Analysis of Jawa Barat Stayput Trends

Aditya Firman Ihsan

Introduction

Overview

- One of key factors of spreadability of Covid-19 is the frequency of interaction between people.
- Facebook has released Movement Range Data that record how often people are moving from its user's location data.
- This data can be a useful measure to analyze people's efforts in applying physical distancing.

Metadata of The Dataset

1. Datestamp
2. Country Code
3. Polygon (region) data
4. Relative daily movement
5. Daily stayput ratio
6. Baseline

Movement Range Maps Data

Owner: Facebook

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Last Updated: December 16th, 2020

Daily Stayput Ratio

Let,

- $U_{d,r}$: the set of eligible users in region r on day d,
- $tiles(u)$: the number of tiles visited by a given user u in $U_{d,r}$.
- L: Laplace distribution as a noise for privacy framework

Stayput Ratio is proportion of user who stay in one tile* on that day, i.e.

$$\boldsymbol{Ratio} = \frac{\boldsymbol{n_s(U_{d,r})}}{\boldsymbol{|U_{d,r}|}}$$

where

$$n_s(U_{d,r}) = \sum_{u \in U_{d,r}} n_u + L\left(0, \frac{1}{\epsilon}\right)$$

$$n_u = \begin{cases} 1, & tiles(u) = 1 \\ 0, & otherwise \end{cases}$$

*level-16 Bing tile, which is approximately 600 meters by 600 meters in area at the equator

Preparation

- Preparing Data

The data is already in clean table of text file for containing many regions daily data from February.

- Filtering Data

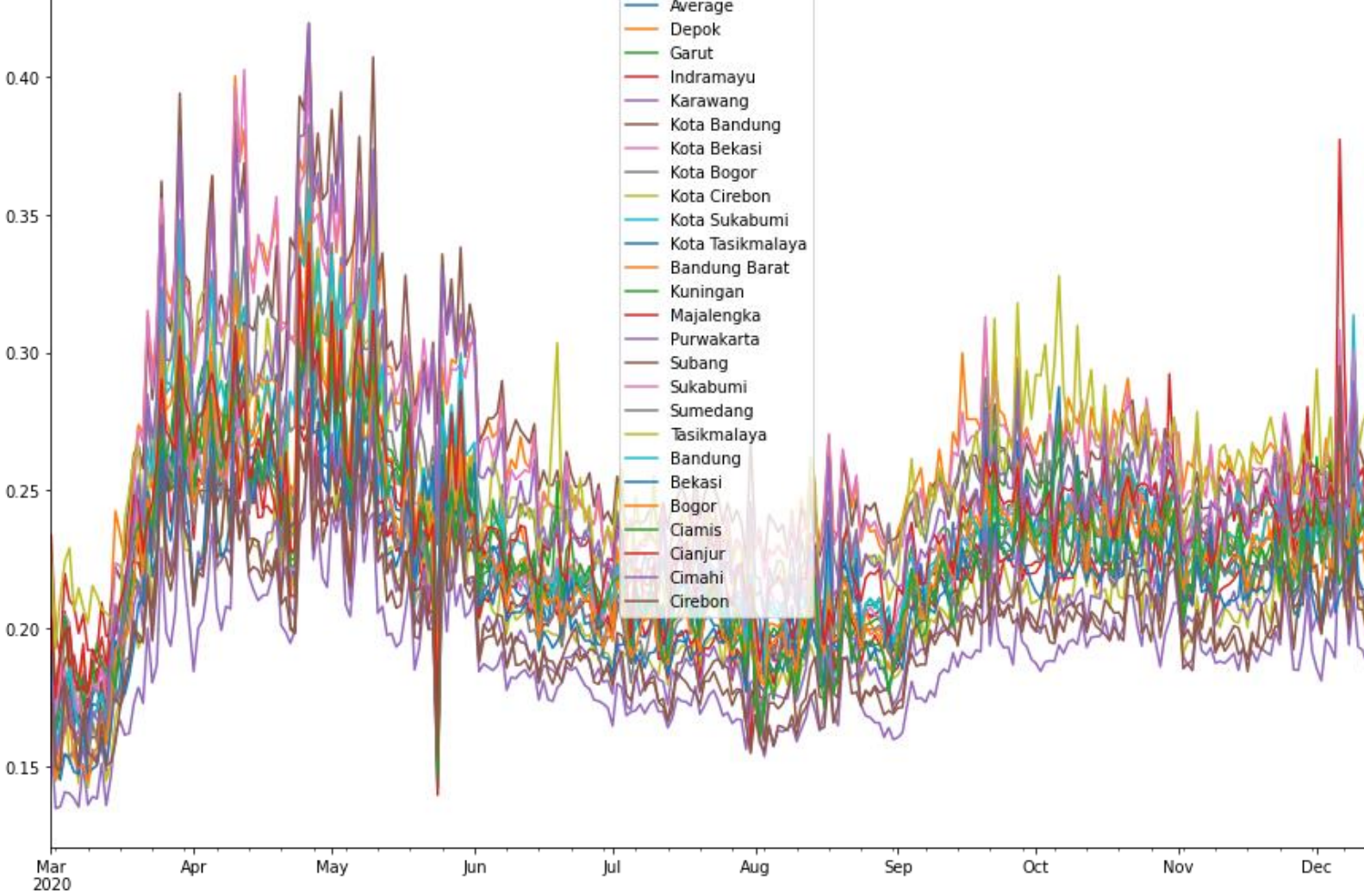
We filter the data to obtain data in all cities and regencies in Jawa Barat. We average it all to obtain overall data for Jawa Barat Province

