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FORECASTING FOR THE ARRIVAL OF INTERNATIONAL TOURISTS AFTER TWO YEARS OF THE COVID-19 PANDEMIC IN INDONESIA

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ABSTRACT

Before to the entrance of COVID-19 Indonesia in March 2020, foreign visitor arrivals have shown a positive trend from 2006 to 2019. Coronavirus COVID-19 is having a "catastrophic" effect on Indonesia's tourism industry, particularly in Bali province. The Indonesian province looks to have escaped the pandemic's worst effects. COVID-19 has the most severe effects on public health and the tourism industry, with the most severe economic implications. Although COVID-19 is relatively under control in contrast to other Asian countries, the tightening of travel restrictions has a significant influence on foreign tourist arrivals. With the Omicron variant's extremely high transmission rate, statistical modeling predicts that the number of international tourist visits in Indonesia will continue to fall.

Keywords: COVID-19, Indonesia, Tourism Industry.

INTRODUCTION

COVID-19 was found in late 2019 in Wuhan, China and had spread to over than 200 countries by early 2022 (Kumar, et al., 2021; Wu, et al., 2020; WHO, 2022). At the beginning of 2022, the global total of cases exceeded 373 million, with a death toll of more than 5.6 million (WHO, 2022). The COVID-19 epidemic is showing no signs of abatement (Charumilind, et al., 2021;

Susanna, 2020). End of 2021 saw the appearance of a new variation named omicron with a very high transmission rate (Ledford, 2022; Taylor, 2022). The introduction of this novel variety has resulted in an upsurge in COVID-19 cases throughout the world, including Indonesia.

COVID-19 pandemic has not only generated health problem, but also social and economic ones. Tourism is one of the areas that has been severely damaged. Travel restrictions imposed by all countries have had a detrimental effect on the tourism industry. In 2020, the number of international tourists visiting Indonesia will have decreased by more than 70%, to only 4 million. This is the lowest figure recorded since 2006. Bali, as one of the world's premier tourism destinations, was hardest damaged (Pramana, Paramartha, Ermawana, Deli, & Srimulyani, 2021).

The purpose of this study is to examine foreign tourist trips to Indonesia and to make a brief prediction for the years 2021 and 2022. This tourist prediction is critical in assisting the government in developing strategic measures that will benefit the community's economy, particularly those who rely heavily on the tourism sector. The government hopes that this research will prompt the development of multiple possibilities for limiting the COVID-19 outbreak while also protecting the national economy from difficulty.

MATERIAL AND METHOD

Data

Data used in this study were obtained from BPS Statistics Indonesia (<https://www.bps.go.id/>) and COVID-19 Data Repository by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University (<https://github.com/CSSEGISandData/COVID-19>). The number of foreign visitors were collected from 2006 to 2020. The COVID-19 data is available from March 2020 to January 2022.

Method

We apply a Bayesian technique to a structural time series model (Harvey & Peters, 1990). We assume that the number of international visitors is distributed in a Poisson or Negative Binomial manner. Let the number of international visitors $y_t \sim \text{Poisson}(\lambda_t)$ with $\lambda_t = E(y_t)$. To develop structural time series model we use Poisson log linear model (Blangiardo & Cameletti, 2015; Lawson, 2006):

$$\log(E(y_t)) = \eta_t = \alpha + \gamma_t; t = 1, \dots, T \quad (1)$$

where η_t is the linear predictor of Poisson log linear model, α denotes the intercept, and γ_t is the temporally structured effects. Using Bayesian approach, α is assumed to follow Gaussian distribution i.e., $\alpha \sim \text{Normal}(0, 10^6)$ and γ_t is assumed to follow Random walk model of order 2.

