

<https://doi.org/10.21272/mmi.2021.3-12>

JEL Classification: Z3, L83, C53

**Gayane Tovmasyan,**

*Ph.D., Associate Professor, Armenian State University of Economics,  
Public Administration Academy of the Republic of Armenia, Republic of Armenia*

 ORCID ID, 0000-0002-4131-6322

email: [tovmasyangayane@yahoo.com](mailto:tovmasyangayane@yahoo.com)

## FORECASTING THE NUMBER OF INCOMING TOURISTS USING ARIMA MODEL: CASE STUDY FROM ARMENIA

**Abstract.** *This paper summarizes the arguments and counterarguments within the scientific discussion on the issue of forecasting tourism demand and touristic flows. During COVID-19 tourism sphere suffered a lot in the whole world. Many countries try to do forecasts and make recovery plans for tourism. Tourism has been a growing sphere in Armenia in recent years. However, the number of incoming tourists decreased by 80 percent because of the pandemic. The main purpose of the research is to forecast tourism demand in the Republic of Armenia. Systematization of scientific sources and approaches for solving the problem identified many methods and models for doing forecasts. The variables used to depend on the method selected. For gaining the research goal, the study was carried out in the following logical sequence: 1) discussion on some literature sources; 2) analysis of the current situation of tourism in Armenia; 3) interpretation of forecast results; 4) providing some recommendations. The methodological tool of the research was mainly the ARIMA method. The data rest on the publications of the Statistical Committee of the Republic of Armenia. Time series for the number of incoming tourists include from 2001-Q1 till 2019-Q4 data. 2020 was not included in the model, as there was a sharp decline. Besides, in the second quarter of 2020, there were no tourists at all because of restrictions and flight cancellations. The obtained data show that if there were no pandemic, the number of incoming tourists would increase on average by 12.81% in 2021, 13.42% – in 2022, and 13.66% – in 2023. The results are realistic. The tourism sphere is expected to grow in 2021. This paper suggested some steps for recovering and restoring tourism, particularly by using aggressive marketing strategies, word-of-mouth, influencer marketing, etc. The research results could be useful for state organs of the sphere to forecast their strategic policies. The applied approach and suggestions may be helpful in many countries which try to restart tourism after the pandemic.*

**Keywords:** tourism, pandemic, ARIMA, forecast, marketing.

**Introduction.** Tourism is one of the main sectors of the economy of the Republic of Armenia (RA). It has a significant impact on a country's socio-economic development. Nowadays, many countries have sustainable development plans. It means that tourism should benefit the countries' social, cultural, economic, and environmental spheres. Tourism generates income, contributes to the development of infrastructures, creates jobs, decreases poverty rates, brings recognition of cultural values, helps to keep the environment, involves new investments, etc.

Many countries today depend on tourism. Herewith the pandemic showed that their economy suffers a lot. Countries today take measures to restart and recover international tourism. Some of them have opened their borders for vaccinated tourists or have negative PCR test results. On the other hand, some countries still have strict restrictions.

However, restarting tourism by keeping all the requirements concerning wearing masks, etc., is vital for economies. According to the publications of the World Travel and Tourism Council, the total contribution of tourism in GDP in the RA amounted to 774.67 billion Armenian dram or 1.6 billion US dollars

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**Cite as:** Tovmasyan, G. (2021). Forecasting the Number of Incoming Tourists using ARIMA Model: Case Study from Armenia. *Marketing and Management of Innovations*, 3, 139-148. <http://doi.org/10.21272/mmi.2021.3-12>

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Received: 20 July 2021

Accepted: 03 September 2021

Published: 13 September 2021



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(11.8% of GDP) in 2019, providing 12.5% of total employment or 124600 jobs (World Travel and Tourism Council, 2020).

Before the COVID-19 pandemic, the tourism sphere was growing at high rates in Armenia. 2020 was a year of significant decline for tourism in the world and Armenia. The number of incoming tourist visits to the RA in the pandemic conditions was 375216 people in 2020. Remarkably, it decreased by 80% compared to the previous year (Statistical Committee of the Republic of Armenia, 2021).