- Tuning the hyperparameter

We tweaked the learning rate, window size, and batch size of the model to effectivize the forecasting process.

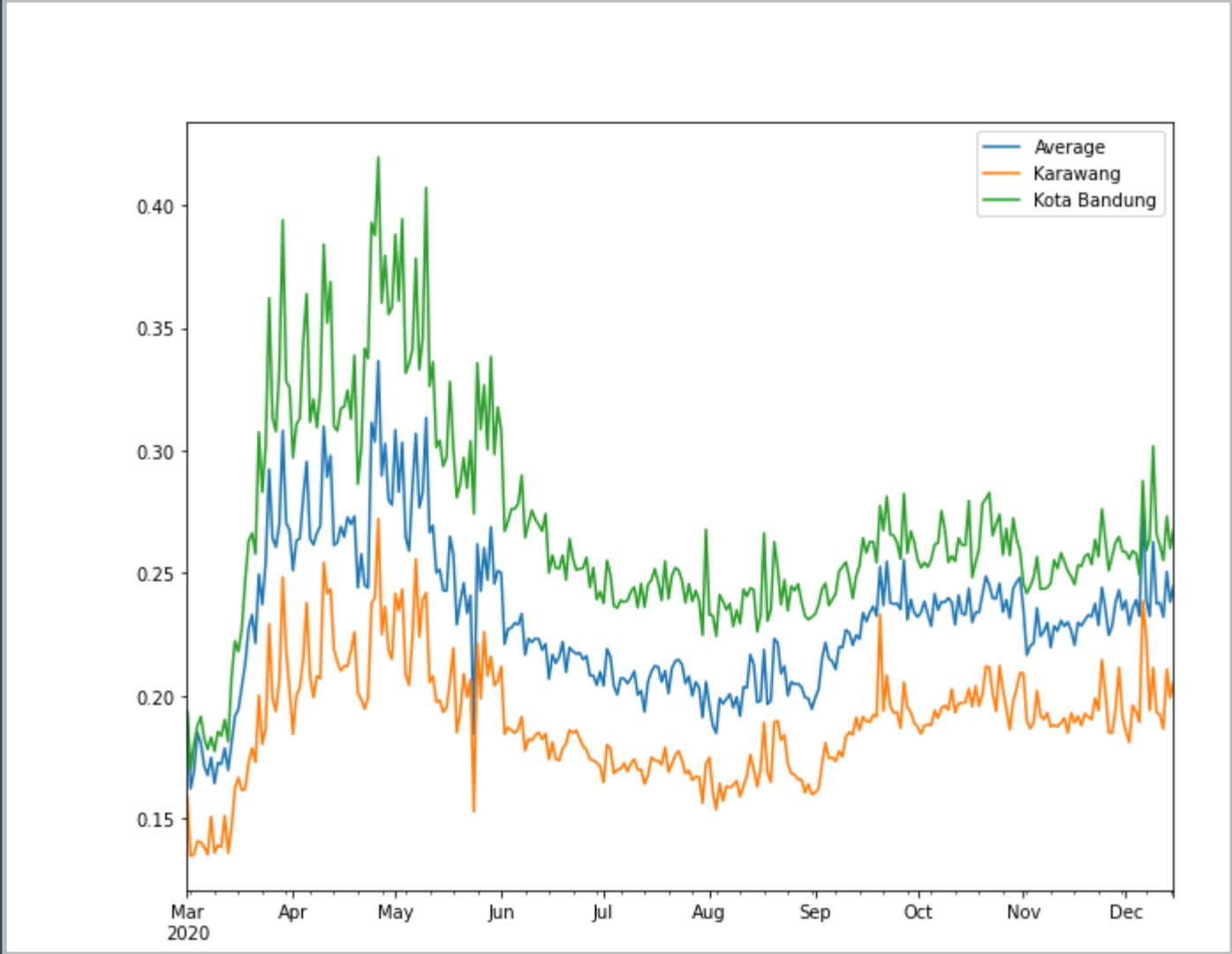
Initial Analysis

Jawa Barat Data Overview