Let vector $\boldsymbol{\gamma} = (\gamma_1, \dots, \gamma_T)$ is built assuming independent second-order increments:

$$\Delta^2 \gamma_t = \gamma_{it} - 2\gamma_{t+1} + \gamma_{t+2} \sim \text{Normal}(0, \sigma_\gamma^2) \quad (2)$$

The density function for $\boldsymbol{\gamma}$ is given by its $T - 2$ second order increments as (Blangiardo & Cameletti, 2015):

$$p(\boldsymbol{\gamma} | \sigma_\gamma^2) \propto (\sigma_\gamma^2)^{-\frac{T-2}{2}} \exp\left(-\frac{1}{2\sigma_\gamma^2} \sum (\Delta^2 \gamma_t)^2\right) \quad (3)$$

$$= (\sigma_\gamma^2)^{-\frac{T-2}{2}} \exp\left(-\frac{1}{2} \mathbf{y}' \mathbf{Q} \mathbf{y}\right)$$

where $\mathbf{Q} = \frac{1}{\sigma_\gamma^2} \mathbf{R}$ and \mathbf{R} denotes the temporal structure matrix that corresponds to the temporal neighborhood structure. In Bayesian setting, we also need hyperprior distribution for σ_γ^2 that is defined as:

$$\theta = -\log(\sigma_\gamma^2) \tag{4}$$

and the hyperprior is define for θ . To estimate the model (1) we use R-INLA (Rue, Martino, & Chopin, 2009)

RESULTS AND DISCUSSION

Descriptive statistics

Before to the COVID-19 outbreak, the average international tourist visit to Indonesia from 2006 through 2019 was 9,370,171, with the peak visit in 2019 being 16,106,954. The average annual increase in foreign tourist visits to Indonesia was 9.8%. The two provinces with the highest levels of foreign tourist arrivals are Bali and Jogjakarta. However, following the COVID-19, the number of foreign tourist visitors dropped dramatically, with a 74.8% drop compared to 2019, with a total visit of only 4,052,923. This is the lowest value from 2006 to 2019. This number of visits is extremely likely to fall further if COVID-19 across the world is not effectively controlled.

