A MACHINE LEARNING APPROACH TO BUILDING A DIGITAL MAP OF COVID-19

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1. INTRODUCTION

From the end of 2019 until now, the COVID-19 epidemic has spread all over the world, including Vietnam. Governments have promoted the development of many applications to limit the spread of the disease. Besides, there are also many types of research that have proposed GIS application solutions to monitor disease developments. Among them, we are especially interested in GIS applications to support building COVID-19 maps, statistical methods, and forecast models to predict the epidemic situation.

Specifically, GIS-based spatial modeling of COVID-19 (Mollalo, Vahedi, & Rivera, 2020) presented the rate in the United States, using maps to illustrate in the state area. Evaluation of map applications and analysis based on COVID-19 data sources in Europe's population (Pászto, Burian, & Macku, 2020). Reviews on spatial analysis and GIS in the research of COVID-19 highlighted important GIS applications to study COVID-19 (Franch- Pardo, Napoletano, Rosete-Verges, & Billa, 2020). Application of GIS map presented the status of COVID19 cases in Maharashtra state of India (Kodge, 2021). The Prophet package was used to predict covid-19 cases in India (Indhuja & Sindhuja, 2020). In general, the studies focused on forecasting and presenting maps showing the epidemic situation of countries.

In the scope of this research, we build a digital map application to support observing the COVID-19 epidemic situation in Vietnam. The map has the automatically update new data about the epidemic situation and detailly present information about the developing epidemic situation. And focus on analyzing epidemic data in the Ho Chi Minh City area to basically predict the number of patients with days using methods of machine learning. Because now the epidemic in the city is the most increasing. This issue is a concern to the whole society.

2. DATASET DESCRIPTION

- Spatial data: Shapefile data of 63-province Vietnam was collected from the Open Development Mekong (ODM) at website (https://opendevelopmentmekong.net).

- Attribute data:
Attribute data of COVID-19 cases is collected at the website of the Ministry of Health.

Table 1. The five samples of cases of each region in Viet Nam

Region	Total
TP HCM	90243
Bình Dương	14679
Long An	5443
Đồng Nai	4126
Khánh Hòa	1710

Table 2. The five samples of cases in Ho Chi Minh City

Date	Total
2021-07-31	4180
2021-07-30	4282
2021-07-29	4592
2021-07-28	4449
2021-07-27	6318

3. PROPOSED METHOD

In this paper, we based on two main library packages:

(1) The Arcpy package is used to support building a digital map representing the number of covid cases by areas. The digital map has the ability to automatically update the map state when the attribute data changes over real-time. In this section, the digital map will continuously automatically show the epidemic situation of provinces and cities so that managers can know the epidemic situation across the country. When the epidemic data changes, the map also updates. In addition, the map presents additional statistics on the epidemic situation.

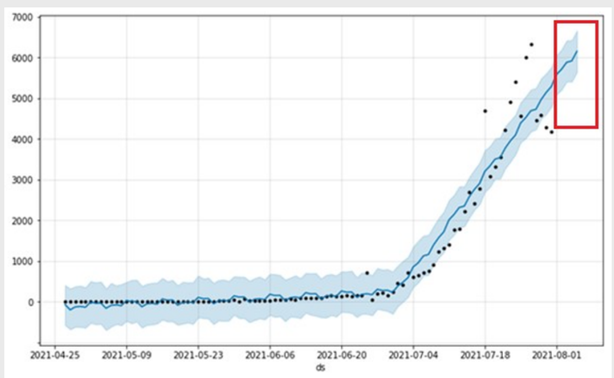

Figure 1. Result of build-in forcasting model.

(2) The Prophet package supports building a machine learning model to predict the number of covid cases in the near fut ure. In this forecast, we only focus on the Ho Chi Minh City area. Because this area has seriously been affected by the Covid-19 epidemic currently. The number of daily infections is increasing rapidly. Therefore, we are very interested and want to build a forecasting model for that area. According to exploratory data analysis, we found the dataset to be very suitable for the Prophet forecast model we proposed.

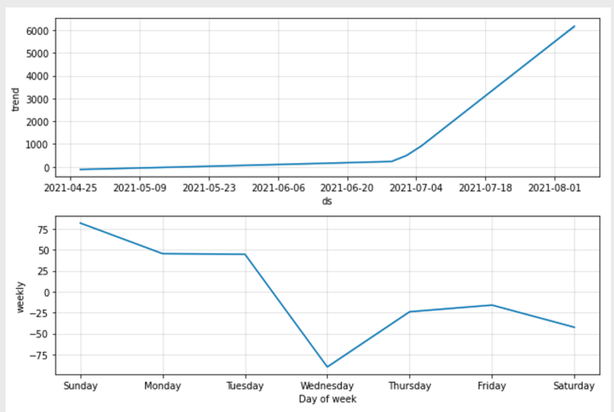

Figure 2. Trend of dataset using build-in forcasting model.

Table 3. Results of 5-day prediction in Ho Chi Minh City.