This article aims to forecast the number of incoming tourists in the RA. For doing forecasts, the study involved the ARIMA model. The theoretical analysis showed many methods and models to conduct forecasts. Besides, many variables are used to model and forecast tourism. Of course, while choosing the best forecasting method, statistical data are important. It is crucial to do many steps to restart and recover tourism, especially aggressive marketing activities, to promote incoming tourists to the RA. For revising tourism development plans, state organs and private tourism organizations should do forecasts. Therefore, the article results may be useful. The article suggested some marketing techniques which should be done using social networks.

**Literature Review.** Different authors use various methods to forecast tourism demand (Table 1). In many cases, the selection of the method depends on the availability of variables' statistical data.

**Table 1. Summary of tourism forecasting methods analyzed in literature sources**

Method	Author
Naïve 1, 2	Witt et al. (1992)
Naïve 1, 2; ARIMA; Trend	Chan (1993)
Delphi	Kaynak et al. (1994)
ARIMA; SARIMA	Dharmaratne (1995); Song and Li (2008); Kulendran and Wong (2005)
Trend; ARIMA; Naïve 1	Pattie and Snyder (1996)
ARMAX	Kim and Uysal (1998)
AR; SARIMA	Kim (1999)
SARIMA	Lim and McAleer (2000); Huang and Min (2002)
ARIMAX; ARIMA	Cho (2001)
ADLM; ECM, ARX	Song and Witt (2003)
VECM	Dristakis (2004)
ADLM; CI; ECM; TVP, VAR	Li et al. (2006); Li (2009)
BVAR; VAR; AR	Wong et al. (2006)
SARIMA; VAR; ADLM; ECM	Wong et al. (2007), Shen et al. (2011)
Delphi; SARIMA; Trend	Lee et al. (2008)
ADLM	Wang (2009), Lin et al. (2015)
ECM	Song and Lin (2010), Goh (2012)
ARIMA	Cho (2001); Andreoni and Postorino (2006), Loganathan and Ibrahim (2010); Krasić and Gatti (2009); Choden and Suntaree Unhapiat (2018); Bigović (2012); Milenkovic et al. (2013); Petrevska (2017)
ARMA	Chu (2009); Ghalekhondabi et al. (2019)
AR, VAR, BVAR, FAAR, FAVAR, BFAVAR	Poghosyan and Tovmasyan (2021)

Source: Composed by author based on the research in academic platforms

Some analyses show that the following factors can influence international tourism demand: income, relative prices between prices of origin and destination, exchange rates, relative prices between a destination and its competing destinations, cost of transportation, marketing expenditures, consumers' preferences, the effects of special events and other factors such as the effects of word of mouth (Yap, 2010). According to Dritsakis and Athanasiadis (2000) the main variable that definitely influences tourist movements positively is growth in Gross National Product (GNP).

According to Ghalekhondabi et al. (2019) there is no forecasting method which can develop the best forecasts for all of the problems. Combined forecasting methods are providing better forecasts in comparison to the traditional forecasting methods. The modern econometric models that have been used in tourism demand analysis are: Autoregressive distributed lag (ADL) model, Cointegration (CI) and error correction models (ECMs), Time varying parameter (TVP) model, Vector autoregressive (VAR) model, etc (Li et al., 2006; Li, 2009). Many researchers use ARIMA model for forecasting tourism flows, for example Choden and Suntaree Unhapipat (2018), Petrevska (2017), etc. The ARMA models are a type of stationary stochastic models that consist of two models of autoregressive and moving average models (Ghalekhondabi et al. 2019). Andreoni and Postorino (2006) used the univariate and multivariate ARIMA models to forecast air transport demand. ARMA-based methods were used by Chu (2009) for forecasting the tourism demand.

Krasić and Gatti (2009) used ARIMA to find the volume of tourist arrivals in Croatia. Their model also considered the interventions of Croatia war activities between 1991 and 1995, based upon historic data.

Loganathan and Ibrahim (2010) used ARIMA to forecast international tourist arrivals to Malaysia. Bigović (2012) used ARIMA to forecast the Montenegrin tourism demand. The ARIMA model was also used by Milenkovic et al. (2013) in order to predict the railway passenger demand.

Empirical studies present contradictory evidence when using ARIMA and SARIMA models (Song, Li, 2008). Cho (2001) showed that the ARIMA model outperformed two other time series models in all cases. Goh and Law (2002) suggested that the SARIMA models outperformed eight other time series methods while the non-seasonal (simple) ARIMA model's performance was above the average of all forecasting models considered. Smeral and Wüger (2005) found that the ARIMA or SARIMA model could not even outperform the Naïve 1 (no-change) model.