Highest ratio city:
Kota Bandung

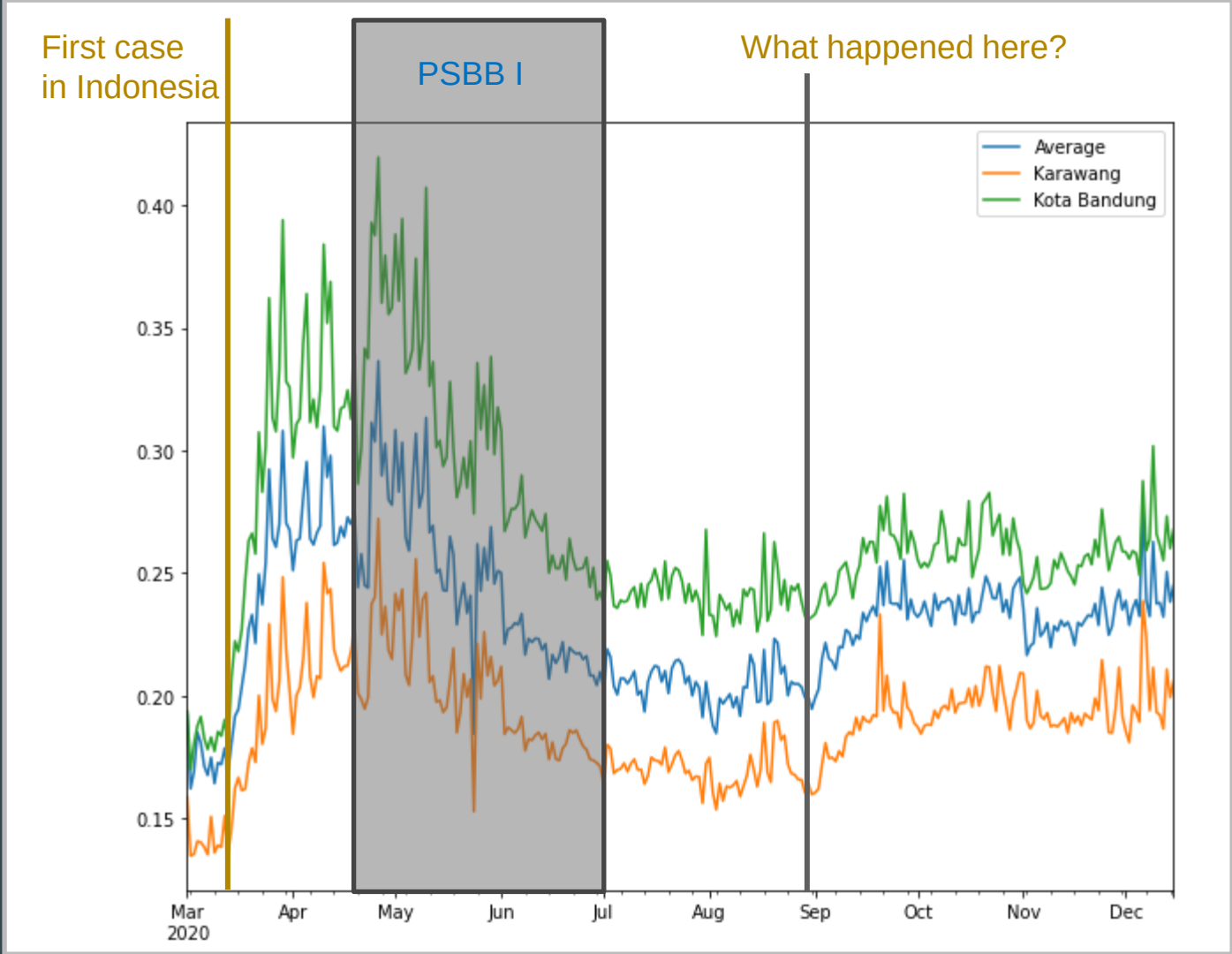
Lowest ratio city:
Karawang



The ratio was skyrocketing just after the first case of Covid-19 was found in Indonesia

The rate keeps high as PSBB is in effect.

