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FORECASTING THE SECTORAL STRUCTURE OF UZBEKISTAN'S ENTREPRENEURSHIP SECTOR TO 2030 USING ARIMA AND SARIMA MODELS

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Abstract

This article forecasts sectoral time series of Uzbekistan's entrepreneurship sector using ARIMA and SARIMA models. Monthly observations for 2022–2026 cover agriculture, industry, construction, wholesale and retail trade, transportation and storage, accommodation and food services, information and communication, and health and social services. ADF and KPSS tests support first differencing (d=1) for all series. According to AIC, SARIMA outperforms ARIMA in all eight sectors, whereas RMSE indicates a closer in-sample fit for ARIMA. Ljung–Box p-values exceed 0.05, suggesting no material residual autocorrelation. By December 2029, growth is projected in agriculture, accommodation and food services, information and communication, and health and social services, while construction shows a declining path. SARIMA is therefore treated as the main forecasting model and ARIMA as a benchmark and control specification.

Keywords: Entrepreneurship, time series, ARIMA, SARIMA, forecasting, ADF, KPSS, AIC, RMSE, Ljung–Box, Uzbekistan

Introduction

Assessing the future structural development of the entrepreneurship sector requires more than an analysis of current shares and growth rates. Monthly sectoral activity may simultaneously contain trends, cyclical fluctuations and seasonality. Because seasonal effects are particularly strong in trade, agriculture,

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tourism, construction and transport, simple trend extrapolation can increase forecast error.

The ARIMA model combines autoregressive and moving-average components with differencing to represent the general trend dynamics of a series. SARIMA extends this structure by adding seasonal autoregressive, seasonal differencing and seasonal moving-average terms. Comparative evaluation of ARIMA and SARIMA is therefore important when forecasting seasonally sensitive economic activity.

The purpose of this article is to diagnose monthly series for eight sectors of Uzbekistan's entrepreneurship sector over 2022–2026, compare ARIMA and SARIMA models using AIC, RMSE and Ljung–Box criteria, and interpret forecasts through December 2029 from the perspective of sectoral structural development. The dissertation presents these results as part of the development outlook "to 2030"; the empirical forecast table itself ends at 2029-M12.

Figure 1. Methodological Sequence for Time-Series Forecasting

Figure 1. Methodological sequence of ARIMA–SARIMA forecasting

Current Sectoral Context of the Entrepreneurship Sector

Statistics for January–September 2025 show that small entrepreneurship is dominant in some sectors and develops alongside large business in others. Its share reaches 96.9% in agriculture, 81.8% in retail trade, 77.6% in construction and 90.9% in passenger transport by road. Although the share in industry is 33.4%, industrial output produced by small business amounts to UZS 258.5 trillion. The volume of services provided by small business is UZS 397.5 trillion, corresponding to a 55.0% share of total services.

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Table 1. Selected sectoral indicators of small entrepreneurship, January–September 2025

Sector	Indicator	January–September 2025
Agriculture, forestry and fisheries	Small-entrepreneurship share	96.9%
Industry	Industrial output produced by small business	UZS 258.5 trillion
Industry	Small-business share of total industrial output	33.4%
Services	Services provided by small business	UZS 397.5 trillion
Services	Small-business share of total services	55.0%
Retail trade	Small-entrepreneurship share	81.8%
Construction	Small-entrepreneurship share	77.6%
Construction	Construction work performed by small business	UZS 169.9 trillion
Road transport	Small-business share of passenger transport	90.9%

Data and Time-Series Methodology

The forecasting database is constructed from monthly observations for 2022–2026. Eight series are analyzed: agriculture, forestry and fisheries; industrial output; construction; wholesale and retail trade; transportation and storage; accommodation and food services; information and communication; and health and social services.

Stationarity is tested using ADF and KPSS procedures. In the ADF test, H0 indicates the presence of a unit root, whereas in the KPSS test H0 indicates stationarity. According to the dissertation results, all eight series are nonstationary in levels; after first differencing, ADF p-values fall below 0.05 and KPSS p-values exceed 0.05. Therefore, d=1 is adopted for all series.

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In general form, ARIMA(p,d,q) expresses the dependence of the differenced series on its own lags and lagged errors. SARIMA(p,d,q)(P,D,Q)s additionally captures seasonal components with period s. Empirical model selection uses the Akaike Information Criterion (AIC), root mean squared error (RMSE), and the Ljung–Box test for residual autocorrelation.