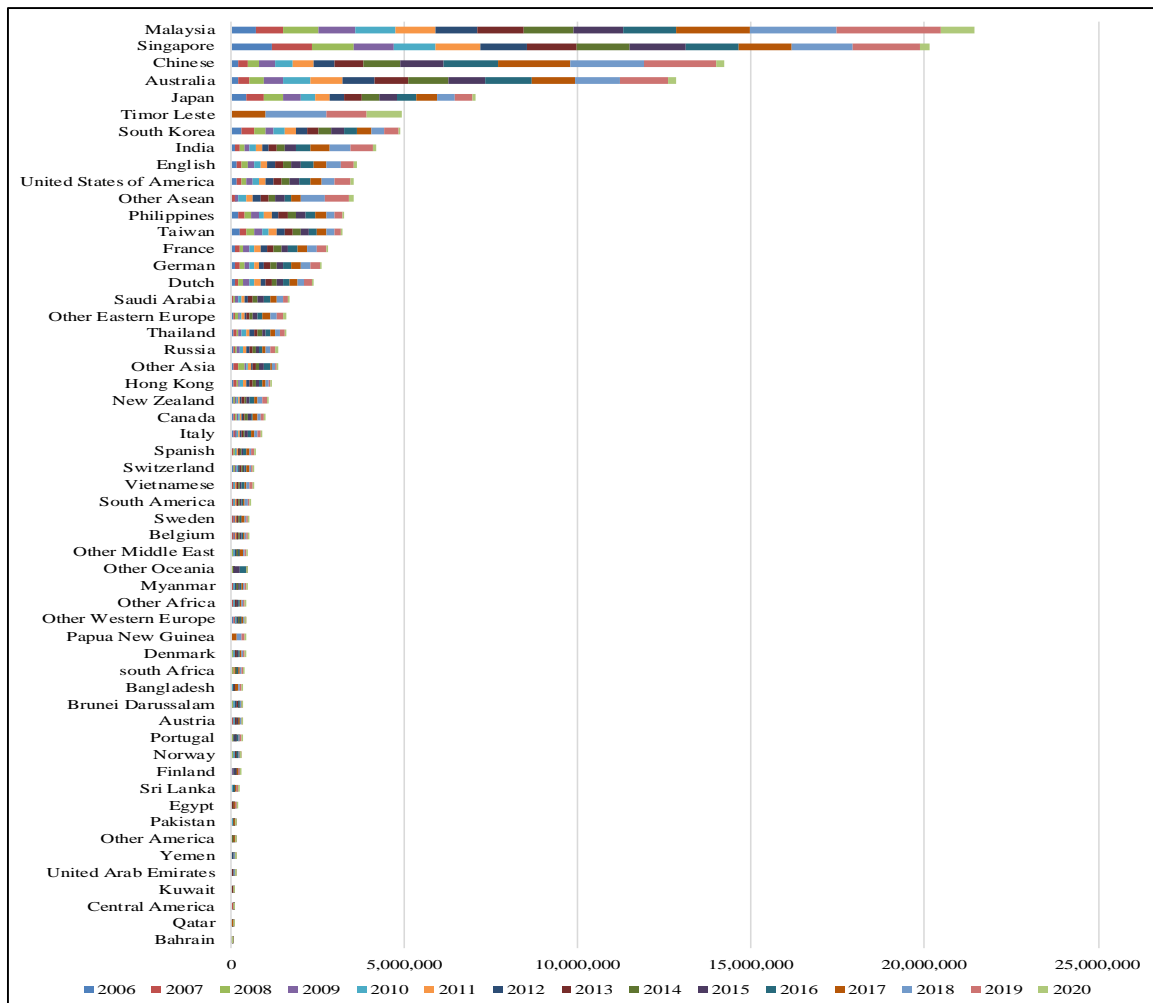


Figure 1: Number of International Tourism Arrival for Several Countries Worldwide from 2006-2020

Figure 1 shows the number of international tourism arrival for several countries worldwide during. In terms of international tourists arriving in Indonesia, Malaysia, Singapore, and China are the top three contributors. Three countries account for 41.3% total international tourism in Indonesia.

