

Relationship between daily number of COVID-19 cases and climate factors using multiple linear regression analysis method in Thailand

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ABSTRACT

A novel coronavirus, now referred to as 2019 Novel Coronavirus (2019-nCoV), is an emerging disease that the World Health Organization had declared a pandemic on 11 March 2020. In this study, the relationship between climatic factors affecting the spread of the virus in Thailand from 01 June 2021 to 30 July 2021 was studied using multiple linear regression analysis method in R. Factors used in the study comprised minimum temperature (°C), maximum temperature (°C), precipitation level (mm) and wind speed (m/s). The results showed that the daily cases was significantly related to maximum temperature in Bangkok ($r = 0.2315$; $p = 0.000529$), Samutprakan ($r = 0.2448$; $p = 0.0208$), and Chonburi ($r = 0.2057$; $p = 0.00242$). The finding might be useful as a contribution to a policy making in terms of the awareness of covid-19 and other airborne infectious diseases outbreak during rainy season in Thailand.

1. INTRODUCTION

Coronavirus disease (COVID-19) is an infectious disease caused by a novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) (WHO, 2020). In early December 2019, an outbreak of COVID-19 originally occurred in Wuhan City, Hubei Province, China and later on January 30, 2020, the World Health Organization declared the outbreak as a pandemic incident with Public Health Emergency of International Concern. On January 12, 2020, in Bangkok, Thailand, the first COVID-19 patient was discovered. The infection has since spread throughout the country affecting various provinces.

Extreme climatic conditions could play a role in the virus's rapid spread, according to Wang et al., 2010's study. COVID-19's potential spread may also be predicted by latitude and seasonality (Sajadi et al., 2020). Certain climatic circumstances have also been recognized as predisposing factors in previous studies on respiratory disorders (D'Amato et al., 2014). Climate factors such as temperature, rainfall, and wind speed may act as biological catalysts in the relationship between covid-19 and humans in this scenario. Virus transmission is influenced by a variety of parameters such as host behavior, host defensive mechanisms, and virus infectivity (Cory, 2015), as well as population density and environmental conditions (Brown et al., 2008).

This study aims to examine the relationship between climatic factors and COVID -19 infection in top three highest numbers of covid 19 provinces of Thailand consisting of Bangkok, Samutprakan, and Chonburi provinces. This study utilized a secondary data analysis of covid-19 surveillance data from the Department of Disease Control, Thailand, and weather data from the website of Thai Meteorological Department. Minimum temperature (°C), maximum temperature (°C), precipitation level (mm), and wind speed (m/s) are the elements of climatic data.

2. Methods and Statistical Analysis

2.1 Study area

Thailand's climate is influenced by its location in the tropical monsoon zone of mainland Southeast Asia, as well as certain physical factors that affect precipitation distribution. Beginning in May, warm, humid air masses from the Indian Ocean travel northeastward across the region, depositing large amounts of precipitation; rainfall peaks in September. The northeast monsoon brings cool, generally dry air in a southwesterly flow between November and February, resulting in cooler temperatures across much of the country. In March and April, stagnant air creates a distinct hot-and-dry inter-monsoonal phase. Average temperatures are relatively stable through the year ranges between 25 and 29 °C.

2.2 Data collection

A secondary data analysis of covid-19 surveillance data was retrieved from the Department of Disease Control, Thailand, and weather data was downloaded from the website of Thai Meteorological Department. Minimum temperature (°C), maximum temperature (°C), precipitation level (mm), and wind speed (m/s).

2.3 Data analysis

The linear regression analysis was used to analyze the relationships between covid-19 daily new cases and climate elements. An analysis at 95% confidence interval was applied.

3. RESULT AND DISCUSSION

During the third phase of pandemic in Thailand since early of April 2021, Covid-19 new cases dramatically increased in Thailand, especially during May to July. Descriptive summary of the climate data suggests (Table 1.) a minimum temperature of 22.1 °C and the highest maximum temperature of 37.2 °C during the study period. In addition to that, the lowest recorded rainfall was 0 mm whereas the highest was 63.8 mm. The lowest wind speed recorded with value of 18.53 m/s and highest wind speed of 83.4 m/s.

Table 1. Variables descriptive statistics.

