The forecasting of the number of passengers transported internationally by air in the United States for 2021 in terms of economic security

Prognozowanie liczby pasażerów przewożonych międzynarodowym transportem lotniczym w Stanach Zjednoczonych na 2021 rok w zakresie bezpieczeństwa ekonomicznego

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Abstract. The article presents a research problem that focuses on the forecasting of the number of passengers transported internationally by air in the United States – in terms of the impact of the COVID-19 pandemic and the maintenance of economic security. The research began with an analysis of the literature on issues such as transport, forecasting and economic security. Then, an analysis and evaluation of the time series of the number of passengers transported internationally by air in the United States from 1 January 2019 to 2 May 2021 were conducted. The obtained evaluation allowed for the selection of the forecasting method for the considered retrospective data. The forecast for the period from 3 May to 31 December 2021 was subjected to a comparative analysis with the same type of data from the same time period from 2019. The obtained evaluation allowed to achieve the goal set in the study. The forecast of the number of passengers travelling internationally by air in the United States for 2021 from 3 May to 31 December is 374 656 674 passengers.
Keywords: transport, forecasting, COVID-19, statistical indices, grouping, economic security

Abstrakt. W artykule przedstawiono problem badawczy, który koncentruje się na prognozowaniu liczby pasażerów przewożonych międzynarodowym transportem lotniczym w Stanach Zjednoczonych – w aspekcie oddziaływania pandemii COVID-19 i utrzymania bezpieczeństwa ekonomicznego. Badania rozpoczęto

od analizy literatury dotyczącej zagadnień, takich jak transport, prognozowanie czy bezpieczeństwo ekonomiczne. Następnie wykonano analizę i ocenę szeregu czasowego liczby pasażerów przewożonych międzynarodowym transportem lotniczym w Stanach Zjednoczonych od 1 stycznia 2019 r. do 2 maja 2021 r. Uzyskana ocena pozwoliła na wybór metody prognozowania rozpatrywanych danych retrospektywnych. Prognoza na okres od 3 maja do 31 grudnia 2021 r. została poddana analizie porównawczej z tym samym rodzajem danych z jednoimiennego przedziału czasowego z 2019 roku. Otrzymana ocena pozwoliła zrealizować cel przyjęty w opracowaniu. Prognoza liczby pasażerów przewożonych międzynarodowym transportem lotniczym w Stanach Zjednoczonych na 2021 rok od 3 maja do 31 grudnia wynosi 374 656 674 pasażerów.

Słowa kluczowe: transport, prognozowanie, COVID-19, mierniki statystyczne, grupowanie, bezpieczeństwo ekonomiczne

Introduction

The article presents a research problem that focuses on the forecasting of the number of passengers transported internationally by air in the United States in terms of the impact of the COVID-19 pandemic and the maintenance of economic security.

The main purpose of the article is an attempt to forecast the number of passengers transported internationally by air in the United States for the period from 3 May to 31 December 2021. The attempt was made to compare the number of passengers in this period with the same data in the same time period in 2019.

The study outlines the main hypothesis:

The conducting of the analysis, evaluation of the considered historical data on the number of passengers transported internationally by air in the United States and participating observation will allow to forecast them for the future.

The subject of the research is the number of passengers transported internationally by air in the United States. The research period is from 1 January 2019 to 31 December 2021.

The following research methods were used in the study: forecasting, multidimensional comparative analyzes. They made it possible to achieve the main goal of the work set in the introduction to the study.

Analysis of the literature on the research object

An analysis of the literature shows that there are many interpretations of the term transport. According to Janusz Neider, transport is the provision of services consisting in the movement of cargo or additional services directly related to it (Neider, 2008, p. 5). On the other hand, Andrzej Kuriata and Zdzisław Kordel interpret transport as a movement – the transport of goods and people (passengers) in domestic and international traffic using means of transport (Kuriata, Kordel, 2020, p. 10). In turn, Marianna Jacyna and Konrad Lewczuk define transport as a production process aimed at covering a distance (Jacyna, Lewczuk, 2016, p. 88). A similar interpretation

of this term is presented by Elżbieta Gołembska, Zbigniew Bentyn and Marcin Gołembski (2017) – as activities related to the movement of material resources of enterprises in the supply chain (Gołembska, Bentyn, Gołembski, 2017, p. 48). From the point of view of the subject of the study, the most accurate is the definition of A. Kuriata and Z. Kordel, identifying transport, among others, with the transport of people (passengers) in domestic and international traffic using means of transport.

