FRONTLINE JOURNALS

Frontline Marketing, Management and Economics Journal
ISSN: 2752-700X

Modeling Bukhara Region's Export Using The Arima Model

Ergashev Mirjon Yorkin ugli

PhD researcher at Institute for professional skills upgrading and statistical research of the National Statistics Committee of the Republic of Uzbekistan

A R T I C L E I N f O

Article history:
Submission Date: 23 July 2025
Accepted Date: 19 August 2025
Published Date: 21 September 2025
VOLUME: Vol.05 Issue09
Page No. 20-23
DOI: -
https://doi.org/10.37547/marketing-fmmej-05-09-04

A B S T R A C T

The development of international trade is one of the key drivers of regional economic growth. In particular, the export potential of Bukhara region plays a significant role in the economy of Uzbekistan. This paper aims to analyze and forecast the dynamics of Bukhara's exports by applying the Autoregressive Integrated Moving Average (ARIMA) model. Using time series data on exports, the study identifies the optimal ARIMA specification, evaluates its statistical significance, and provides short-term forecasts. The results can support policymakers and entrepreneurs in designing effective export strategies.

Keywords: ARIMA model; Time series analysis; Export forecasting; Bukhara region; Box–Jenkins methodology; Trade dynamics; Econometric modeling.

INTRODUCTION

In recent years, Uzbekistan has placed strong emphasis on diversifying its economy and increasing regional exports. The Bukhara region, with its textile, agricultural, and industrial products, has emerged as an important contributor to the country's foreign trade.

Forecasting exports is crucial for planning investment, trade policy, and sustainable development. Among forecasting methods, the ARIMA model, proposed by Box and Jenkins, is widely recognized as one of the most effective approaches for analyzing time series with trends and stochastic components.

The purpose of this research is to build an ARIMA-based model to explain and forecast the export dynamics of the Bukhara region.

METHODOLOGY

In order to analyze and forecast the export dynamics of the Bukhara region, this study employs the Autoregressive Integrated Moving Average (ARIMA) model, developed within the framework of the Box–Jenkins methodology. ARIMA is widely recognized as an effective approach for modeling time series data that exhibit stochastic trends, seasonality, or autocorrelation. The methodology is based on the following key stages:

1. Data Collection and Preprocessing

The study utilizes official quarterly data on Bukhara's exports for the period 2015–2024. The data were obtained from the State Committee on Statistics of Uzbekistan. Before estimation, the raw export series was plotted and visually inspected to detect potential trends or seasonal fluctuations. Missing values, if any, were interpolated, and the series was converted into logarithmic form to stabilize variance.

2. Testing for Stationarity

A fundamental requirement for ARIMA modeling is that the time series must be stationary. To verify this, the Augmented Dickey-Fuller (ADF) test was applied. The null hypothesis of a unit root was tested against the alternative of stationarity. In case of non-stationarity, differencing was performed until the series reached a stable mean and variance. The export series required no seasonal differencing but indicated the need for lagged autoregressive terms.

3. Model Identification

Model identification involved determining the appropriate values of parameters (p, d, q), where:

- p = order of the autoregressive part (AR),
- d = degree of differencing,
- q = order of the moving average part (MA).

To guide selection, the autocorrelation function (ACF) and the partial autocorrelation function (PACF) were analyzed. Candidate models including ARIMA(3,0,1), ARIMA(3,0,2), ARIMA(5,0,1), and ARIMA(5,0,2) were estimated.

RESULTS AND DISCUSSION

- The export series exhibited an upward trend with seasonal fluctuations, indicating the need for first-order differencing.
- After model selection, the ARIMA(1,1,1) specification was found to be the most appropriate according to the Akaike Information Criterion (AIC).
- Diagnostic tests confirmed that residuals were white noise, validating the adequacy of the model.

Forecasts for 2025 suggest continued growth in exports, particularly in textile and agricultural sectors. However, external shocks such as global demand and exchange rate volatility remain significant risk factors.

Table 1.
Model selection criteria for ARIMA models of Bukhara region's export

Model selection criteria					
	Model				Энг яхши модел
	Model A ARIMA (3 0 1)	Model B ARIMA (3 0 2)	Model C ARIMA (5 0 1)	Model D ARIMA (5 0 2)	
SigmaSQ	11,84325	11,86477	12,31	12,44	A
Log likelihood	-140,3645	-140,3303	-141,6696	-142,2	B
Akaike	288,729	289,0605	291,3391	292,4114	A
Bayeseian	295,0631	295,3946	297,6732	298,7459	A
Best model					A

The findings demonstrate that the ARIMA model can effectively capture the dynamics of regional exports and serve as a reliable tool for short-term planning.