ARIMA: $\varphi(B)(1-B)^d y_t = \theta(B)\,\varepsilon_t$
SARIMA: $\Phi(B^s)\varphi(B)(1-B)^d(1-B^s)^D y_t = \Theta(B^s)\theta(B)\,\varepsilon_t$

Model Diagnostics and Selection

For all eight sectors, the SARIMA specification has a lower AIC than ARIMA. For example, AIC decreases from 913.358 to 717.877 in agriculture, from 1009.680 to 792.999 in trade, and from 743.968 to 589.789 in information and communication. This indicates that accounting for seasonal components improves model quality in terms of the information criterion.

Table 2. Diagnostic comparison of ARIMA and SARIMA models

Sector	ARIMA AIC	SARIMA AIC	ARIMA RMSE	SARIMA RMSE	Main model
Agric.	913.358	717.877	1382.308	1573.907	SARIMA
Industry	956.268	751.343	2080.982	2090.522	SARIMA
Constr.	891.061	700.687	1122.504	1261.426	SARIMA
Trade	1009.680	792.999	3425.890	5110.920	SARIMA
Transp.	783.541	618.326	407.048	707.301	SARIMA
Accom.	834.754	659.643	657.605	738.204	SARIMA
Info. & comm.	743.968	589.789	280.234	342.311	SARIMA
Health	660.051	525.385	125.953	167.710	SARIMA

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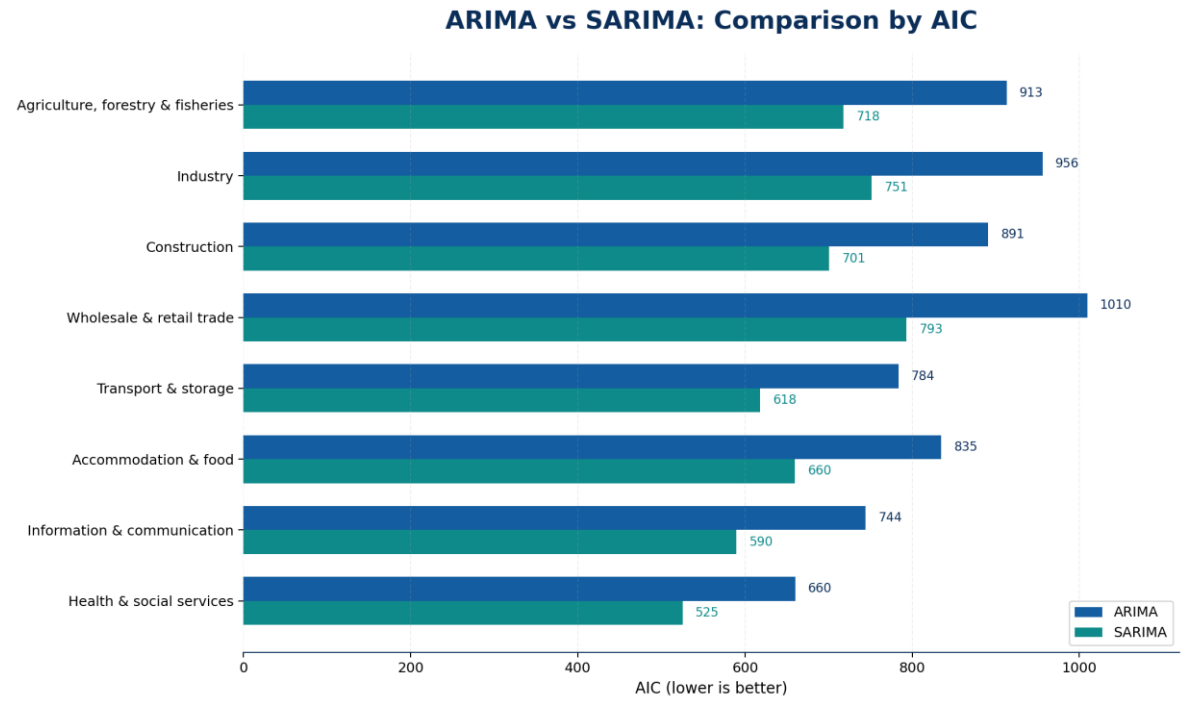

Figure 2. Comparison of ARIMA and SARIMA by AIC

Source: Author's calculations based on official statistical data of the Republic of Uzbekistan and the calculations presented in R.O. Xaitova's dissertation.