The study analyzed and evaluated the time series of data on the number of passengers transported internationally by air in the United States from 1 January 2019 to 2 May 2021. It started with a multidimensional data analysis by grouping them (Łuniewska, Tarczyński, 2006, p. 20). Then, the following indices were calculated: arithmetic mean, standard deviation, variance, which were analyzed, evaluated and compared (Bąk, Markowicz, Mojsiewicz, Wawrzyniak, 2020, pp. 185-194; Leśkow, Lenart, 2005, pp. 8-10; Sobczyk, 2010, pp. 75-78; Parlińska, Parliński, 2018, pp. 31-58; Żyżyński, 2017, pp. 28-78; Puławska-Turyna, 2011, pp. 46-80; Bielecka, 2017, pp. 107-153).

The research shows that the number of passengers transported internationally by air in the United States has decreased since February 2020, caused by the COVID-19 pandemic.

The first case of the COVID-19 infectious disease was observed in Wuhan, China (Zhu, Zhang, Wang et al., 2020). On 12 March 2020, the World Health Organization declared COVID-19 a pandemic (Satomi, Rodrigues de Souza, da Costa Thomé et al., 2020). This, in turn, led to global anxiety and crisis (Matuka, 2020). There has been a collapse in the world passenger air transport sector, including such an economic power as the United States. This was due to the actions of the governments of respective countries to slow down the spread of an infectious disease, including the introduction of restrictions such as the cancellation of flights, the prohibition of travelling to selected regions of the world or the limitation of the operation of certain sectors of the economy. This, in turn, led to a huge increase in unemployment in the United States in April 2020 – to a level of around 14.7%, the US economy shrank by around 20.5 million jobs (*Dramatyczny wzrost bezrobocia w USA. Tak źle nie było od 70 lat*, 2021; Lemire, Boak, Barrow, 2020). The decrease in the number of passengers transported internationally by air has been visible until today – 2 May 2021. This became the premise for the forecasting of the number of passengers in order to compare the obtained forecasts with the same data in the same time period in 2019.

In the study, the considered time series was subjected to the forecasting which used indices of dynamics with a constant base, calculated from 1 April to 31 December 2021 (Kozicki, Mizura, 2020, pp. 65-78).

According to Paweł Dittmann, forecasting is based on the regularities characterizing the forecast phenomenon, occurring between it and other phenomena in the past or assumed in the future (Dittmann, Szabela-Pasierbińska, Dittmann, Szpulak,

2016, p. 21). The obtained forecasts of the number of passengers transported internationally by air for the period from 3 May to 31 December 2021 were compared with raw data from the same time period from 2019, correlating them in the categorized box plot. The evaluation of the comparison is important in terms of the maintenance of the economic security of the air transport sector in the United States.

Literature indicates that economic security means the certainty of the survival and the development of the economic system of countries that guarantee entities to maintain an appropriate position in international economic relations and a proper standard of living of the population (Nurzyńska, 2016, p. 22).

The next substantive point of the study concerns the analysis of the time series of the number of passengers transported internationally by air in the United States from 1 January 2019 to 2 May 2021.

Analysis of the number of passengers transported internationally by air in the United States

The first stage of the research was to outline a line graph of data on the number of passengers transported internationally by air in the United States from 1 January 2019 to 2 May 2021 in figure 1.
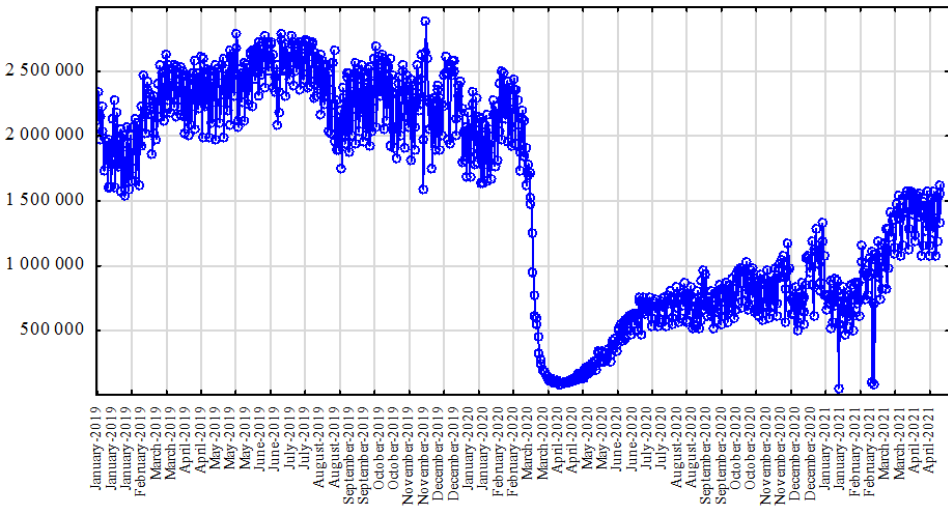