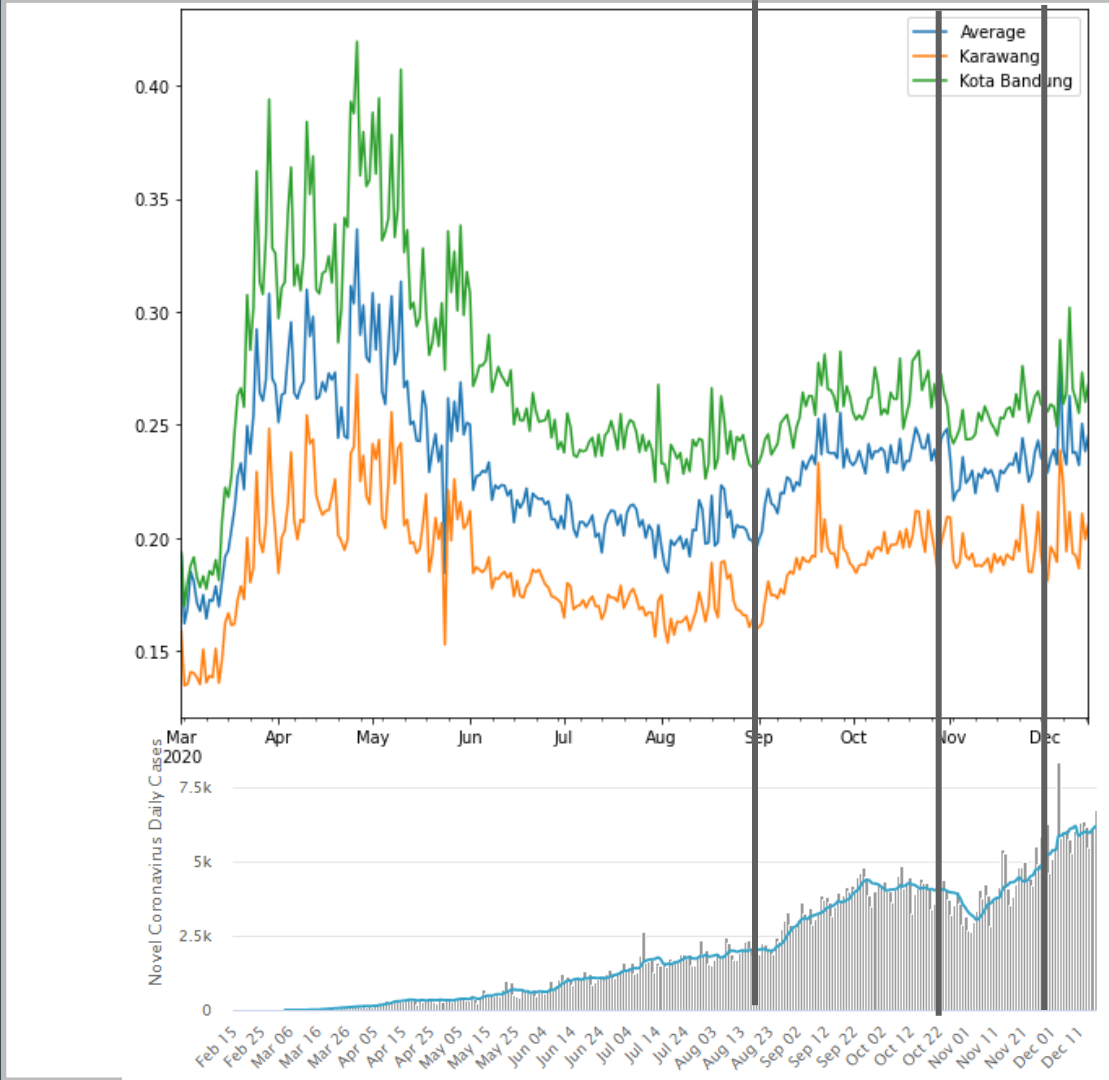
When the new normal policy is implemented, no significant change in the trend



Comparing the graph with daily new cases graph, it can be seen the ratio is in line with new cases number.

When the new cases increases, the ratio increases, vice versa.

