TIME SERIES ANALYSIS OF UKRAINE'S IT EXPORT PERFORMANCE

UDC 339.56

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Annotation. *The study examines the use of a Seasonal Autoregressive Integrated Moving Average model to forecast the dynamics of computer services exports. The research is based on NBU statistical data on computer services exports for the period 2015–2025. The modeling results can provide the basis for forecasting the contribution of the IT sector to the national economy.*

Keywords: *dynamics of computer services exports, IT services, autoregressive and moving average models, time series forecasting.*

Анотація. *У роботі розглянуто використання сезонної авторегресивної моделі з ковзним середнім для прогнозування динаміки експорту комп'ютерних послуг. Дослідження спирається на статистичні дані НБУ про експорт комп'ютерних послуг у період з 2015 по 2025 рік. Результати моделювання можуть дозволити прогнозувати внесок ІТ-сектору у національну економіку.*

Ключові слова: *динаміка експорту комп'ютерних послуг, ІТ-послуги, моделі авторегресії та ковзного середнього, прогнозування часових рядів.*

Problem statement Information technology (IT) services play a vital role in the export structure of many countries, including Ukraine. In 2022, despite a deep economic crisis, the Ukrainian IT industry showed considerable stability, with computer service exports in some months accounting for as much as 48% of all service exports [1]. The global rise in demand for digital services has strengthened Ukraine's potential to secure stable foreign currency inflows, which emphasizes the importance of this sector for fiscal sustainability. In this context, the analysis and forecasting of IT service exports are essential for understanding their contribution to the national economy. Given that the Ukrainian IT sector is largely oriented toward foreign markets, studying the dynamics of computer service exports provides valuable insights into the overall condition and development prospects of the industry.

Literature review. Research on the export of IT services in Ukraine has been carried out by scholars such as Balashova [2], Lisik & Moryak [3], Zavhorodnya & Melnyk [4]. Their studies are mainly concentrated on theoretical aspects, which do not allow them to be fully applied for strategic planning. Therefore, mathematical forecasting of computer service export volumes becomes a crucial task for evaluating the potential and ensuring effective planning of both Ukraine's IT sector and the national economy.

The aim. The purpose of this study is to apply the SARIMA model for forecasting computer service export volumes, thereby identifying key trends and potential seasonal fluctuations. The findings are expected to offer valuable insights into the prospective growth of Ukraine's IT industry and to support the development of alternative scenarios under varying market conditions.

Presentation of the main research material. One of the widely used approaches to time series forecasting is the Autoregressive Moving Average (ARMA) family of models, which are effective in predicting future values by utilizing historical data patterns. The process of constructing an ARIMA model typically involves several stages: testing the series for stationarity, applying differencing to achieve stationarity when necessary, analyzing autocorrelation and partial autocorrelation functions, estimating the model parameters, and evaluating the model's adequacy. In this context, the ARIMA model is characterized by three parameters: p (the autoregressive order, reflecting the number of lagged observations), d (the differencing order, indicating the degree of transformation required to stabilize the series), and q (the moving average order, which accounts for lagged forecast errors).

When a time series exhibits seasonality, the model can be extended to a Seasonal ARIMA (SARIMA) specification. In this case, additional parameters are introduced: P (seasonal autoregressive order), D (seasonal differencing order), Q (seasonal moving average order), and s (the length of the seasonal cycle). The complete specification is written as SARIMA(p, d, q) × (P, D, Q, s), which integrates both non-seasonal and seasonal dynamics of the data.

For the analysis, this study relies on foreign trade statistics provided by the National Bank of Ukraine (NBU), covering monthly computer service export data from January 2015 to July 2025 [5]. The modeling and analytical procedures were carried out using the Python library statsmodels.

An initial examination of the data (Fig. 1) highlights a strong upward trajectory in computer service exports up to 2022, after which the series demonstrates a sharp decrease, followed by a gradual downward movement.