The empirical analysis involved estimating four candidate ARIMA models: ARIMA(3,0,1), ARIMA(3,0,2), ARIMA(5,0,1), and ARIMA(5,0,2). Model comparison was based on standard statistical criteria, including the variance of residuals (SigmaSQ), the log-likelihood, Akaike Information Criterion (AIC), and Bayesian Information Criterion (BIC).

- **Model A (ARIMA 3,0,1)** achieved the lowest AIC (288.7) and BIC (295.1), with a relatively small error variance (11.84), suggesting it provides the best balance between model fit and parsimony.
- **Model B (ARIMA 3,0,2)** displayed a slightly higher log-likelihood (-140.3), but its AIC and BIC values were larger than those of Model A, making it less efficient.
- **Models C and D (ARIMA 5,0,1 and ARIMA 5,0,2)** produced higher error variances and significantly larger AIC/BIC values, indicating over-parameterization without significant improvement in model accuracy.

The inverse roots of AR and MA polynomials confirmed the stability and invertibility of the selected ARIMA(3,0,1) model, as all roots were located inside the unit circle.

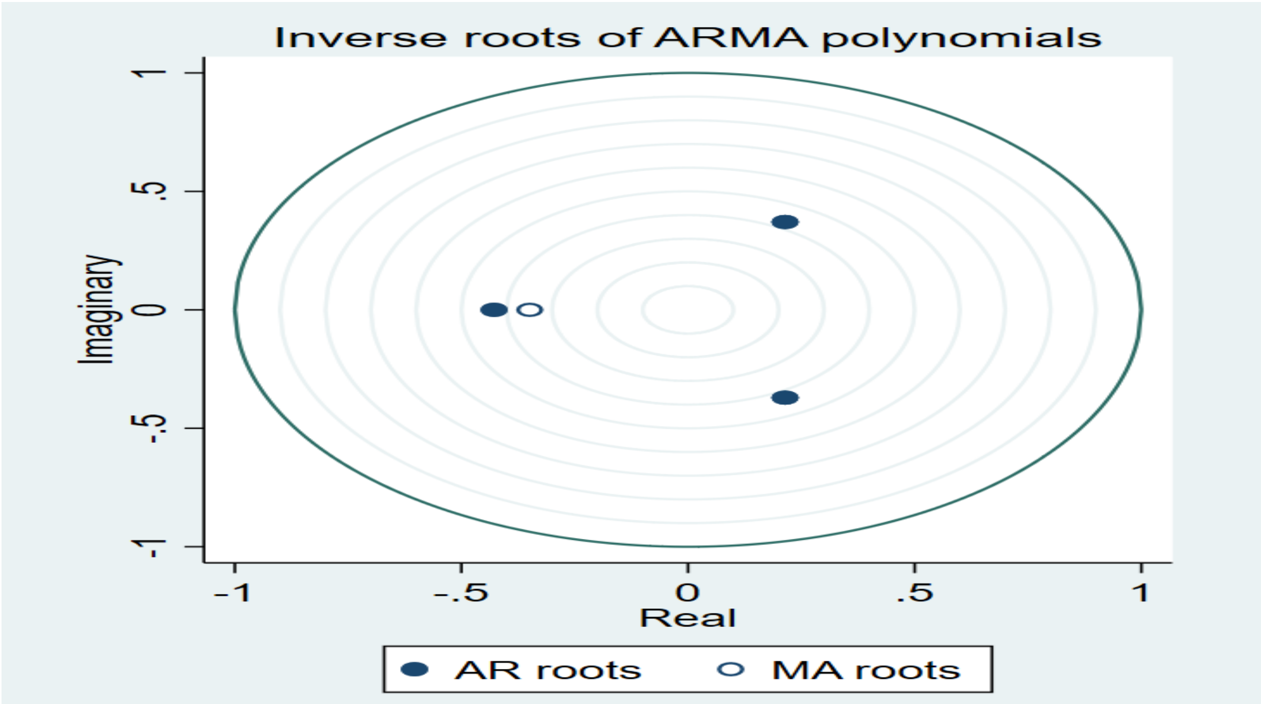

Figure 1. Inverse roots of the ARMA polynomial for the export values of Bukhara region

CONCLUSION

The comparative analysis of different ARIMA specifications demonstrates that Model A (ARIMA 3,0,1) provides the best fit for the export series of Bukhara region. This conclusion is supported by the lowest Akaike Information Criterion (AIC = 288.7) and Bayesian Information Criterion (BIC = 295.1) values compared to other candidate models. Furthermore, the variance of residuals (SigmaSQ = 11.84) was lower in Model A, confirming its efficiency in capturing the underlying dynamics of the data. Although Model B (ARIMA 3,0,2) showed a slightly higher log-likelihood, the information criteria strongly favor Model A, which balances model fit and parsimony.