Thus, the literature review demonstrates the variety of forecasting methods. For the Republic of Armenia there are no research works done on forecasting incoming tourism demand. For filling the research gap for Armenia, the best discussed method which will be suitable for Armenia, is ARIMA, as there are no available statistical data for different variables of incoming tourism. The necessity and importance of this study is conditioned with the lack on research studies on this topic for Armenia. This research may have both empirical and theoretical significance, as it will add value to Armenian tourism research and theory, besides, the results may be used for further forecasts and policy making.

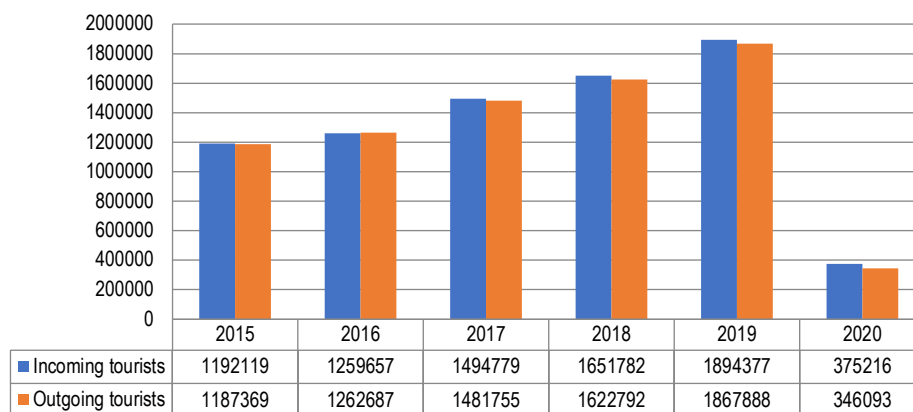
**Methodology and research methods.** In order to do forecasts for incoming tourists the ARIMA modelling and forecasting approach was used in this article. The research question of the investigation was as follows: How will the number of incoming tourists change in future years? This article involved the ARIMA modeling and forecasting approach to forecasting the incoming tourists. It stands to note that Box and Jenkins (1970) suggested this approach. That is why ARIMA is also called the Box-Jenkins approach. The Box-Jenkins modeling procedure involved a preliminary analysis (data transformation) and an iterative three-stage process as follows: model-identification; model estimation; model-checking.

Each stage concerns a question:

- Preliminary analysis: Are the time series stationary?
- Model identification: What class of models can generate the transformed series in the best way?
- Model estimation: What are the model parameters?
- Model-checking: Are the residuals from the estimated model white noise?

According to the preliminary analysis, it should be mentioned that the preliminary time series was not stationary. Thus, the trend component was included. Some preliminary transformations were conducted to transform the series to be stationary, particularly logarithmic levels that have been seasonally adjusted and then differenced. As a result, the series was made stationary. For checking the stationarity, Dickey-Fuller test statistics were used (Enders, 2010). The source of statistical information for the analysis is the Statistical Committee of the Republic of Armenia. The time series for the number of incoming tourists included 2001-Q1- 2019 Q4 data.

**Results.** Tourism is one of the main economic sectors in the Republic of Armenia. Remarkably, it has shown growth tendencies in recent years. However, the COVID-19 pandemic disrupted the growth of the tourism sector in the world and Armenia. Because of closed borders and international restrictions on movement, the tourism sector suffered significant losses worldwide. In 2019 the number of international tourists in the world was 1.5 billion people (UNWTO, 2020a). According to forecasts, it should reach up to 1.8 billion in 2030 (UNWTO, 2011). However, in 2020 the number of international tourists was 381 million, the decrease was 74% (UNWTO, 2020b). According to the Statistical Committee data of the Republic of Armenia, in 2019, 1894377 tourists arrived in the RA (increasing by 14.7% compared to 2018) (Statistical Committee of the Republic of Armenia, 2020b). In turn, in 2020, the number of incoming tourists to the RA under the pandemic conditions was 375216. Thus, it decreased by 80% compared to the previous year (Statistical Committee of the Republic of Armenia, 2021).



**Figure 1. Number of incoming and outgoing tourists in Armenia, 2015-2020**

Sources: developed by the authors based on (Statistical Committee, 202).