RMSE produces the opposite ranking: ARIMA is closer to historical values in all series. For trade, ARIMA RMSE=3425.890 compared with SARIMA RMSE=5110.920; in agriculture the corresponding values are 1382.308 and 1573.907. This divergence shows why model selection should not rely on a single criterion. AIC captures the balance between complexity and fit, whereas RMSE represents the numerical magnitude of forecast error.

Ljung–Box p-values are well above 0.05 for both models, generally between 0.999 and 1.000. The dissertation also reports that the ARCH LM test does not reveal meaningful conditional heteroskedasticity in the residuals. SARIMA is therefore adopted as the principal forecasting model because it captures seasonality, while ARIMA is retained as a benchmark and control specification.

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Forecast Results

The forecast table covers July 2026 through December 2029, using June 2026 as the baseline for comparison. In agriculture, the baseline of 47,297 units is projected to reach 58,196 under ARIMA and 62,589 under SARIMA by December 2029. These figures correspond to increases of approximately 23.0% and 32.3%, respectively.

Table 3. Baseline values and December 2029 forecasts

Sector	2026-M06	ARIMA 2029-M12	SARIMA 2029-M12	ARIMA Δ%	SARIMA Δ%
Agric.	47,297	58,196	62,589	23.0	32.3
Industry	68,743	74,730	65,431	8.7	-4.8
Constr.	42,599	40,161	34,138	-5.7	-19.9
Trade	173,727	225,308	168,659	29.7	-2.9
Transp.	22,538	25,586	19,362	13.5	-14.1
Accom.	28,905	40,171	41,410	39.0	43.3
Info. & comm.	14,817	20,196	21,676	36.3	46.3
Health	9,890	12,959	14,729	31.0	48.9

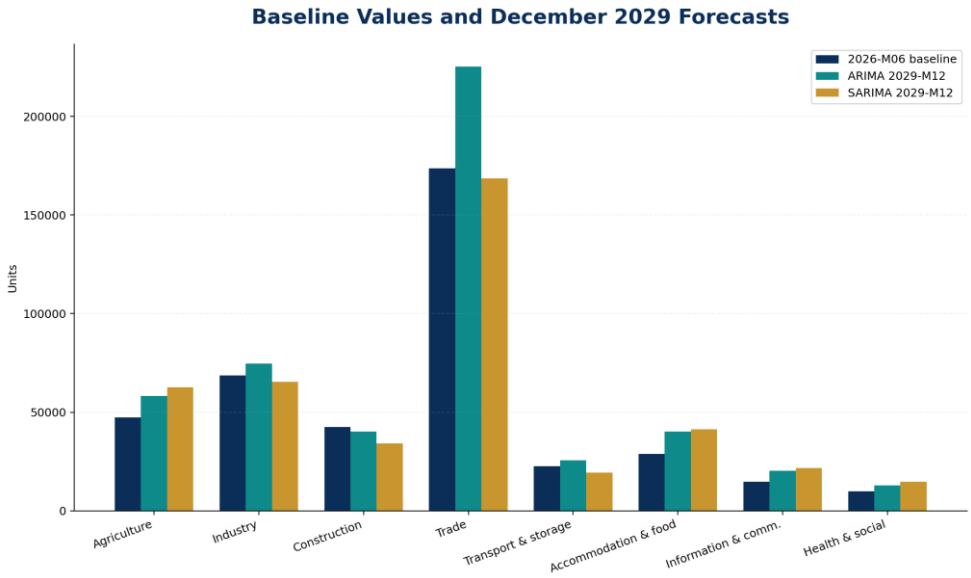

Figure 3. June 2026 baseline values and December 2029 forecasts

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Source: Author's calculations based on official statistical data of the Republic of Uzbekistan and the calculations presented in R.O. Xaitova's dissertation.