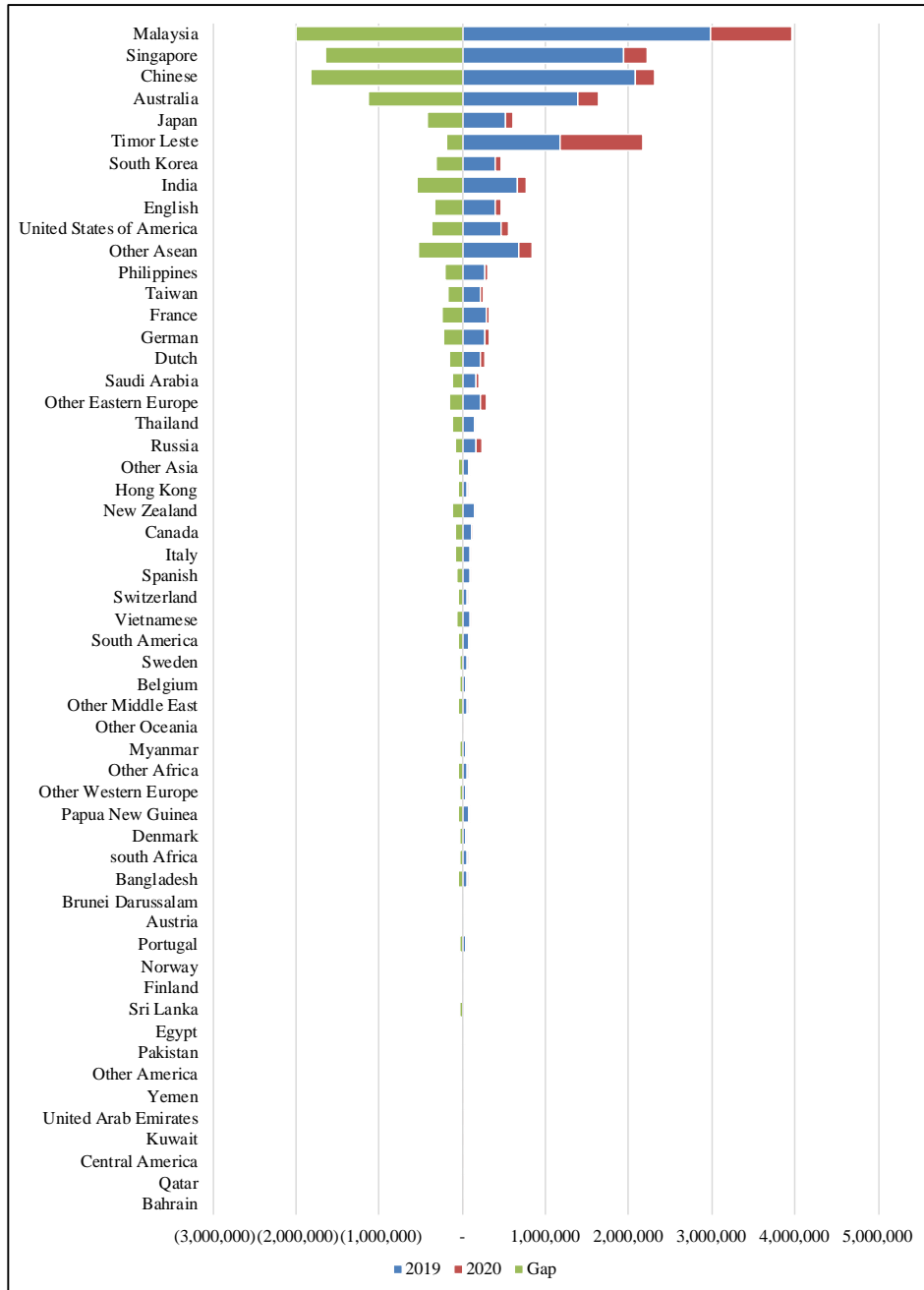


Figure 2: Number of Tourism Arrival 2019-2020 and its Gap during Pandemic COVID-19

Figure 2 depicts the number of international tourists who arrived in various nations throughout the world during the epidemic of 2019-2020, as well as the disparities between them. The chart illustrates that the greatest gap occurs during the pandemic era. The number of people who arrive drops considerably.