Observe three timestamp pointed by lines in the picture



Forecasting

Techniques

Recurrent Neural Network

Moving Average Forecast

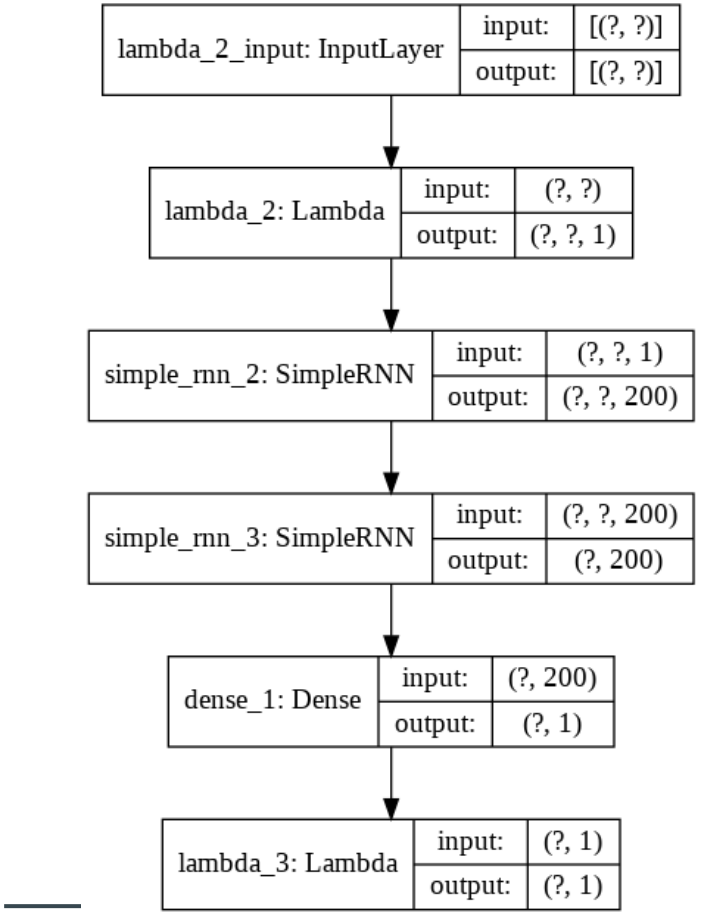
- 10 days window forecast

Recurrent Neural Network (RNN)