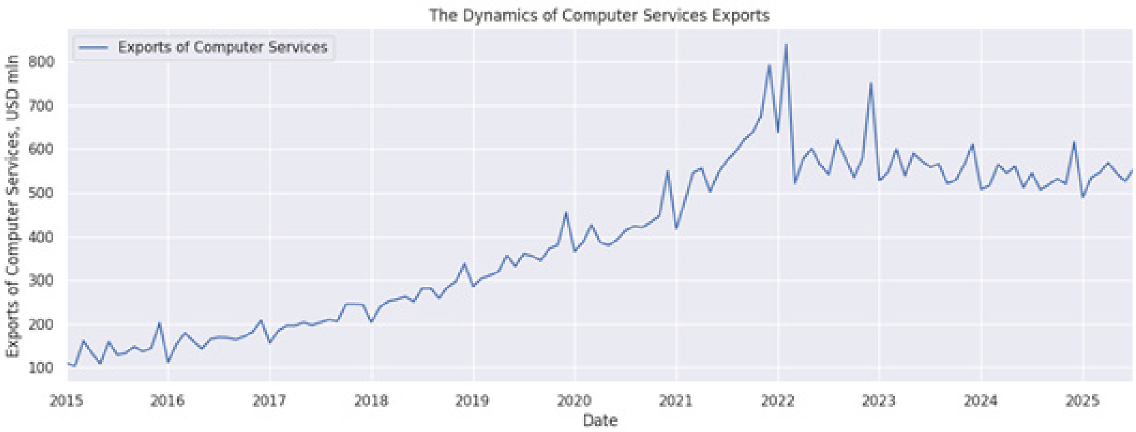

Fig. 1. **The Dynamics of Computer Services Exports**

Source: National Bank of Ukraine

Seasonal patterns are also evident in the data presented in the graph. Export volumes in the final month of each year consistently exceed those of the preceding months. This seasonal effect becomes more apparent once the time series is decomposed into its trend, seasonal, and residual components, as illustrated in Fig. 2.

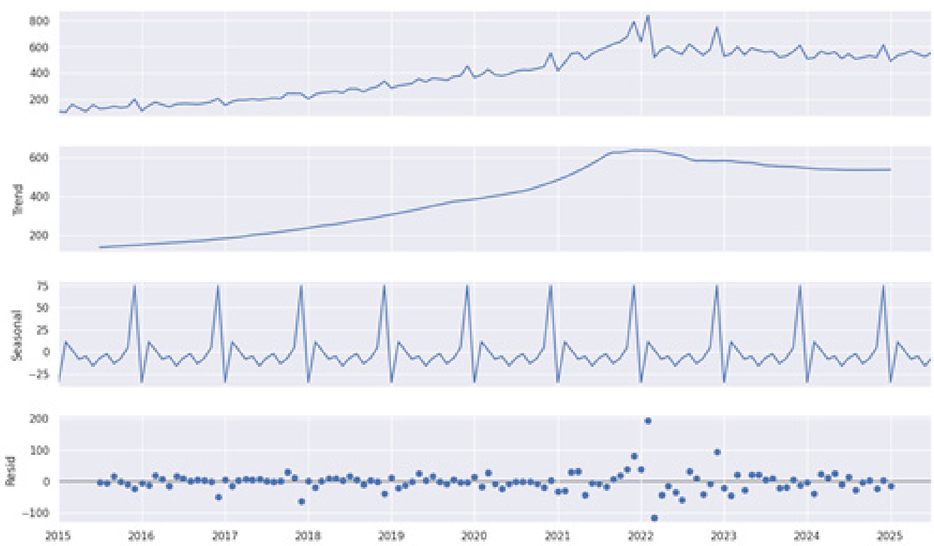

Fig. 2. **Trend-Seasonal Decomposition of Time Series**

The detection of both trend and seasonal components in the dataset indicates that the time series is non-stationary and needs to be transformed into a stationary form. To verify this formally, the Dickey-Fuller test was applied. The calculated test statistic is 1.40, which is higher than the critical value of 2.89 at the 95% significance level, with a p-value of 0.58. These results confirm the non-stationarity of the series. To stabilize the mean, second-order differencing was performed. After this transformation, the recalculated Dickey-Fuller test statistic is 11.37, which is significantly lower than the critical value, with a p-value close to zero. Consequently, the parameter d for the SARIMA model should be set to 2.