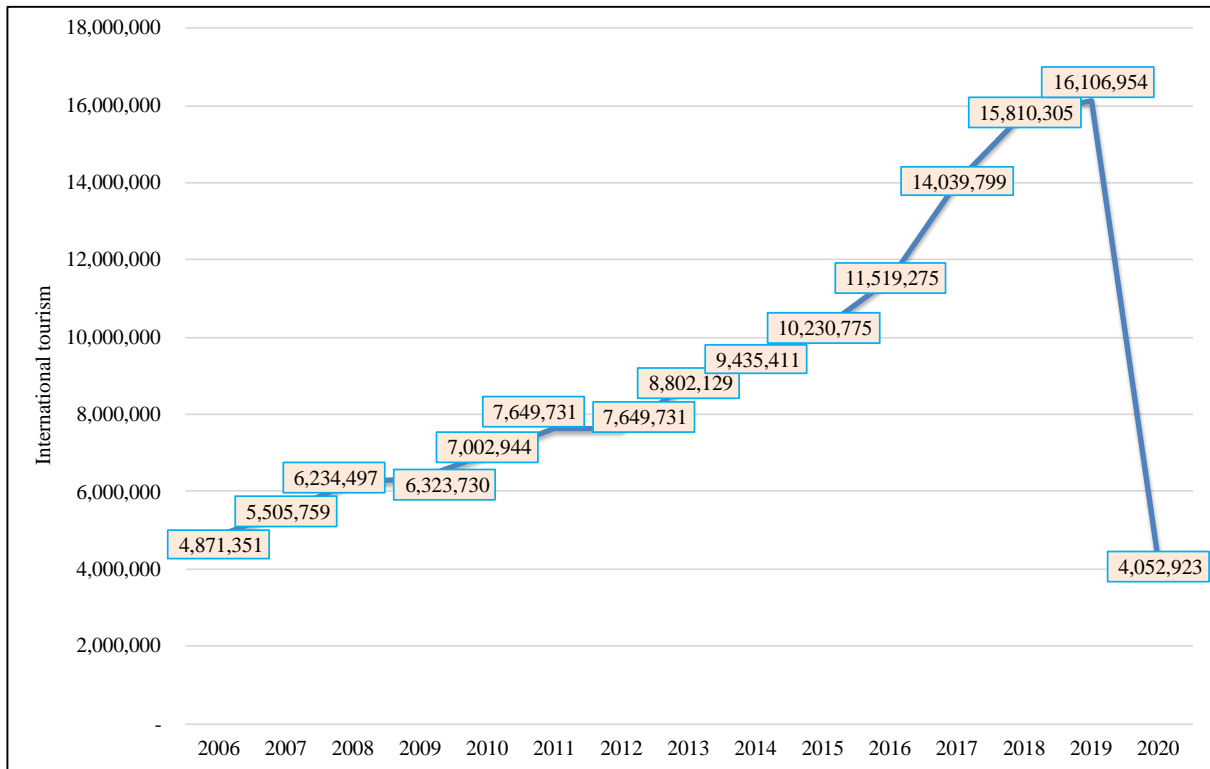


Figure 3: Temporal Trend Foreign Tourism Arrival 2006-2020

Figure 3 depicts the temporal trend in international tourist arrivals from 2006 to 2020, as represented by the number of visitors from each country. The chart depicts a considerable fall in the number of arrivals from 2019 to 2020, with a 4.8 % decrease in the number of arrivals compared to 2019.

Structural Forecasting Model

We used a structural forecasting model in conjunction with a Bayesian technique. We analyze two alternative probability distributions: the Poisson distribution and the Negative Binomial distribution. The deviance information criteria (DIC), Watanabe Akaike information criteria, and marginal predictive likelihood are used to determine the optimal probability (MPL) (Blangiardo & Cameletti, 2015). When it comes to modeling, the best model is the one with the lowest DIC and WIC but the highest MPL. Based on the results shown in Table 1, we found that the Poisson likelihood is the most appropriate model to use.

Table 1

Model Comparison

| Distribution | DIC | WAIC | MPL |
|-------------------|--------|--------|---------|
| Poisson | 296.55 | 291.95 | -270.93 |
| Negative Binomial | 487.79 | 488.61 | -285.50 |

Table 2

Parameter and Hyperparameter

| Parameter and Hyperparameter | Mean | SD | Q(0.025) | Q(0.775) |
|------------------------------|--------|--------|----------|----------|
| Intercept | 15.823 | 0.0054 | 15.8129 | 15.834 |
| SD of RW2 | 1.0919 | 0.2324 | 0.737 | 1.641 |

The estimations for the parameters and hyperparameters are shown in Table 2. In the structural forecasting model, we take into account the intercept and temporal trend, which are generated by a random walk of second order. Using the intercept $\alpha = 15.823$, we can see that the overall mean of international tourism arrivals is around $\exp(15.823) = 7,444,604$ every year. The standard deviation (SD) of RW2 is greater than one, indicating that the temporal trend has a significant impact on the trend of foreign tourism.

The graph in Figure 4 depicts the observed and forecasted results for the period 2021-2022. We forecast international arrivals for 2021 as well, as data is not yet available. We anticipated that foreign tourism arrivals will continue to decline in the years 2021 and 2022 using a structural forecasting model. In 2021, we forecast only 3,532,414 tourists, and slightly fewer in 2022, with only 3,081,569 tourists expected. The detail forecasting result is provided in Table 4.

The forecasted outcome of the foreign arrival is pessimistic, which is consistent with the COVID-19 criterion. Due to the omicron variant's high infection rate, the number of new cases is expected to increase considerably beginning in early January 2022 (WHO, 2022). As a result, it makes sense that international tourist arrivals will continue to fall in the period 2021-2022.