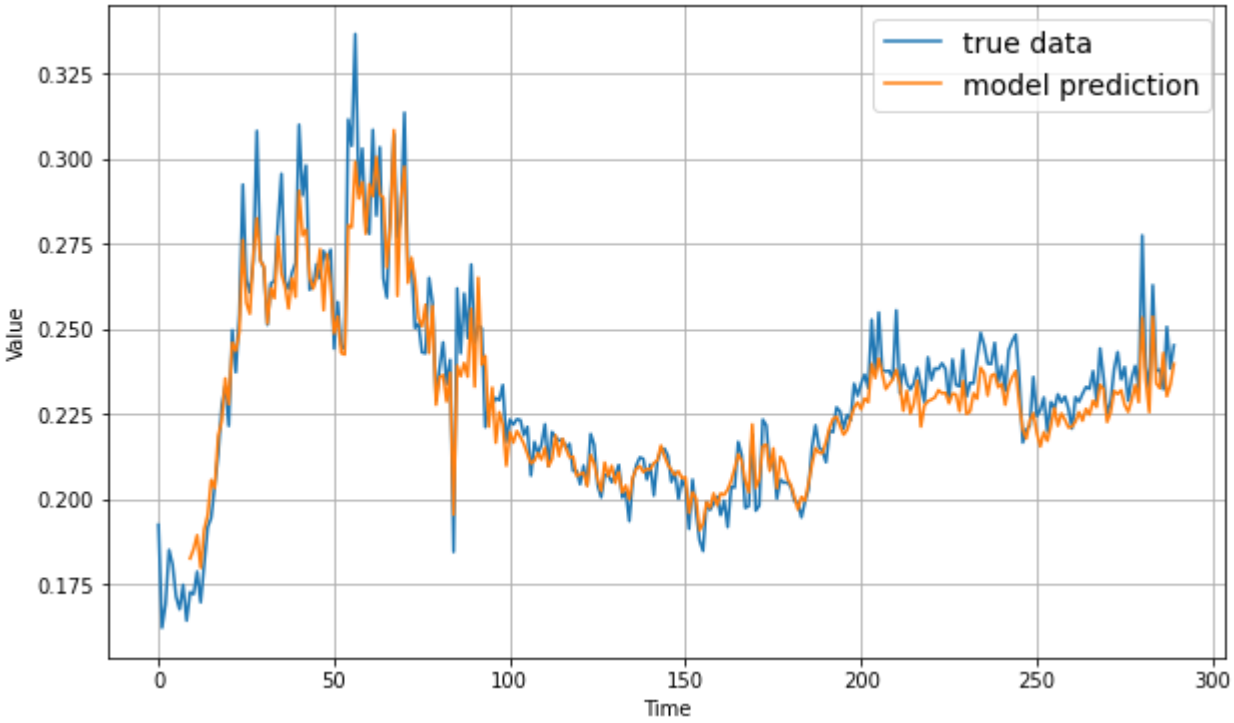
Tensorflow v2.3.0 API

200 cells of Double RNN Layers

Stateless Learning

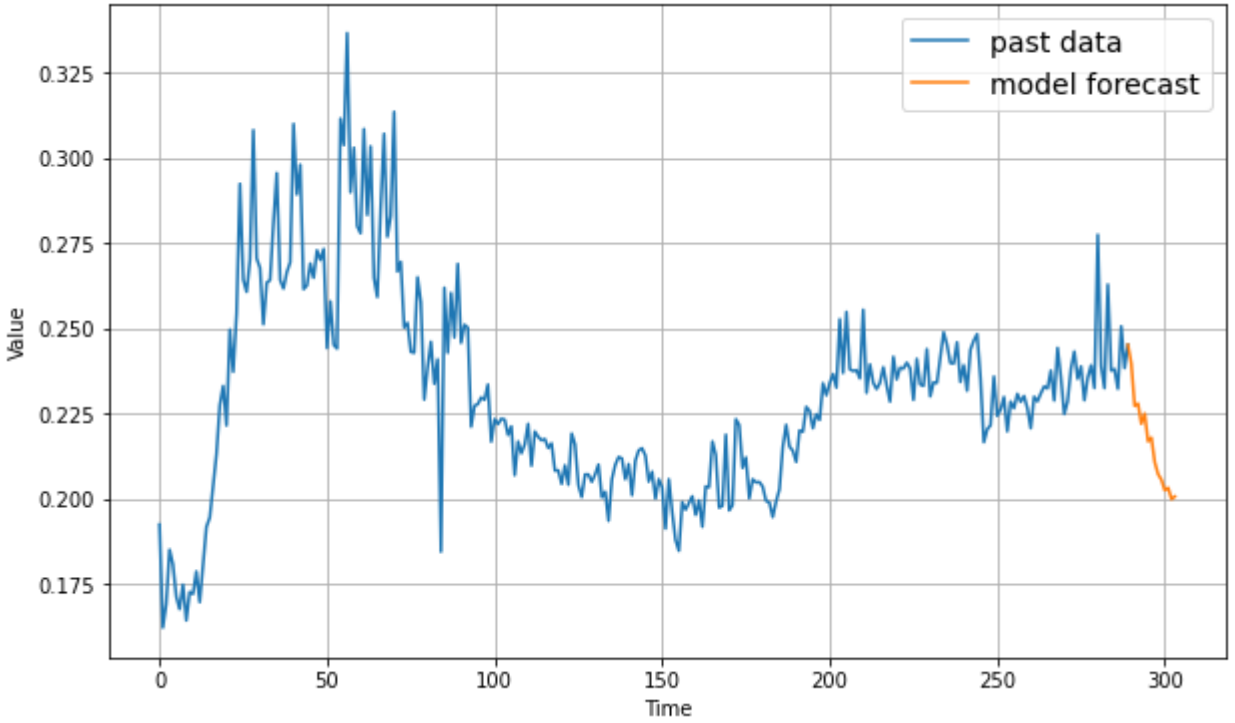


Used RNN Model Architecture



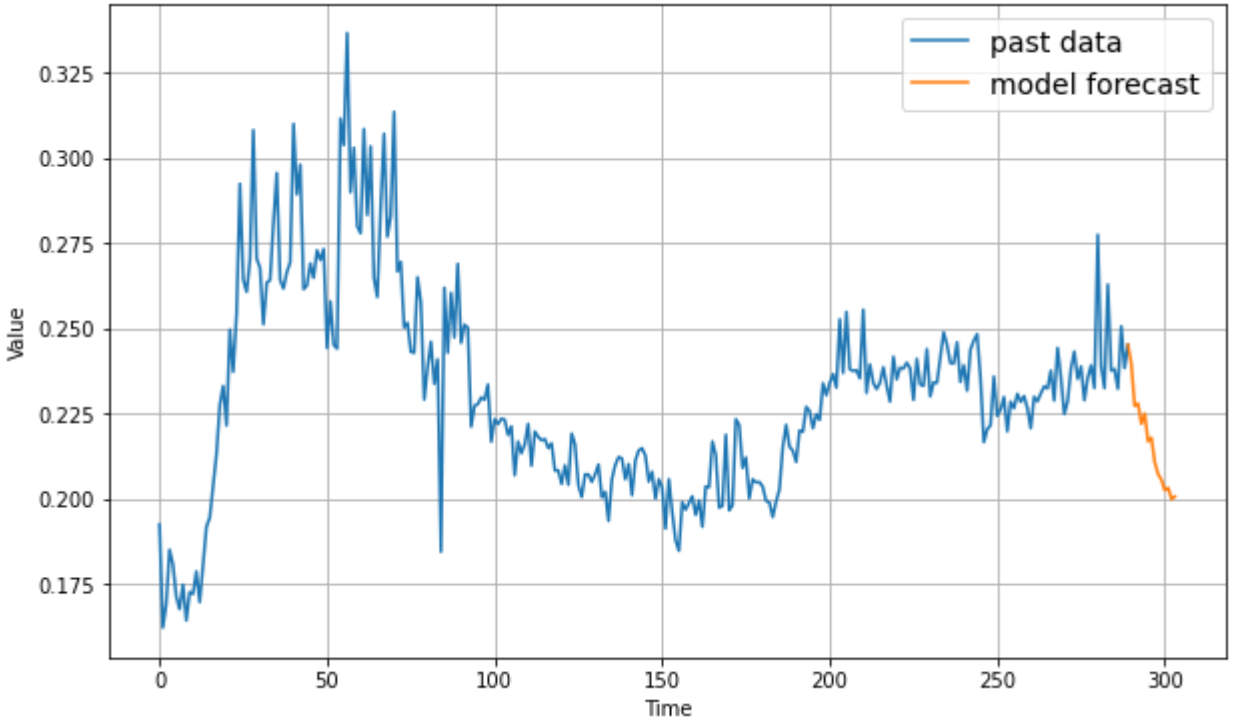
RNN
-Approximation

Mean Absolute Error:
0.006429806



RNN
-Forecast

The model forecast that in two weeks, the ratio will decrease



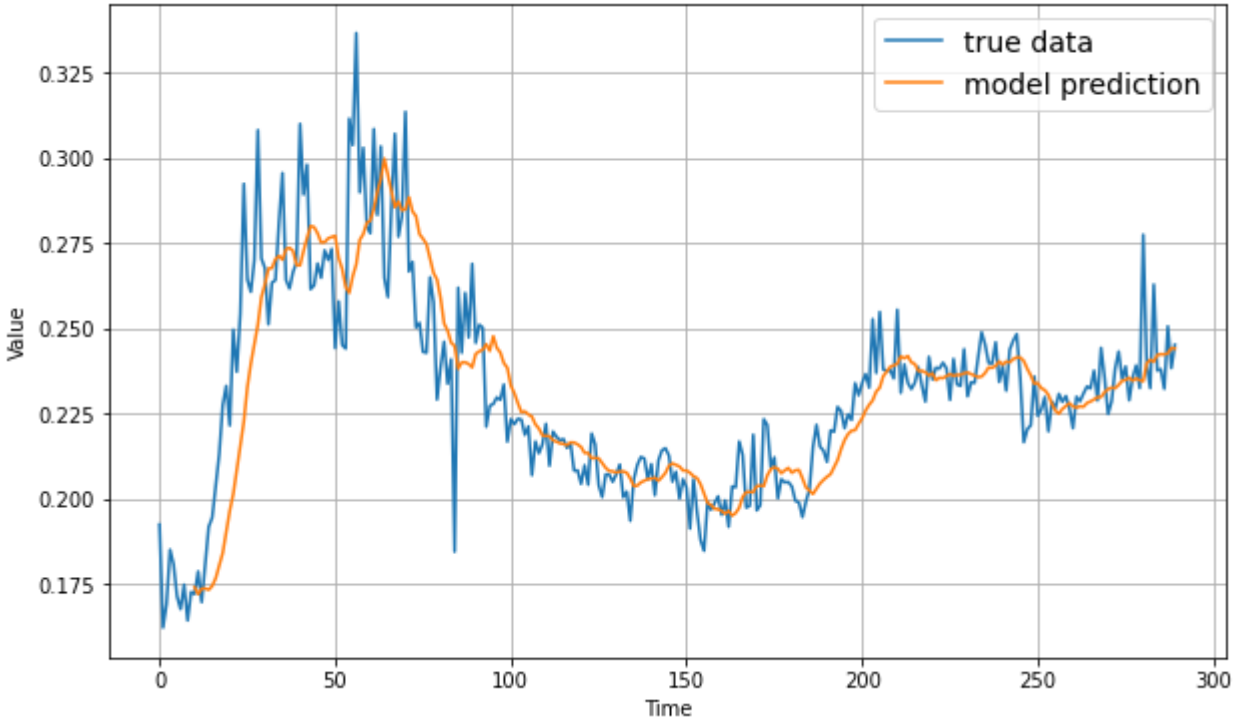
RNN
-Forecast