Fig. 1. Line chart of the number of passengers transported internationally by air in the United States from 1 January 2019 to 2 May 2021

Source: own study based on data obtained from the website: https://www.tsa.gov (04.05.2021)

The information summarized in figure 1 indicates that 842 809 122 passengers were transported internationally by air in the United States in 2019. Due to the COVID-19 infectious disease, the number of passengers in 2020 decreased to 323 911 649. The variance from 81 026 867 803 in 2019 increased to 413 560 314 497. The increase is also visible in indices in the form of standard deviations from the arithmetic mean. In 2019, the standard deviation from the arithmetic mean amounted to 284 654 passengers and in 2020 it increased to the level of 643 087 passengers. In 2021, the United States has seen an increase in the number of passengers transported internationally by air. From 1 January to 2 May 2021, 128 790 161 passengers were transported. The variance was 125 296 774 345 and the standard deviation of the arithmetic mean was 353 973. The increase in the number of passengers in 2021 was due to the fact that potential passengers were partially vaccinated against COVID-19, as well as the desire to move after the long downtime observed in 2020.

Then, for research purposes, the distribution of data on the number of passengers transported internationally by air in the United States from 1 January 2019 to 2 May 2021 was examined in figure 2.
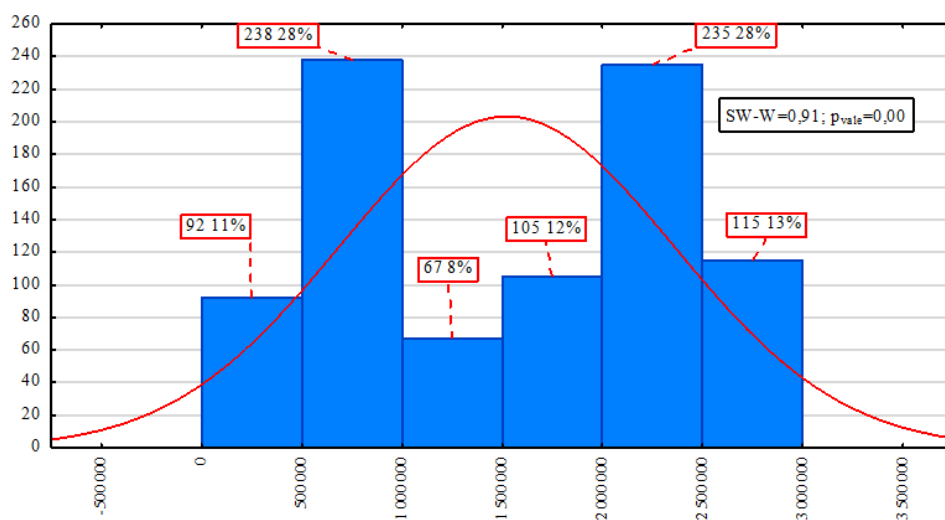

Fig. 2. Histogram of the number of passengers transported internationally by air
in the United States from 1 January 2019 to 2 May 2021
Source: own study based on data obtained from the website: https://www.tsa.gov (04.05.2021)

The distribution of the examined data is bimodal. Two maxima can be observed. The literature shows that in such cases it can be assumed that the sample is heterogeneous (Rabiej, 2018, p. 44). The Shapiro-Wilk test clearly shows that the distribution of the number of passengers transported internationally by air

from 1 January 2019 to 2 May 2021 is not normal. This is due to the declines observed since February 2020 because of the COVID-19 pandemic and, then, the gradual increase in the number of passengers traveling internationally by air in the United States from April 2020. This phenomenon led to the creation of two groups of variables that are similar in number in the following ranges: from 500 000 to 1 000,000 (238 cases accounting for 28% of all variables) and from 2000 000 to 2500 000 (235 cases accounting for 28% of all variables).