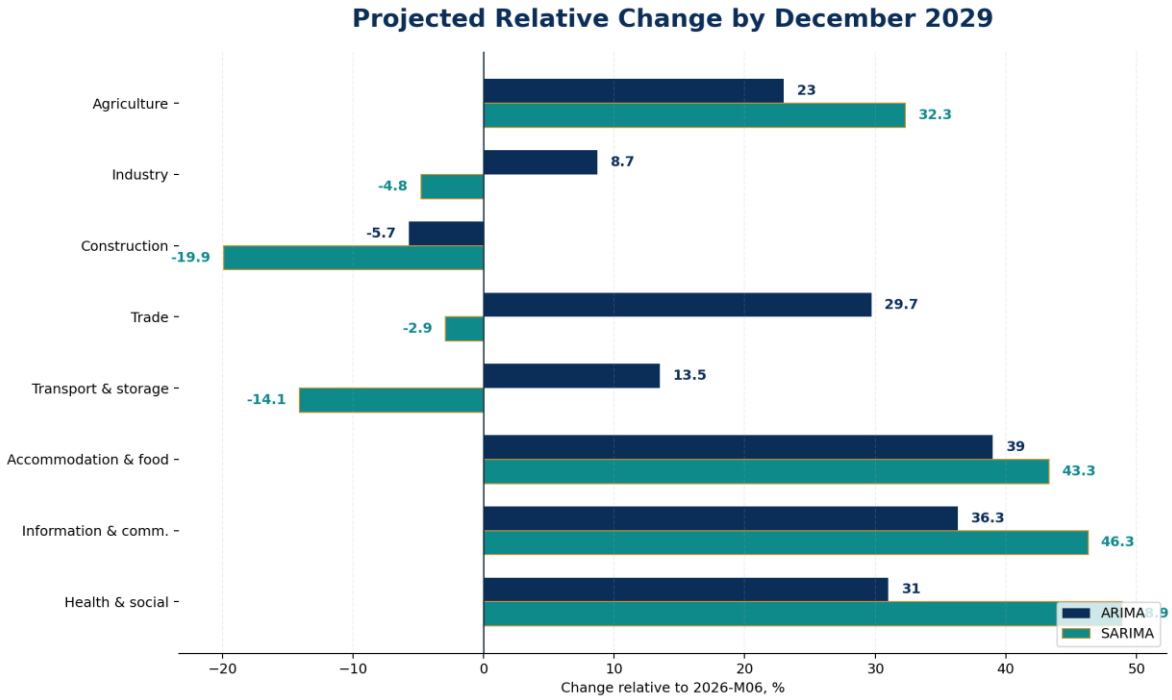

Figure 4. Projected relative changes from the June 2026 baseline

The largest divergence between the two models occurs in wholesale and retail trade. From a June 2026 baseline of 173,727 units, ARIMA projects 225,308 units by December 2029 (+29.7%), whereas SARIMA projects 168,659 units (−2.9%). This difference demonstrates the strong sensitivity of the trade series to seasonality and demand fluctuations. The trade forecast should therefore be interpreted as a scenario range rather than as a single point estimate.

Accommodation and food services show growth under both models, rising from 28,905 units to 40,171 under ARIMA (+39.0%) and 41,410 under SARIMA (+43.3%). Information and communication shows even stronger growth, from 14,817 units to 20,196 (+36.3%) and 21,676 (+46.3%), respectively. These patterns suggest that tourism, catering, e-commerce, IT outsourcing and digital services are becoming important prospective segments of entrepreneurship.

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In health and social services, the baseline of 9,890 units increases to 12,959 under ARIMA (+31.0%) and 14,729 under SARIMA (+48.9%). Private healthcare, diagnostics, rehabilitation and social services therefore emerge as activities with sustained demand growth.

In industry, ARIMA projects an increase from 68,743 to 74,730 units (+8.7%), while SARIMA projects a decline to 65,431 (−4.8%). Both models indicate a downward path in construction: 40,161 under ARIMA (−5.7%) and 34,138 under SARIMA (−19.9%). For transportation and storage, ARIMA projects +13.5% growth while SARIMA projects a −14.1% decline. Investment cycles, large projects and seasonal demand increase forecast uncertainty in these sectors.

Dynamic View of the ARIMA Trajectory

The monthly ARIMA forecast table reported in the dissertation shows a consistent upward trend in several service sectors and a gradual decline in construction. The following table and figure summarize selected points from the monthly trajectories.

Table 4. ARIMA forecast trajectory for selected periods

Period	Agriculture	Trade	Accommodation/food	Information/ communication	Health
2026-M05	46.864	172.558	28.522	14.602	9.767
2026-M06	47.297	173.727	28.905	14.817	9.890
2026-M12	48.842	181.096	30.701	15.553	10.363
2027-M06	50.396	188.464	32.382	16.325	10.810
2027-M12	51.954	195.833	33.995	17.099	11.245
2028-M06	53.514	203.202	35.567	17.873	11.675
2028-M12	55.074	210.570	37.114	18.648	12.104
2029-M06	56.635	217.939	38.647	19.422	12.532
2029-M12	58.196	225.308	40.171	20.196	12.959