Day	yhat	yhat_lower	yhat_upper
2021-08-01	5575.304875 ~ 5575	5086.763709 ~ 5086	6047.794081 ~ 6047
2021-08-02	5708.581069 ~ 5708	5201.778696 ~ 5201	6195.450087 ~ 6195
2021-08-03	5877.611387 ~ 5877	5406.962430 ~ 5406	6413.376456 ~ 6413
2021-08-04	5913.098525 ~ 5913	5403.379973 ~ 5403	6423.361159 ~ 6423
2021-08-05	6148.652844 ~ 6148	5641.224548 ~ 5641	6658.201478 ~ 6658

4. RESULTS

Map of the situation of the COVID-19 epidemic in Vietnam by the method of representing the quality background. The map shows the epidemic situation distributed over 63 provinces in Vietnam with main
information as follows: total number of cases and results of 5-day prediction in Ho Chi Minh City. The overview interface of the results is shown in Figure 3.

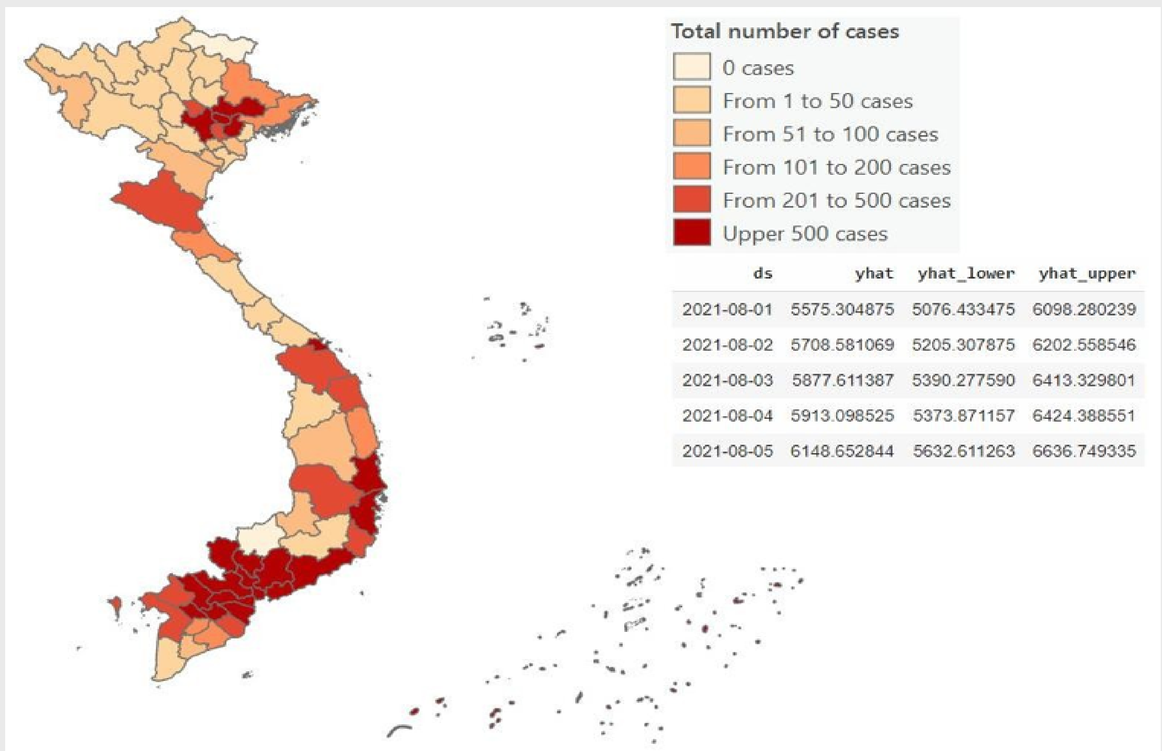

Figure 3. Overall results.

Figure 3 presents the results of the study. The left part is an automated map showing the COVID-19 epidemic situation of regions of Vietnam. The right part presents the scales showing the number of cases in the regions and the forecasted results of the total number of cases at Ho Chi Minh City in the next 5 days.

5. CONCLUSIONS

This paper presented a method for building an automatic digital map to visualize the COVID-19 epidemic situation of administrative regions in Vietnam and a forecast analysis of the number of cases in Ho Chi Minh City. The implementation method is based on two main approaches ArcPy package and Prophet package on Python programming. Firstly, after completing the application, the combination of both ArcGIS Pro and ArcPy for building an automatic digital map not only saves time and effort but also has high accuracy. That has helped us to complete an automated digital map of the covid-19 epidemic extremely smoothly. Secondly, the prediction results of the Prophet machine learning model are also acceptable. This forecast will help managers plan to respond to the growing number of patients. The downside of the Prophet model is that it only correctly predicts when the trend is up or down, does not predict when the number of cases will peak or when the epidemic is likely to end. The results are well applicable, taking advantage of the advances and new features of the software, contributing to improving the position of maps and geographic information systems in many fields.

In future work, we will conduct more automatic data collection from COVID-19 news websites of the Ministry of Health. That means we will build a website scraper and crawler that will automatically get the data when the source site changes. Then the map can perform real-time data updates.

6. REFERENCES

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