly as you wish" products to encourage travelling (¥ 2999)

Prediction

- The key point of our prediction is that we make predictions on the month-on-month change of domestic and international passenger volume respectively first, according to the factors we discussed before. To predict the passenger volume for on month, we plug the expected change-of-rate and the base line we got before (amount of same month last year if there's no COVID) into the formula of change of rate to get the forecasting of passenger volume.





- change-of-rate=((month m this year)-(month m last year)) / (month m last year)

Prediction

Assumptions:

we discussed three situations,

1) There is no rebound of COVID-19;

2) There is a rebound in late August due to the summer holidays;

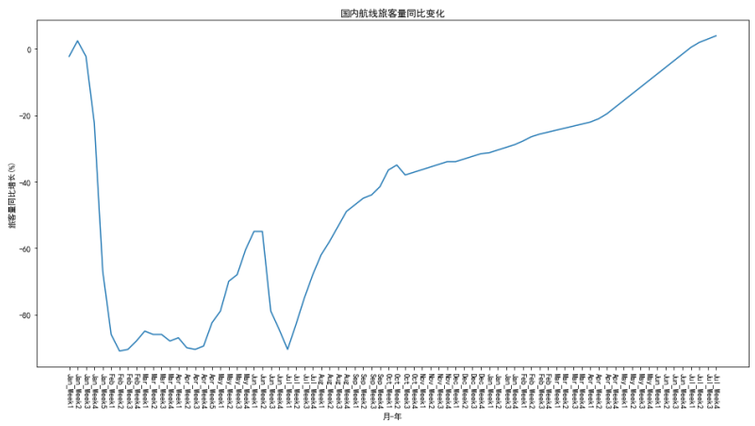
3) There is a rebound in this winter due to the possible biological activities of the virus

In all situations above, we assumed that we would employ the vaccine widely in March 2020.

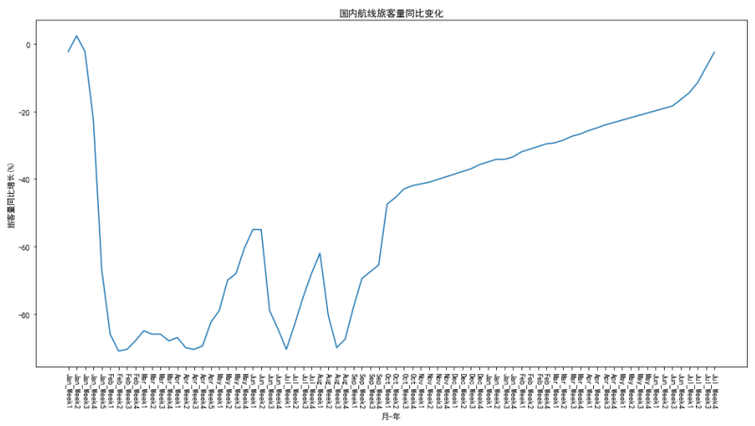
Prediction

- Here are the predictions of domestic and international passenger volume under the three situations we discussed