The remaining parameters of the model were determined using a grid search procedure, with the optimal specification identified by maximizing the Log Likelihood function and simultaneously minimizing the Akaike Information Criterion (AIC) among the constructed models. As a result of building models with various parameters, the optimal model was determined to be SARIMA(3, 2, [0,1])x(1,0,1,12). This model has a Log Likelihood value of 648.675 and an AIC of 1311.350. The parameter estimates for the model are shown in Fig. 3.

	coef	std err	z	P>|z|	[0.025	0.975]
ar.L1	-1.6583	0.056	-29.852	0.000	-1.767	-1.549
ar.L2	-0.9848	0.088	-11.146	0.000	-1.158	-0.812
ar.L3	-0.3237	0.057	-5.643	0.000	-0.436	-0.211
ma.L2	-0.9614	0.093	-10.352	0.000	-1.143	-0.779
ar.S.L12	0.9971	0.036	27.504	0.000	0.926	1.068
ma.S.L12	-0.9503	0.298	-3.190	0.001	-1.534	-0.366

Fig. 3. **The Estimated Coefficients for the Parameters of the Model**

To evaluate the predictive performance of the model, forecasted values were compared with actual data using the Mean Absolute Percentage Error (MAPE). The obtained MAPE of 7.61% indicates strong predictive accuracy. Furthermore, residual diagnostics confirmed the adequacy of the model: the residuals are normally distributed, exhibit no autocorrelation, and maintain homoscedasticity, aside from distortions caused by shock variables related to the outbreak of the full-scale war. Therefore, this model is suitable for forecasting.

A chart of forecasted values for the next six months, with a 95% confidence level, is presented in Fig. 4.

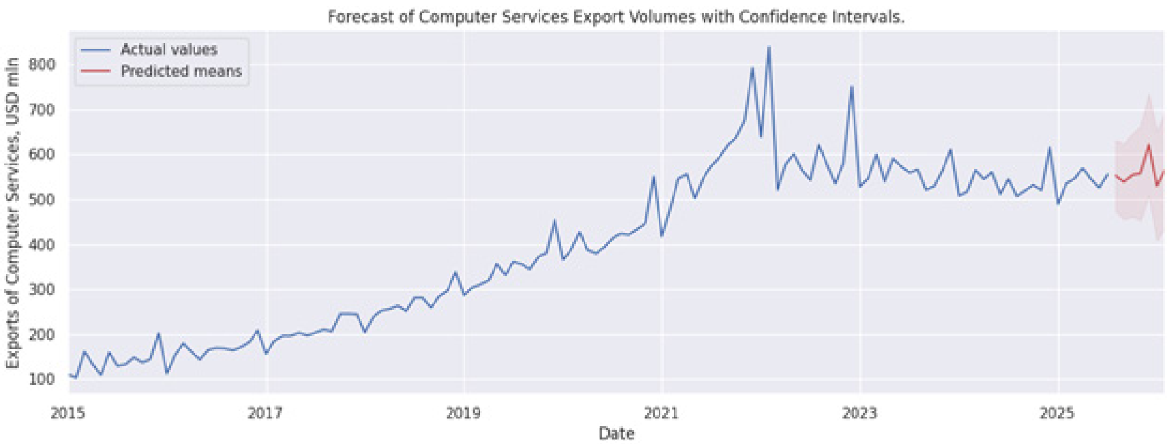

Fig. 4. **Forecast of Computer Services Export Volumes with Confidence Intervals**

Conclusion. The forecasting results suggest that the dynamics of computer service exports will remain relatively stable over the next six months. By December 2025, export volumes are projected to reach approximately $620 million, which is comparable to the levels observed in the previous year. This outcome underscores the resilience of Ukraine's

IT sector to wartime shocks and highlights its continued capacity to generate a stable inflow of foreign currency into the national budget, in line with performance over the past two years.

Scientific supervisor – D.Sc., Professor L. Guryanova

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PECULIARITIES OF CONTEMPORARY VALUE-ORIENTED MARKETING

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Annotation. *This article examines contemporary value- oriented marketing in different industries. It explores key peculiarities, which may be observed in marketing activity. The article also evaluates the challenges and future prospects of such kind of marketing. Consumers beliefs, expectations, values become the cornerstone of successful marketing activity.*

Keywords: *contemporary, value-oriented marketing, peculiarities, consumers, beliefs, expectations.*

Анотація. *У статті досліджується сучасний ціннісно-орієнтований маркетинг у різних галузях. Досліджено ключові особливості, які можуть спостерігатися в маркетинговій діяльності. У статті також оцінено виклики та майбутні перспективи такого напряму маркетингу. Переконання, очікування, цінності споживачів стають наріжним каменем успішної маркетингової діяльності.*

Ключові слова: *сучасний, ціннісно-орієнтований маркетинг, особливості, споживачі, переконання, очікування.*

Problem statement. Nowadays marketing becomes more heterogeneous. Scholars study and analyze different topics and areas of marketing. Marketing research has broadened dramatically in the last decade. Scholars now combine