The model may learn that every time the ratio increases much, it will decrease later

It is acceptable as people can't handle boredom in a long time.

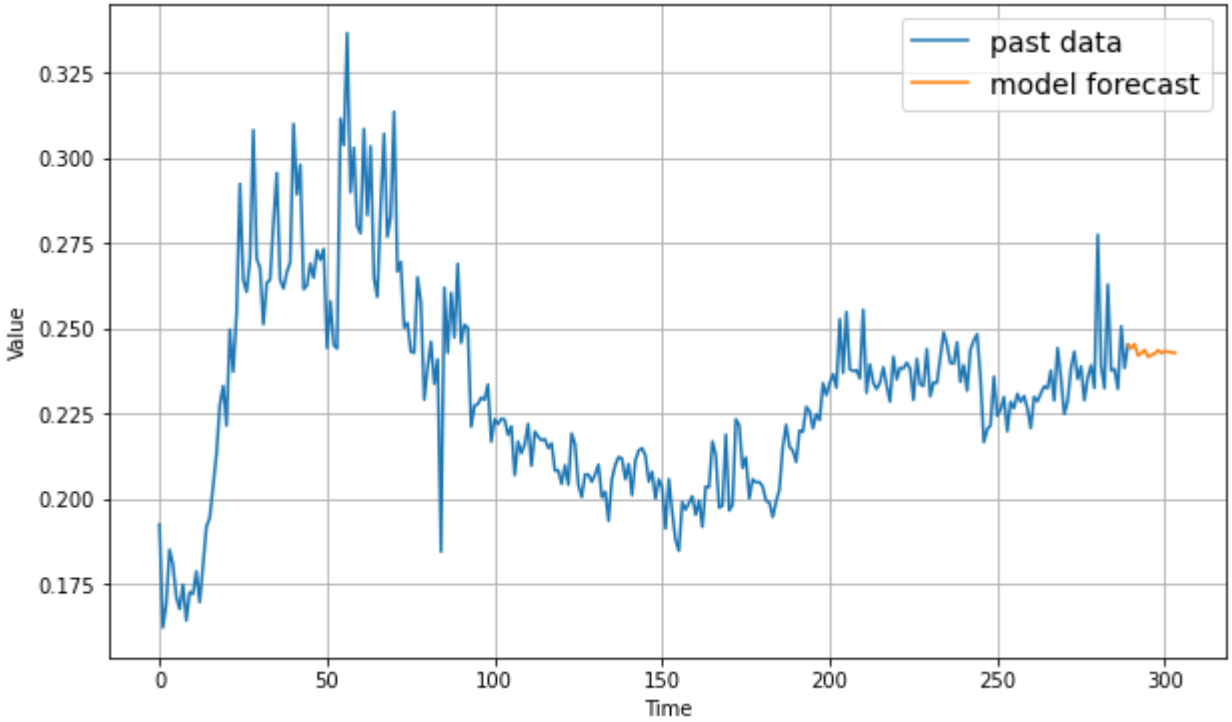
Moving Average

Compute average of data in a time window as approximation for the next data



Mov.Average -Approximation

Mean Absolute Error: 0.0109106907



RNN
-Forecast

The model forecast that in two weeks, no significant change in ratio occurs. This is one of weakness of moving average method

Conclusion

By the model result, we conclude,

- Stayput ratio is in line with number of new cases
- In the next two weeks, the stayput ratio will decrease
- The RNN model is better in giving insight to the time series data

Note:
All codes used in this analysis can be accessed here
https://colab.research.google.com/drive/1ZPN5U0-f36C7Yuisb3uMjsU6YIZ1xbTC?usp=sharing