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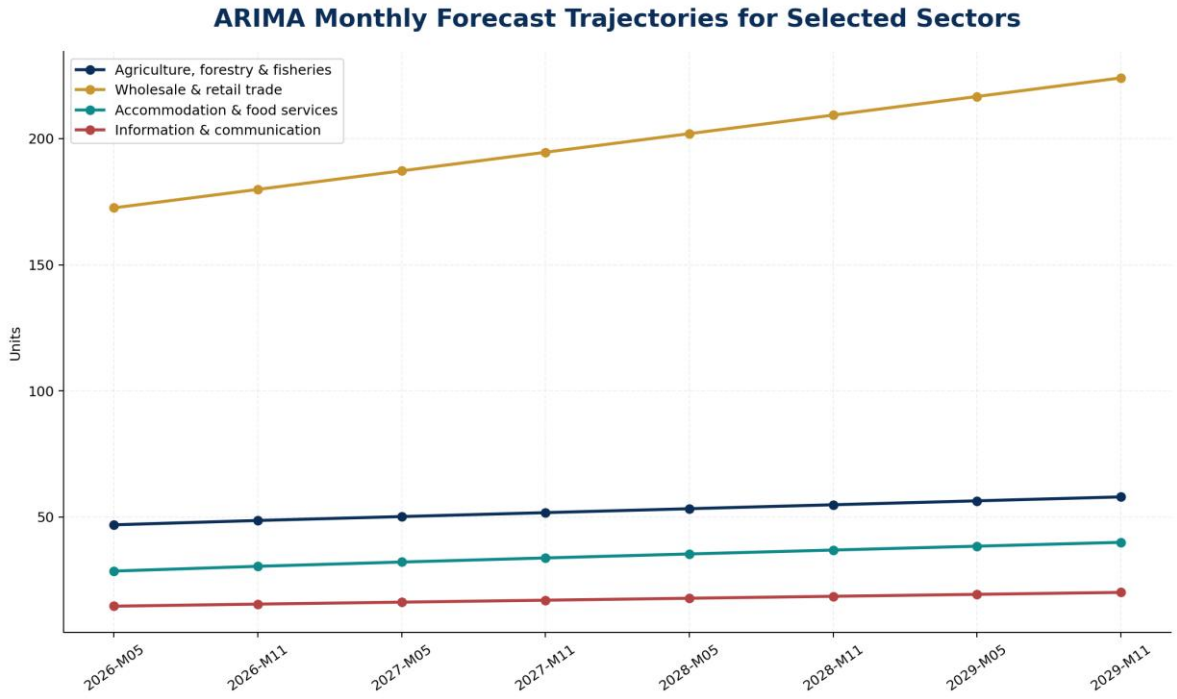

Figure 5. Monthly ARIMA forecast trajectories for selected sectors

Discussion and Policy Implications

The forecast results indicate that services, agribusiness and the digital sector are likely to be key structural growth points of entrepreneurship. Policy priorities include moving agribusiness from primary production toward processing, agro-logistics, storage and export chains; expanding tourism, catering, healthcare, education and professional services; and promoting e-commerce, fintech and outsourcing in the IT sector.

Model divergence in industry, construction and transport requires cautious forecast-based policy. Large investment projects, public procurement, construction cycles and logistics flows may create structural breaks in time series. Future models could therefore test a SARIMAX specification that incorporates exogenous variables such as investment, interest rates, export orders or construction permits. This is a methodological extension proposed for future research; the empirical calculations in this article are based on ARIMA and SARIMA results.

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Forecasts should be interpreted as uncertainty ranges rather than isolated point estimates. The large differences between ARIMA and SARIMA in trade, industry, construction and transport reveal specification uncertainty. In practical management, the common direction of the models, AIC/RMSE diagnostics and real economic drivers should be considered jointly.

Conclusion

ADF and KPSS tests indicate that all eight sectoral series of Uzbekistan's entrepreneurship sector are integrated of order one and require d=1 differencing. AIC favors SARIMA in all sectors, whereas RMSE indicates that ARIMA fits the historical series more closely. Ljung–Box diagnostics confirm the absence of material residual autocorrelation in either specification.

The December 2029 forecasts identify agriculture, accommodation and food services, information and communication, and health services as the most consistently growing segments. Both models project a decline in construction, while industry, trade and transport show substantial model divergence. SARIMA should therefore be used as the principal model for seasonal forecasting, with ARIMA retained as a benchmark specification.

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