Variables	Bangkok			Samutprakan			Chonburi		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Daily new cases	624	3997	1810	124	1386	543	10	1062	341
Min temp (°C)	22.3	28.5	25.93	24.6	28	26.45	24	29.7	27.03
Max temp(°C)	30.1	36.6	33.32	29.5	38	33.36	30.1	37.2	33.96
Precipitation (mm)	0	41.1	4.37	0	63.8	3.52	0	41	4.67
Wind speed (m/s)	27.8	83.4	39	22.24	79.69	35.21	18.53	59.3	30.94

3.1 Spatial Pattern Analysis

The total number of cases (from 1 April to 28 July 2021) in each province and the rate of the disease were mapped using GIS. The number of cases and infection rate are divided into five categories

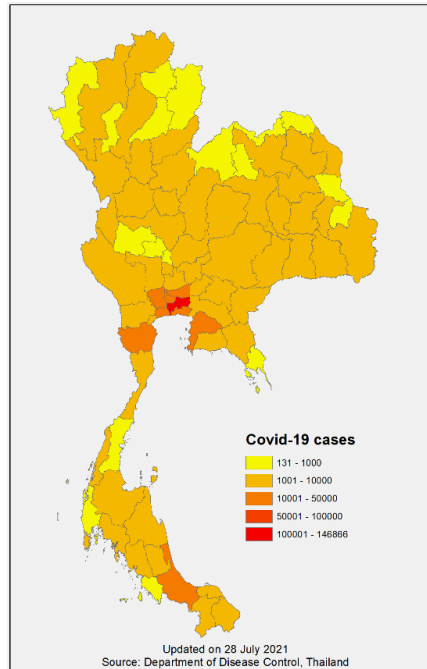


Figure 1. The county-level of COVID-19 cases Thailand on 28 July 2021. The map shows the number of COVID-19 daily cases. The number of cases is divided into five categories and illustrated by colors from light yellow (low number) to deep red (high number), respectively.

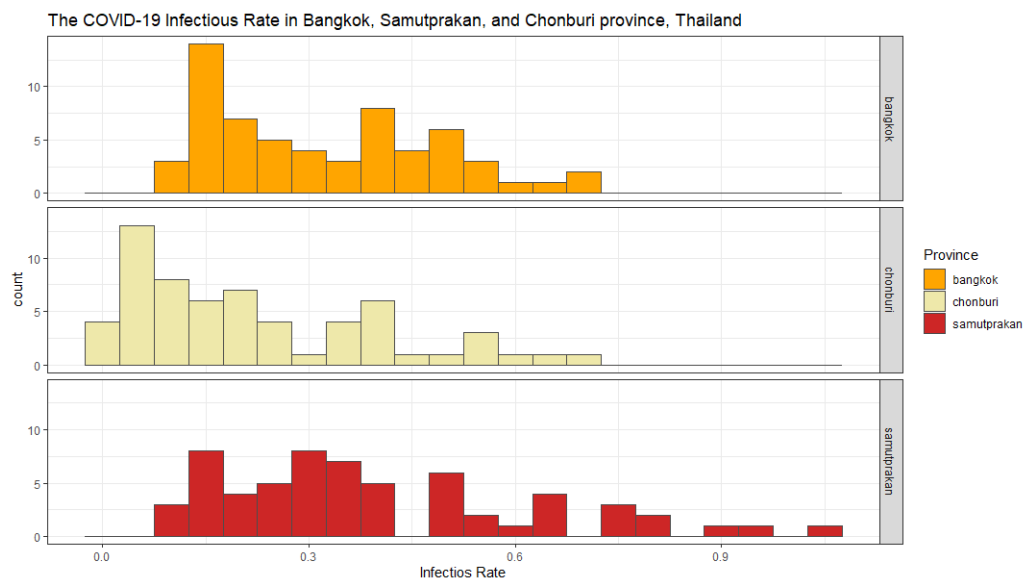


Figure 2. The COVID-19 infectious rate in Bangkok, Samutprakan, and Chonburi province, Thailand on 28 July 2021.

3.2 Multiple Linear Regression Analysis

Table 2. Multiple Linear Regression Analysis

Climatic factors	p-value		
	Bangkok	Samutprakan	Chonburi
Minimum temperature (°C)	0.97536	0.082	0.91656
Maximum temperature (°C)	0.000529 ***	0.0208 *	0.00242 **
Precipitation(mm)	0.748486	0.7784	0.20502
Wind speed (m/s)	0.624421	0.4182	0.48519
Multiple R-squared	0.2315	0.2448	0.2057

*** Significance level of 0.0001

** Significance level of 0.001

* Significance level of 0.01

Among the four weather variables, maximum temperature data in Bangkok ($r = 0.2315$; $p = 0.000529$), Samutprakan ($r = 0.2448$; $p = 0.0208$), and Chonburi ($r = 0.2057$; $p = 0.00242$) was negatively significant with covid-19 cases. On the other hand, minimum temperature, precipitation, and wind speed were not significantly associated with covid-19 daily cases.