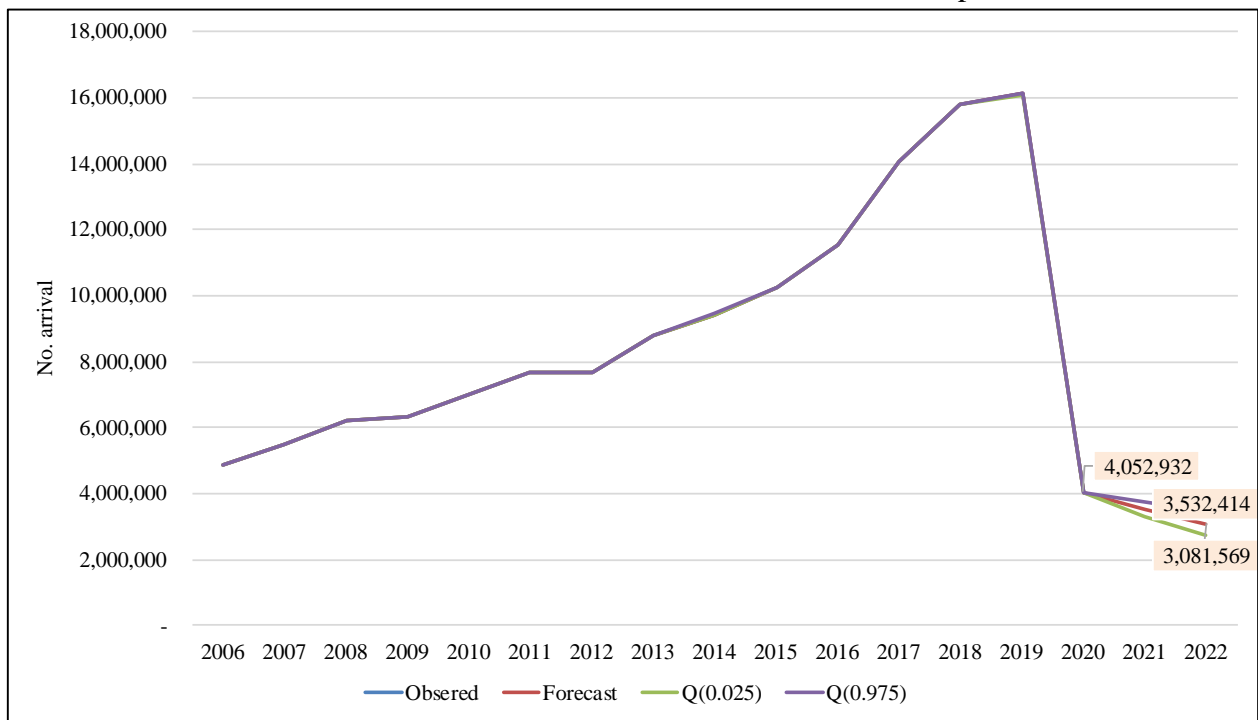


Figure 4: Forecasting result of international arrival 2021-2022

Table 3
Forecast Result

| Year | Observed | Forecast | $q(0.025)$ | $q(0.975)$ |
|------|------------|------------|------------|------------|
| 2006 | 4,871,351 | 4,871,351 | 4,867,026 | 4,875,680 |
| 2007 | 5,505,759 | 5,505,760 | 5,501,162 | 5,510,362 |
| 2008 | 6,234,497 | 6,234,496 | 6,229,602 | 6,239,392 |
| 2009 | 6,323,730 | 6,323,732 | 6,318,804 | 6,328,664 |
| 2010 | 7,002,944 | 7,002,944 | 6,997,758 | 7,008,134 |
| 2011 | 7,649,731 | 7,649,730 | 7,644,309 | 7,655,154 |
| 2012 | 7,649,731 | 7,649,734 | 7,644,314 | 7,655,158 |
| 2013 | 8,802,129 | 8,802,128 | 8,796,313 | 8,807,946 |
| 2014 | 9,435,411 | 9,435,412 | 9,429,392 | 9,441,436 |
| 2015 | 10,230,775 | 10,230,775 | 10,224,507 | 10,237,048 |

| Year | Observed | Forecast | $q(0.025)$ | $q(0.975)$ |
|------|------------|------------|------------|------------|
| 2016 | 11,519,275 | 11,519,277 | 11,512,625 | 11,525,932 |
| 2017 | 14,039,799 | 14,039,799 | 14,032,455 | 14,047,147 |
| 2018 | 15,810,305 | 15,810,313 | 15,802,520 | 15,818,111 |
| 2019 | 16,106,954 | 16,106,938 | 16,099,072 | 16,114,808 |
| 2020 | 4,052,923 | 4,052,932 | 4,048,987 | 4,056,880 |
| 2021 | | 3,532,414 | 3,328,317 | 3,745,693 |
| 2022 | | 3,081,569 | 2,727,722 | 3,468,404 |