Analysis of the tourist visits by quarters of 2019-2020 (Table 2) showed that in 2020 Q1 inbound tourist visits amounted to 311264. Thus, it decreased by 14.6% compared to the same period of the previous year. In April-June, July-August, no incoming tourist visits to the RA were registered since the borders were closed and flights canceled. Remarkably, 16471 inbound tourist visits were registered in September, while 47481 – in the fourth quarter (October-December). It turns out that in 2020, compared to 2019, 1519161 fewer tourists came to Armenia.

Still, at the beginning of 2020, the Government of the RA took steps to restrict travel, ban foreigners from entering the RA, and declared a state of emergency. The government has adopted a comprehensive COVID-19 countermeasures program (packages of economic impact mitigation measures). Herewith some beneficiaries of this program were tourism organizations and employees. A detailed analysis of these steps may be found in the previous research studies (Tovmasyan, 2020).

**Table 2. The number of incoming and outgoing tourists of the RA, in 2019-2020 by quarters**

	2019 Q 1	2019 Q2	2019 Q3	2019 Q 4	2020 Q1	2020 Q2	2020 Q3	2020 Q 4
Incoming tourists	364,489	405,566	689,097	435,225	311,264	-	16,471	47,481
Outgoing tourists	317,891	366,917	627,474	555,606	275,716	-	10,511	59,866

Sources: developed by the authors based on (Statistical Committee, 2021).

Now non-citizens of the RA may visit the country both by air and land if they have a certificate of up to 72 hours confirming the negative result of the COVID-19 PSR test or have a certificate of vaccination.

**Table 3. Incoming tourist visits to the RA by purpose, 2017-2020**

	2017	2018	2019	2020
Incoming tourists to Armenia	1494779	1651782	1894377	375216
Incoming tourists staying in hotel facilities	264702	307473	550289	97550
of which by purpose:	100%	100%	100%	100%
– business	23,9 %	27,3 %	15,9 %	15,8%
– leisure and entertainment	52,8 %	48,8 %	55,4 %	50,3%
– medical treatment	0,2 %	1,4 %	0,5 %	0,4%
– other	23,1 %	22,5 %	28,2 %	33,5%

Sources: developed by the authors based on (Statistical Committee, 2021).

Table 2 shows that in 2019, 29% of incoming tourists (550289 tourists) stayed in hotel facilities, while the rest of 1344088 – in a friend's or relative's house, or rented apartments, etc. In 2020, 26% of incoming tourists (97550 tourists) stayed in hotel facilities. The purpose of the visit of the majority was leisure and entertainment. Forecast of incoming tourism in Armenia. As shown above, tourism visits into the RA have been growing in recent years. To forecast the number of incoming tourists for the future, the ARIMA model was used. In the methodology part, it is already described some steps of analysis. After checking the stationarity of the time series, the ARMA process order was identified using differenced series. For that, Akaike information and Bayesian information criteria were used. These criteria can be calculated using the following formulas.

$$AIC(p, q) = \ln(\sigma^2) + \frac{2(p+q)}{T} \quad (1)$$

$$BIC(p, q) = \ln(\sigma^2) + \frac{\ln(T)(p+q)}{T} \quad (2)$$

where p and q are orders for autoregression and moving average processes; T is the length of times series;  $\sigma^2$  is the variance of the white noise (Johnston and DiNardo, 1996).

Thus, the AIC and BIC have been calculated. Table 4 presents the obtained results. Table 4 presents all possible combinations for AR and MA orders. Thus, 8 possible cases were considered, where the orders can be 0, 1, and 2. The orders are the corresponding lags of the ARMA model. Table 4 shows the lowest values of the AIC and BIC were reached in the case of AR = 2 and MA = 2, AR = 2, and MA = 1. Both cases were applied for forecasting the numbers of incoming tourists. A maximum likelihood estimation approach, particularly a nonlinear optimization algorithm, was used to estimate the unknown parameters.

**Table 4. AIC and BIC results for AR and MA processed**

	AR = 2, MA= 2	AR = 2, MA = 1	AR = 1, MA = 2	AR = 2, MA = 0	AR = 0, MA = 2	AR = 1, MA = 1	AR = 1, MA = 0	AR = 0, MA = 1
AIC	384.2	385.0	411.8	408.3	393.0	410.9	420.9	422.8
BIC	396.5	395.2	422.1	414.5	401.3	419.1	425.0	429.0

Sources: developed by the authors based on (GitHub, 2020).