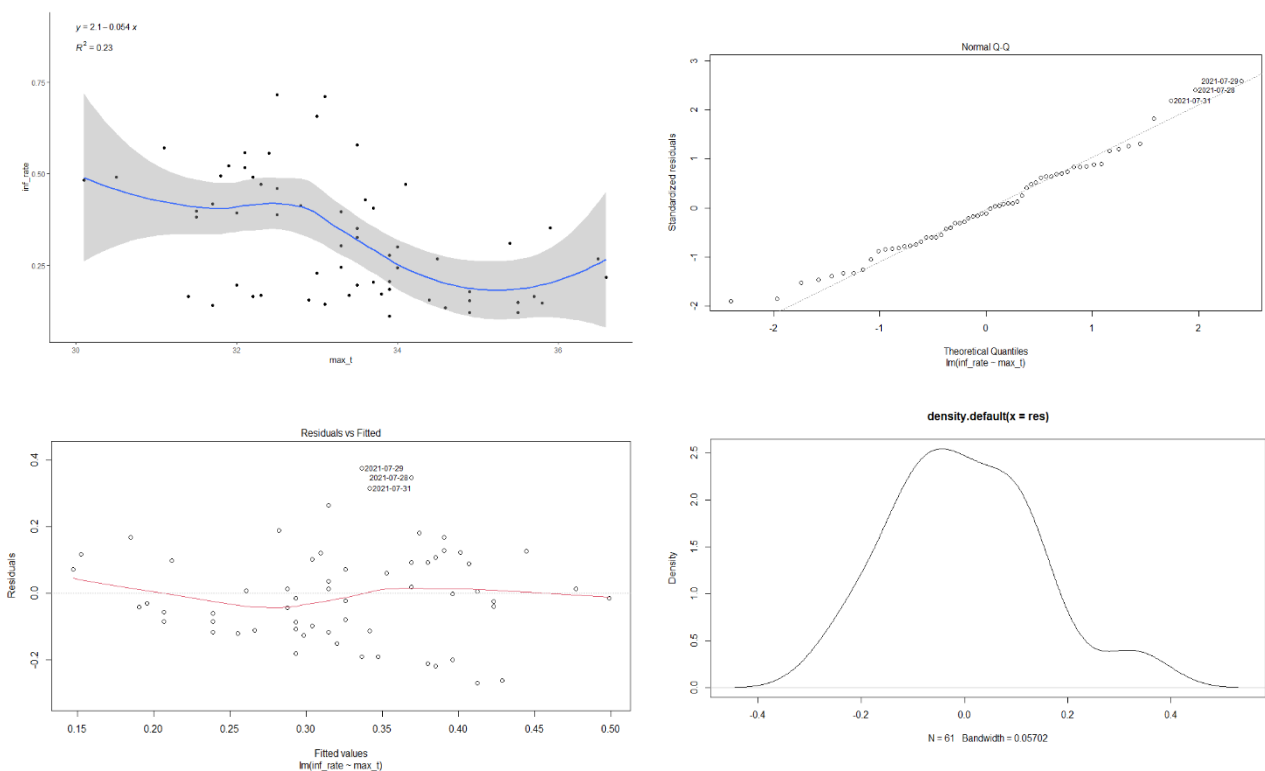


Figure 3. Diagnostic plots of the residuals from the linear regression analysis model (Bangkok province)