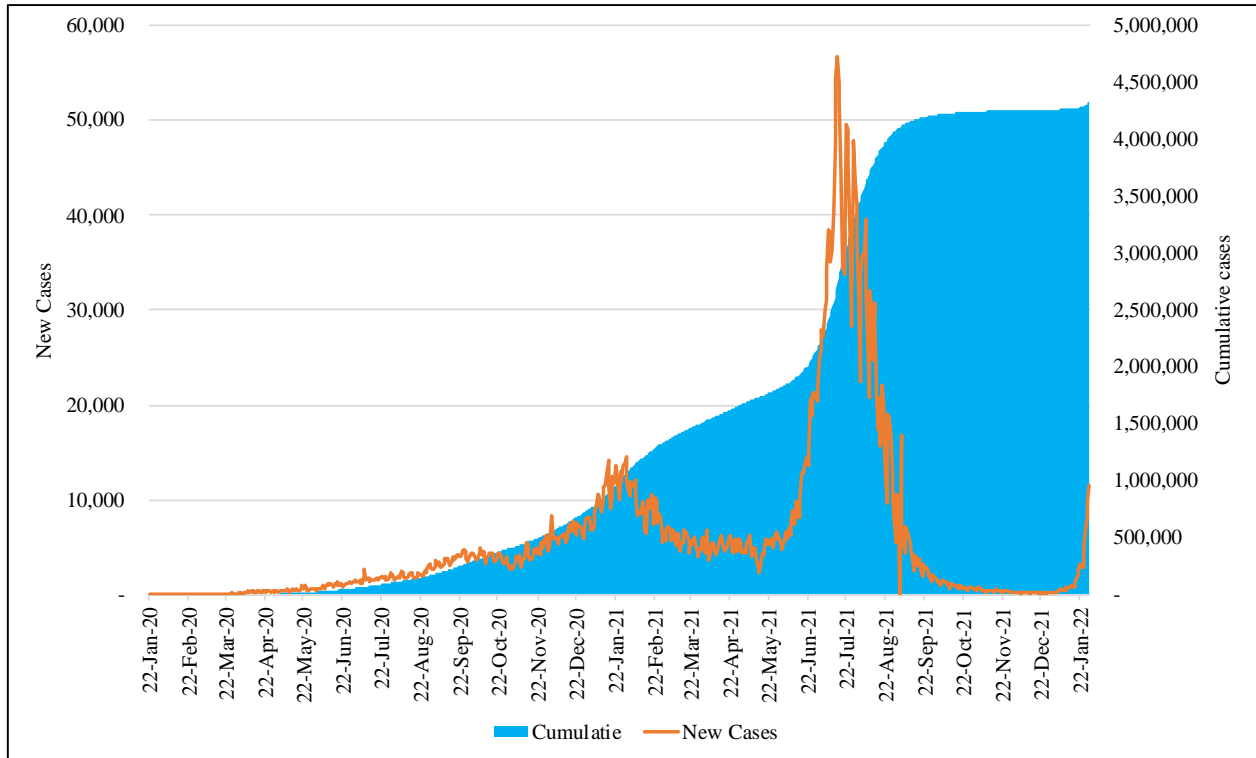


Figure 5: New Cases and Cumulative Cases Temporal Trend COVID-19 for period 22 January 2020 to 29 January 2022

CONCLUSION AND RECOMMENDATION

COVID-19 has had a serious negative impact on the Indonesian tourism industry and its supporters, particularly in provinces whose economies are highly dependent on tourism, such as Bali and Yogyakarta, where the sector is particularly important. In spite of the pandemic's two-year duration, there has been no improvement in the tourism sector in Indonesia, particularly in terms of foreign visitor arrivals. This can be explained by a number of factors, including the large number of COVID-19 cases not only in Indonesia, but also in countries that have a high number of visitors to Indonesia, such as Malaysia, Singapore, the United States, and other nations. Second, nations of origin are prohibited from traveling outside their country in order to avoid getting COVID-19. Foreign tourists have shied away from visiting Indonesia because of the country's strict quarantine restrictions, which are still in effect.

As long as this situation persists, it will have a negative influence not just on the economy but also on social conditions, particularly in the province of Bali (Pramana, Paramartha, Ermawana, Deli, & Srimulyani, 2021). Using the structural time series model method, forecasters have discovered that there would be a continued fall in the number of international tourist visits from

various nations in 2022, owing in part to the Omicron variant's extremely quick transmission rate. A solution to increase international tourist visits or other alternative ways to support economic growth must be found by the government. This is especially true for provinces that are heavily reliant on the tourism industry.

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Conflict of Interest Statement

No potential conflict of interest was reported by the authors