After estimation, it was checked whether the model errors were white noise processes. In other words, it was checked whether:

$$E \cdot (\varepsilon_t) = 0 \tag{3}$$

$$E \cdot (\varepsilon_t^2) = \sigma^2 \tag{4}$$

$$E \cdot (\varepsilon_t \cdot \varepsilon_\pi) = 0, \text{ for } t \neq \pi \tag{5}$$

After all these steps, the average values of forecasts produced by the above-mentioned two models were taken. Table 5 shows the results of the forecast.

**Table 5. Predicted values of the growth of the number of incoming tourists (in %, compared to the same quarter of the previous year), 2021-2023**

	Q1	Q2	Q3	Q4	Yearly average
2021	12.18	13.80	12.21	13.05	12.81
2022	13.72	12.68	13.74	13.54	13.42
2023	13.31	13.95	13.61	13.75	13.66

Sources: developed by the authors based on (GitHub, 2020).

Thus, the results of the study indicate, that in 2021 the number of incoming tourists will increase by an average of 12.81% per year, in 2022-13.42%, and in 2023-13.66%. Based on the results, the answer of the research question is, that in future years the number of incoming tourists will continue to grow.

**Conclusion.** COVID-19 pandemic has affected the world tourism sector. Nowadays, many countries again impose severe restrictions, while flights are not fully restored. Therefore, it is obvious that in the future, tourism still has to be organized in conditions of «closure» until it is possible to return to normal life after being vaccinated against the infection. The forecast results showed that incoming tourism would grow in future years. It means that the government and the private organizations of this sphere should take some measures and implement some activities to promote tourism at a high speed.

However, it should be noted that the time series for the number of incoming tourists included 2001-Q1- 2019-Q4 data. 2020 was not included in the model, as there was a sharp decline, in addition, in the second quarter of 2020 there were no tourists at all. However, the data obtained show that if there were no pandemic, then for example in 2021 the number of incoming tourists would increase by an average of 12.81% per year. This result may be expected in 2021, as after last year lockdown, now tourism is restarting slowly. It should be noted that since there are no more detailed statistics on the incoming tourism to Armenia for the whole period, what country they come from, what gender or age the tourists are, what their preferences are, what factors influence their decision to visit Armenia, then the ARIMA method is the most convenient method for making predictions in this case. In case of obtaining detailed statistical data on incoming tourists regarding their country of origin, age, income, etc., other models may be used as well for doing forecasts. For example, it may be possible to forecast how much tourists will come from certain

countries taking into account their income level, distance from Armenia, traveling costs, tour costs to other countries, visa requirements, and other parameters. However, this was the first step to forecast incoming touristic flows to Armenia, and the results seem realistic. Being the first attempt, this research has both theoretical and empirical significance. First of all it adds value to scientific literature, besides Armenian tourism theory and practice will be developed based on such studies. This study comes to fill the research gap for Armenia. The empirical significance of the study is that researchers, private sector of tourism, state agencies of tourism development may elaborate tourism development policies based on the forecasts results. ARIMA model seemed to present good forecasting results, and it may be used in future for more forecasts. Based on the study results the incoming tourism will grow, so now it is very important to present Armenia abroad as a safe and attractive tourist destination. It is necessary to pursue an aggressive marketing policy, presenting our tourism resources - rich historical and cultural heritage, the fact of being the first Christian country, delicious national cuisine, wine - brandy, beautiful nature, favorable conditions for rural recreation, resort resources, etc.

When promoting incoming tourism, the expected trends of tourism for 2021 should be taken into account, that international travel will be reduced, will be implemented in the most urgent cases, for example, for business visits or treatment, tourists will be more cautious, will take into account the level of tourism safety, will visit safer countries or places where the risk of infection is low, the demand for non-mass tourist attractions will be increased, etc.

The Republic of Armenia is considered as a non-mass tourist destination, in the conditions of the pandemic this circumstance can be used as an advantage, presenting the country in advertisements carried out through social networks as a safe place. In order to promote incoming tourism, it is necessary to develop new routes, carry out aggressive marketing, branding, expand the information on the official tourism website, etc. Now the existence of a well-developed brand is of great importance, it can position Armenia as an attractive tourist destination.