Forecasting

The observation of the data compiled in figure 1 in the form of a line chart of the number of passengers transported internationally by air from January 2019 to 2 May 2021 and in figure 2 in the form of a histogram has become the premise for the forecasting of the retrospective data for the period from 3 May to 31 December 2021 with the use of the dynamics indices observed in the analyzed historical data 1 from April to 31 December 2019.

The forecast results for the period from 3 May to 31 December 2021 along with the number of passengers transported internationally by air from 1 January 2019 to 2 May 2021 are shown in figure 3.
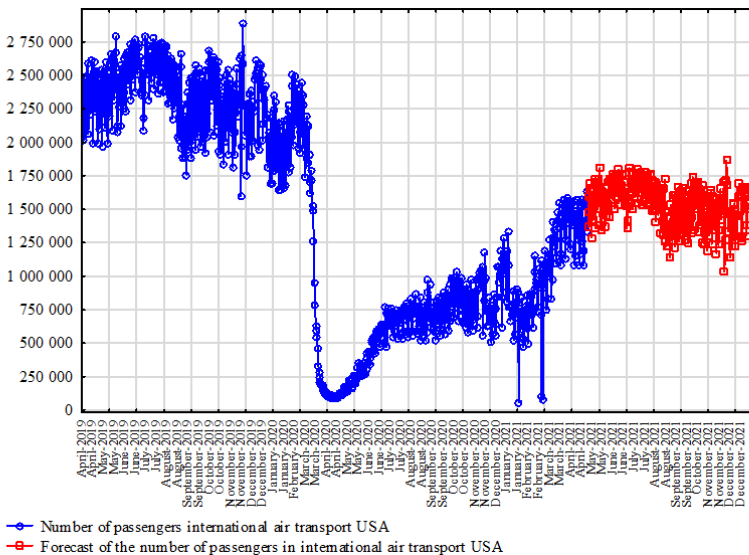

Fig. 3. Forecast of the number of passengers transported internationally by air
in the United States from 3 May to 31 December 2021 with the examined historical data

Source: own study based on data obtained from the website: https://www.tsa.gov (04.05.2021)

The forecasted number of passengers shows that in the forecasts obtained from 3 May to 31 December 2021 there will be the same dynamics of changes in the number of passengers observed in the same period in 2019. From 3 May to 31 December 2019, 578 527 594 passengers were transported internationally by air in the USA. In the same period in 2020, the number of passengers decreased to the level of 162 820 170 due to the COVID-19 pandemic. The forecast for 2021 for the same time period is 374 656 674 passengers. According to the author, the number of passengers of international air transport will reach the level visible in 2019 when most of the human population in the USA is vaccinated with COVID-19 vaccines, and this is most likely in 2023.

For illustrative purposes, the categorized box plot compares the forecasts obtained from 3 May to 31 December 2021 with the raw data observed in the same time period in the United States in 2019.
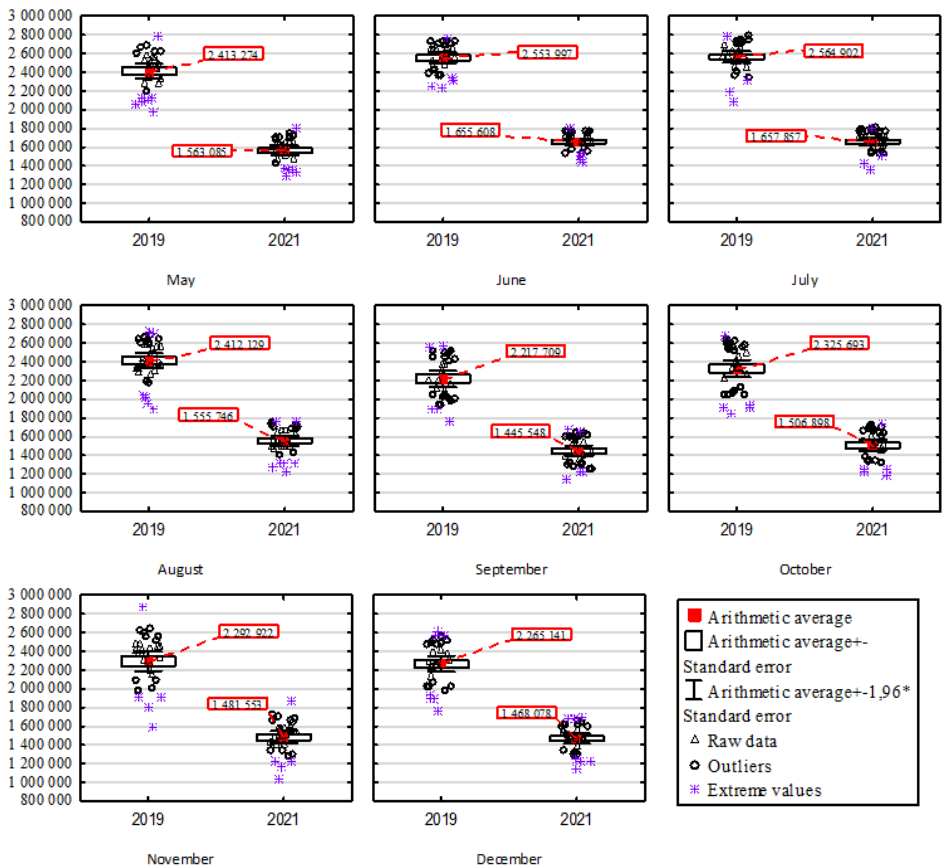