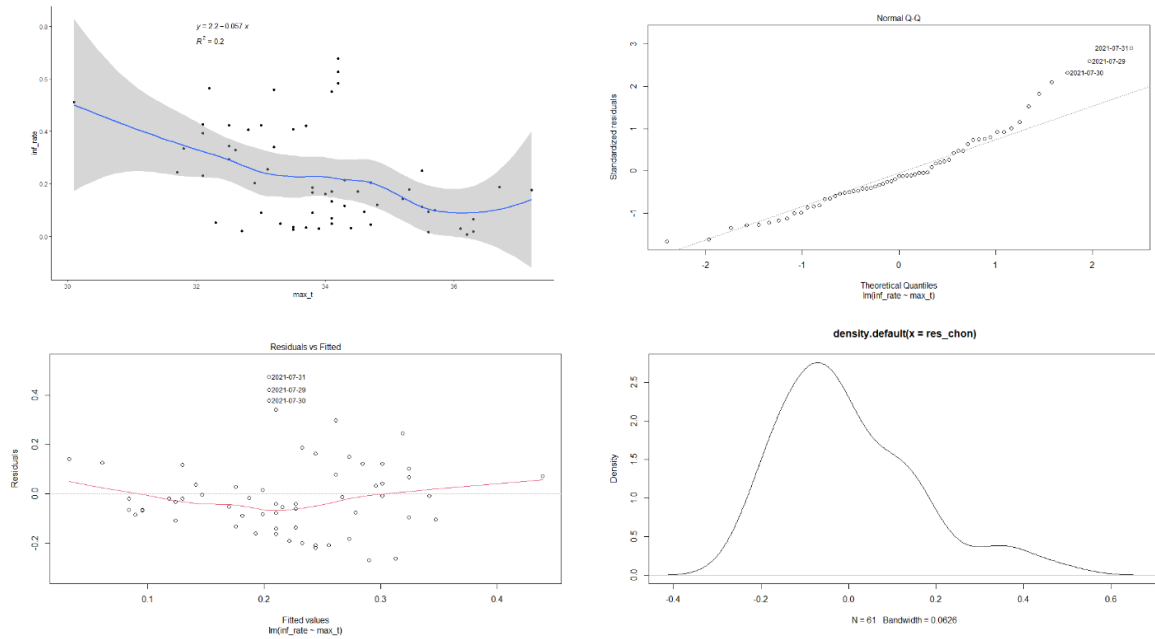


Figure 4. Diagnostic plots of the residuals from the linear regression analysis model (Samutprkan province)

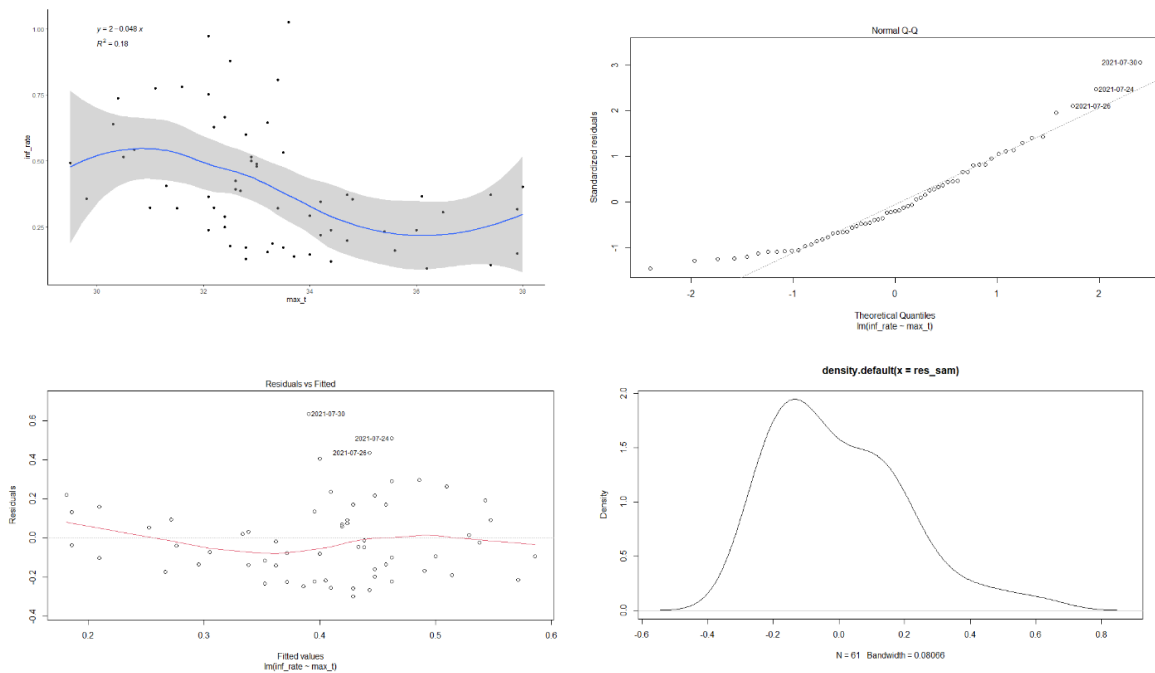


Figure 5. Diagnostic plots of the residuals from the linear regression analysis model (Chonburi province)

The result of this study shows that the pattern of climate elements delivers a scenario of the incidence of covid-19 in Thailand. It is found that maximum temperature negatively associates with occurrence of Covid-19 (Table 2). This finding is consistent with prior research that has found a link between temperature and human West Nile Virus infections (Ruiz et al., 2010). The result of this study also relates with a recent finding by Wang, J., et al. (2020) where their study claimed that high temperature lessens the transmission of Covid-19. However, there are a range of viewpoints on the positive association between temperature and new cases, with some claiming that people are more likely to disobey lock-down rules and thus become infected. However, the finding of this study is in contrast with Mesay M. (2020) which state that maximum temperature and normal temperature are positively associated with covid-19.

4. CONCLUSION

Maximum temperature associate with the decreasing of incidence rate of daily covid-19 cases in Bangkok, Samutprakan, and Chonburi provinces, Thailand. Maximum temperature and normal temperature are positively associated with covid-19. In contrast to the weather conditions, it is considered that factors such as high social mobility, population density, household condition affect new covid-19 in metropolitan area like Bangkok. Bangkok, Samutprakan, and Chonburi provinces are the main economic destinations for job seekers who come from various regions. High population density of these areas allows covid-19 transmission to be very rapid (Kuchler et al., 2020).

5. REFERENCES

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