As known, currently the main information platform for tourists is social media, so it is necessary to carry out an "information-psychological war" on various social platforms: Facebook, Twitter, Vkontakte, Instagram etc., by disseminating materials not only to inform about the tourist offers of the Republic of Armenia, but also to create a certain mood, knowledge and a behavior among the international community, forcing them to visit Armenia. Moreover, such special campaigns should be organized so that the above-mentioned is carried out not only by travel companies, by the official tourism page of the Republic of Armenia, but also by all citizens using social networks. Dissemination of information by everybody with relevant pictures and hashtags "Visit Armenia", "Visit the world's first Christian country", "Visit one of the oldest countries in the world" will certainly increase the level of awareness about Armenia as an international tourism destination. This campaign should be organized by the Tourism Committee, which will systematically develop relevant materials, which will be actively disseminated by the users. Today, information-psychological wars are widely used on social networks for various purposes, especially political. The same can be done to promote tourism in Armenia. Social platforms are used a lot nowadays by tourists and being very active in such websites is very important for Armenia. The promoting information about Armenia should be very convincing, the slogans, pictures should be attractive for eye in order to provoke a desire to visit Armenia.

Today many countries use social networks for connecting people, attracting tourists. The results show, that social marketing has a great impact on tourism flows. In the current conditions, considering the economic crisis situation created by the outbreak of the pandemic, it is vital to take measures to stimulate the economy, so restarting the tourism sector is essential for the Armenian economy. Thus, the forecast results and the suggestions may be useful for developing policy and for further research of the sphere. As ARIMA forecast model showed the future growth of incoming tourism demand, the aggressive marketing

and promotion steps suggested here are highly significant and should be done by all stakeholders of the sphere.

**Funding:** This research received no external funding.

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**Гаяне Товмасян**, Ph.D., Вірменський державний економічний університет, Академія державного управління Республіки Вірменія, Республіка Вірменія

#### **Прогнозування туристичного попиту на основі ARIMA-моделювання: на прикладі Вірменії**

У статті узагальнено аргументи та контраргументи у рамках наукової дискусії щодо методів прогнозування попиту у туристичному секторі. У статті наголошено, що туристична галузь Республіки Вірменія стрімко розвивається. Однак, внаслідок настання пандемії COVID-19 кількість туристів скоротилась майже на 80%. Пандемія COVID-19 спричинила значні збитки у туристичній індустрії всього світу. З огляду на це, доцільним є прогнозування розвитку туристичного сектору з метою формування ефективної стратегії його відновлення. Метою дослідження є прогнозування розвитку туристичного попиту в Республіці Вірменія. Для досягнення поставленої мети, дане дослідження проведено у наступній логічній послідовності: 1) огляд наукових напрацювань з даної проблематики; 2) аналіз розвитку туристичної індустрії Республіки Вірменія; 3) інтерпретація отриманих результатів прогнозування; 4) формування рекомендацій відповідно до отриманих прогностичних даних. За результатами аналізу наукових напрацювань та підходів до вирішення досліджуваної проблематики було узагальнено інструментарій та моделі прогнозування. Встановлено, що змінні моделей залежать від обраного методу прогнозування. Зважаючи на це, автором запропоновано використовувати модель ARIMA. Емпіричний аналіз базується на даних Статистичного комітету Республіки Вірменія з 2001 по 2019 рік. До вибірки дослідження не включено дані за 2020 рік, через різке скорочення кількості міждержавних туристів. Наголошено, що через жорсткі обмеження та скасування рейсів, у

другому кварталі 2020 року у країні не було зареєстровано жодного іноземного туриста. За результатами прогнозування встановлено, що у випадку відсутності пандемії, кількість приїжджих туристів зросла б у середньому на 12,81% у 2021 році, на 13,42% – у 2022 році та 13,66% – у 2023 році. При цьому отримані результати дають підстави стверджувати, що на кінець 2021 року кількість туристів зросла б. У роботі надано рекомендації щодо відновлення сфери туризму, зокрема, за допомогою агресивних маркетингових стратегій, сарафанного радіо, інфлюенсерів тощо. Результати дослідження можуть бути корисними для органів державної влади під час формування стратегічної політики у сфері туризму. Запропонований підхід та пропозиції є актуальними для різних країн, які намагаються відновити туристичний сектор від негативного впливу пандемії.

**Ключові слова:** туризм, пандемія, ARIMA, прогноз, маркетинг.