Fig. 4. Categorized box plot of the number of passengers transported internationally by air in the United States in the time period from 3 May to 31 December in 2019 and the obtained forecast in the same period in 2021

Source: own study based on data obtained from the website: https://www.tsa.gov (04.05.2021)

The comparative analysis of the data on the number of passengers transported internationally by air in the United States in the period from 3 May to 31 December 2019 and forecasts for the same time period in 2021 shows that when considering the month group, the smallest difference between the arithmetic means in the analyzed dependent variables (identical months) will be in September and it will amount to 772 161 and the highest one in July: 907 045 passengers. When ranking the arithmetic mean of the forecast of transported passengers from 3 May to 31 December 2021, it was observed that the following months set the highest value:

- July – 1657 857 passengers;
- June – 1655 608 passengers;
- May – 1563 085 passengers;
- August – 1555 746 passengers;
- October – 1506 898 passengers;
- November – 1481 553 passengers;
- December – 1468 078 passengers;
- September – 1445 548 passengers.

The largest median of the forecasts obtained in the month group was observed in June and it amounted to 1 690 382 passengers and the lowest one in September with the result of 1 454 963 passengers.

The highest standard deviation from the arithmetic mean in the month group in the forecasts obtained was visible in November and it amounted to 183 954 while the lowest one in June: 103 491 passengers.

The forecast conducted for the period from 3 May to 31 December 2021 will be lower than the same time period in 2019 by 203 870 920 passengers. The forecast of the number of transported passengers from 3 May to 31 December 2021 constitutes about 65% of the number of passengers transported in the same time period in 2019. Comparing the obtained forecast to 2020, there will be the increase in the number of passengers in the United States transported internationally by air in the same time period in 2021 (obtained forecast) by 230%.

Summary and Conclusions

Air transport is one of the sectors of the economy that influences the economic growth of respective countries and organizations. It is a form of balancing the demand and supply for services provided by carriers. In the 21st century, air transport is equated with safety, reliability, speed and comfort as far as covering a distance is concerned. Since February 2020, due to the COVID-19 pandemic, there has been a large decrease in the number of passengers transported internationally by air including in the largest economy of the world, which is the United States.

From May 2020, a growing trend is visible, but the level of transported passengers is much lower than that observed before the outbreak of the infectious disease.

The main goal set in the introduction to the study has been achieved. The forecasting of data on the number of passengers transported internationally by air for the period from 3 May to 31 December 2021 was conducted. The forecast for 2021 from 3 May to 313 December is 374 656 674 passengers. Then, a comparative analysis of the obtained forecasts was conducted with the same data in the same time period in 2019with the use of the box plot for illustrative purposes. The research shows that the obtained forecast of the number of passengers transported by air in the United States for the period from 3 May to 31 December 2021 will be lower than the same time period in 2019 by 203 870 920 passengers. This forecast accounts for about 65% of the number of passengers transported in the same time period in 2019.

The obtained research results will allow for a more precise determination of the value of the financial outlays necessary to strengthen the air transport sector in the United States in terms of the survival of the crisis caused by the COVID-19 pandemic and the assurance of economic security.

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