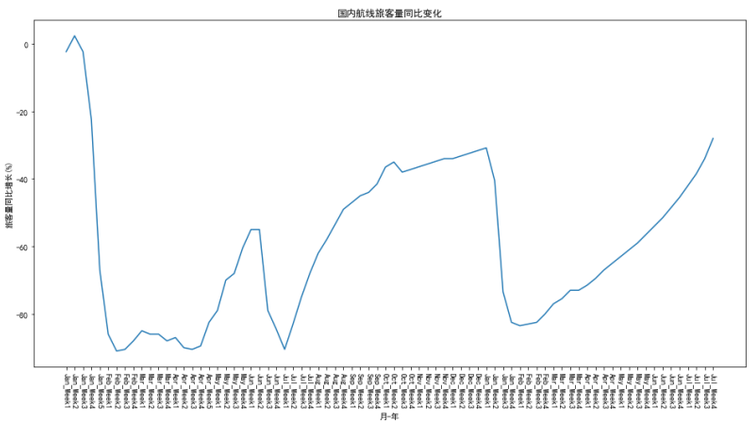
Domestic



1) no repetition

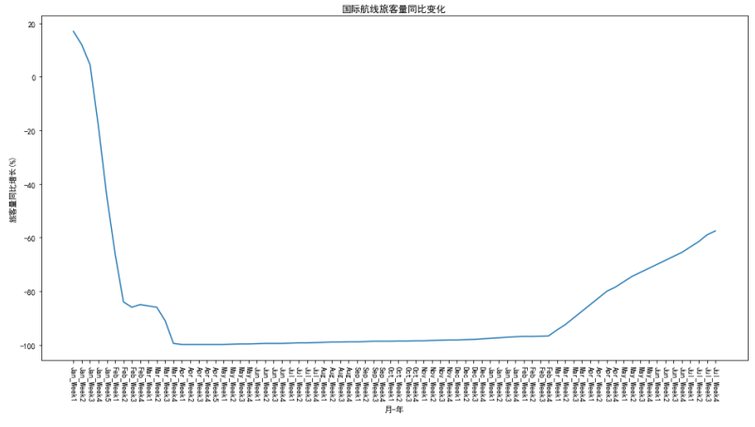


2) repetition in August

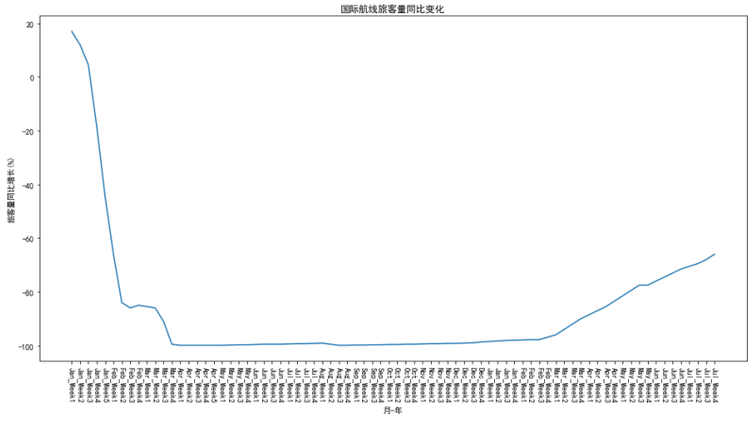


3) repetition in this winter

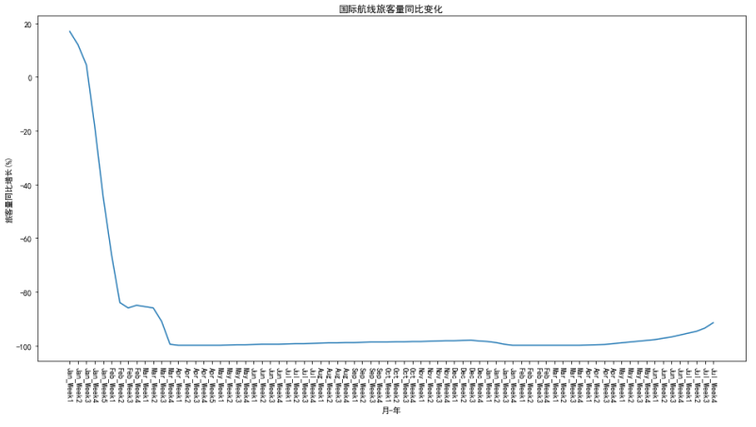
International



1) no repetition



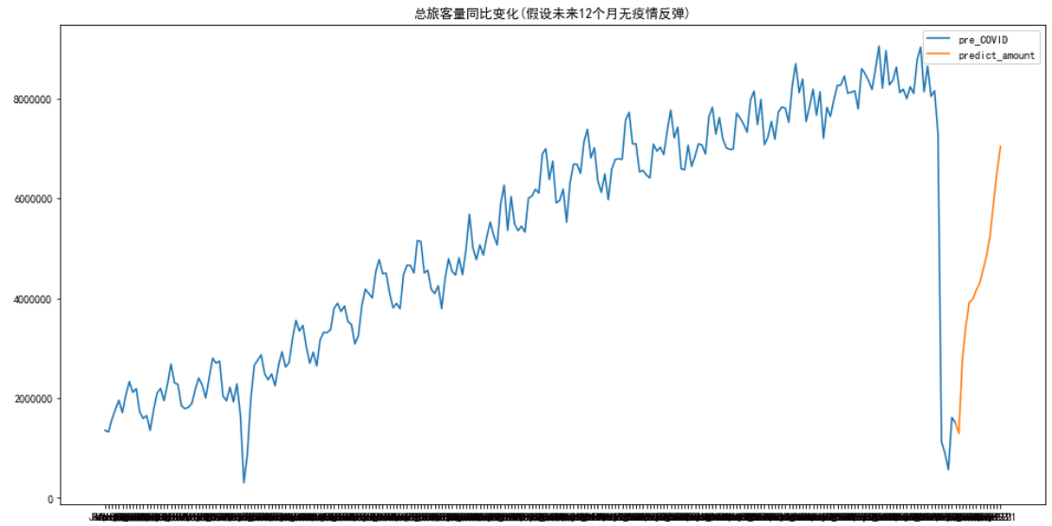
2) repetition in August



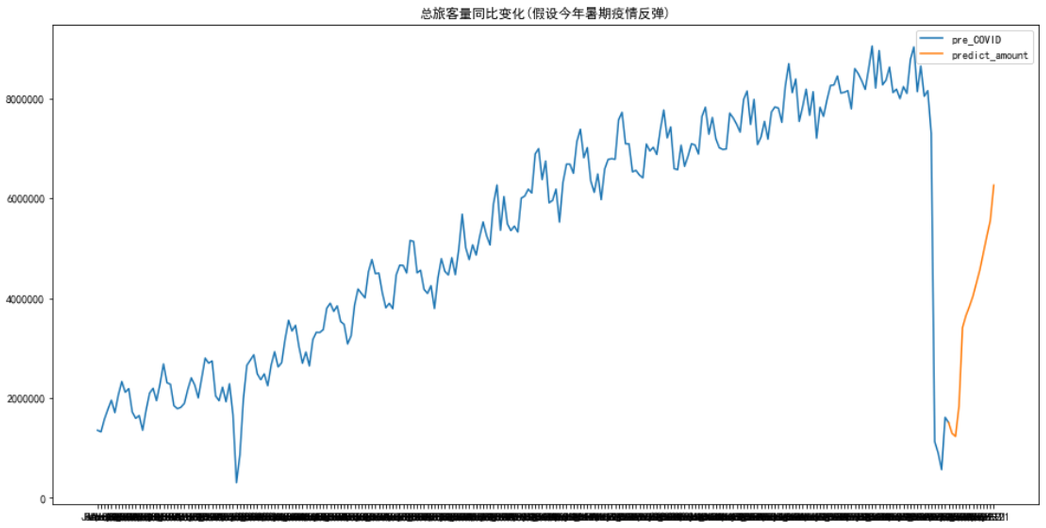
3) repetition in this winter

Prediction

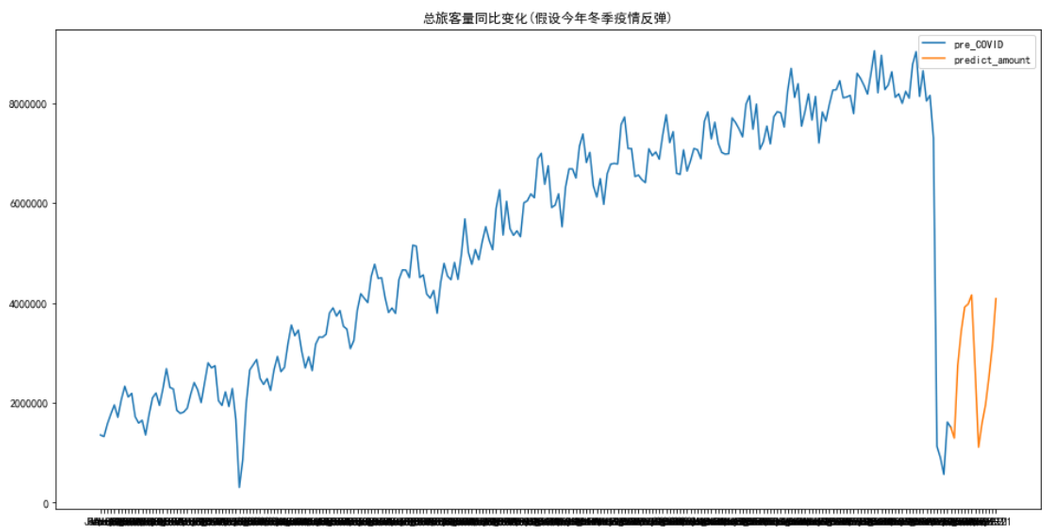
- Then, we applied the formula talked about before, plug in the rate-of-change and baseline. We plotted the predicted total passenger volume in BCA in the next 12 months, under three different situations:



Situation 1) no repetition



Situation 2) repetition in August



Situation 3) repetition in this winter

- *Note: **The predicted volume values can be found in the table:* 首都机场周变化量预测*.csv***

Insights

From the model we build, we get:

1. The daily passenger volume of air industry will have a big increase in July and August (maybe due to the tourism's boom in summer).

2. In November, the daily passenger volume will have a relatively small increase.

3. The passenger volume of international flights will take a longer time (more than 12 months) to be recovered comparing with the domestic flights. Therefore, the air industry's recovery of Beijing Capital Airport mostly should be based on domestic air flights in the next 12 months.

Recommendation

We can focus on three turning points of air industry

- First Turning point —Takeoff inflection point

At the first turning point, the number of flight and traveler gradually recover.

Traveller’s demand for flight is at 30%~40% of the total demand, supply is greater than demand.

Achieve the goal that some airlines sell some flight tickets packages.

Recommendation

- **Second Turning point —Profit turning point**

Traveller’s demand for flight and the price of tickets gradually increase.

Traveller’s demand for flight is at 70%~80% of the total demand, supply is greater than demand.

- **Third Turning point —Profit elasticity inflection point**

Supply of flight tickets is smaller than demand, the price of tickets starts to increase.

References

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