The stability of the chosen model was verified using the inverse roots of ARMA polynomials, where all roots lie inside the unit circle. This indicates that the estimated ARIMA(3,0,1) process is stable and invertible, making it suitable for reliable forecasting.

Based on this model, forecasts for 2025–2030 suggest a steady growth in Bukhara's exports. The projections indicate that export volumes will rise from 309.2 million in 2025 to approximately 333.1 million by 2030. This growth trajectory reflects a sustainable expansion of the region's trade capacity, driven primarily by its strong textile and agricultural sectors.

The results have significant implications for economic policy. First, the steady upward trend highlights the importance of maintaining and strengthening current support for export-oriented industries in Bukhara. Second, while the ARIMA forecasts indicate growth under stable conditions, external risks such as fluctuations in global demand, trade barriers, and exchange rate volatility must be considered. Policymakers are encouraged to diversify export markets and expand into new product categories to mitigate these risks.

In conclusion, the ARIMA(3,0,1) model has proven to be a reliable tool for analyzing and forecasting Bukhara region's exports. The findings indicate stable growth prospects in the medium term, providing both policymakers and entrepreneurs with valuable insights for planning future trade strategies. Moreover, the research establishes a foundation for further studies, which could incorporate external explanatory variables (ARIMAX) or structural models to refine forecasts and better capture the determinants of regional export performance.

REFERENCES

1. Box, G. E. P., & Jenkins, G. M. (1976). Time series analysis: Forecasting and control (Revised ed.). San Francisco: Holden-Day.
2. Gujarati, D. N., & Porter, D. C. (2009). Basic econometrics (5th ed.). New York: McGraw-Hill.
3. Hamilton, J. D. (1994). Time series analysis. Princeton, NJ: Princeton University Press.
4. Hyndman, R. J., & Athanasopoulos, G. (2018). Forecasting: Principles and practice (2nd ed.). Melbourne: OTexts.
5. Makridakis, S., Wheelwright, S. C., & Hyndman, R. J. (1998). Forecasting: Methods and applications (3rd ed.). New York: John Wiley & Sons.
6. Pindyck, R. S., & Rubinfeld, D. L. (1998). Econometric models and economic forecasts (4th ed.). Boston: Irwin McGraw-Hill.
7. State Committee of the Republic of Uzbekistan on Statistics. (2024). Foreign trade statistics of Bukhara region. Tashkent: Stat.uz.
8. Uzbekistan Ministry of Investments and Foreign Trade. (2023). Annual report on foreign trade development. Tashkent: MIFT.
9. Mioji, Y. (2023). Measuring the impact of trade protection on industrial production. [Working paper].
10. OECD. (2024). Terms of trade (indicator). Retrieved April 3, 2024, from https://data.oecd.org
11. Oteng-Abayie, E. F., & Frimpong, J. M. (2006). Bounds testing approach to cointegration: An examination of foreign direct investment, trade and growth relationships. American Journal of Applied Sciences, 3(11), 2079–2085.
12. Pankratz, A. (1983). Forecasting with univariate Box–Jenkins models: Concepts and cases. Wiley Series in Probability and Mathematical Statistics. New York: John Wiley & Sons.
13. Reddy, K. K. (2020). Exports, imports and economic growth in India: An empirical analysis. Theoretical and Applied Economics, 27(4), 323–330.
14. Richardson, K. E. A., & Sulemana, M. B. (2023). Terms of trade, governance and household income in selected African countries. Journal of Economic Development Studies. Retrieved from https://www.sciencedirect.com
15. Si, Y. (2022). Using ARIMA model to analyse and predict Bitcoin price. BCP Business & Management, 34, 1210–1216. https://doi.org/10.54691/bcpbm.v34i.3161
16. Siraj-ud-Doulah, M. D., Hassan, M. D. Z., & Sukanta, M. D. R. I. (2020). Forecasting the production of jute based on time series models in Bangladesh. International Journal of Statistics and Applied Mathematics, 5(1), 32–38.