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Time-Series Modeling and Predictive Analysis of USD/UZS Exchange Rate Movements: An ARIMA-Based Approach

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Abstract: Exchange rate stability is one of the key indicators of macroeconomic performance and financial resilience. Understanding and forecasting the movements of a national currency are essential for designing effective monetary and fiscal policies. This study investigates the dynamics of the Uzbek soum against the U.S. dollar and provides a short-term forecast of its future trajectory using the Autoregressive Integrated Moving Average (ARIMA) model. The analysis is based on weekly data covering the period from September 2017 to October 2025, obtained from reliable financial databases.

Before model estimation, the Augmented Dickey–Fuller (ADF) test was employed to check the stationarity of the exchange rate series. The results indicated that the variable is non-stationary in levels but becomes stationary after first differencing. The autocorrelation and partial autocorrelation functions (ACF and PACF) of the differenced series were examined to identify suitable model parameters. Based on these diagnostics, the ARIMA(1,1,0) model was selected as the best-fitting specification for capturing the short-term dynamics of the weekly exchange rate.

The estimated model coefficients were statistically significant, confirming that past changes in the exchange rate have predictive power for future movements. Diagnostic tests, including the correlogram and Ljung–Box Q-statistics, verified that the model residuals are free from serial correlation, indicating that the ARIMA(1,1,0) model provides an adequate

representation of the data. Using this model, forecasts were generated for ten future weekly periods to assess the potential direction of the exchange rate.

The results of the study provide important insights into the short-run behavior of the Uzbek soum and offer a data-driven basis for future exchange rate analysis and policy planning. The application of ARIMA modeling demonstrates its usefulness as a forecasting tool for monetary authorities and researchers monitoring currency stability.

Keywords: Exchange rate, ARIMA model, forecasting, stationarity, Uzbekistan, time series analysis.

Introduction: Exchange rate stability is one of the most critical indicators of a country's macroeconomic health. It directly affects international trade competitiveness, inflation levels, and overall financial stability. For countries with emerging economies such as Uzbekistan, maintaining a stable and predictable exchange rate is essential for fostering investor confidence and ensuring sustainable economic growth. Sudden fluctuations in the value of the national currency can lead to uncertainty in imports and exports, affect inflation expectations, and complicate the implementation of monetary policy.

In the context of Uzbekistan, the exchange rate of the Uzbek soum has undergone significant changes over the past decade, influenced by both domestic reforms and global economic factors. Since the liberalization of the foreign exchange market in 2017, the soum–US dollar exchange rate has shown gradual adjustments reflecting market forces and external shocks. As a result, understanding the time-series behavior of the exchange rate and forecasting its short-term movements have become increasingly important for policymakers, economists, and financial analysts.

Forecasting the exchange rate is a complex task due to the dynamic and stochastic nature of currency markets. Various models have been developed to capture these dynamics, among which the Autoregressive Integrated Moving Average (ARIMA) model is one of the most widely used statistical approaches. The ARIMA model is especially useful when the goal is to describe and forecast a single time series based on its own historical patterns without relying on external explanatory variables. By identifying autoregressive and moving average structures in the data, ARIMA helps capture short-run persistence and random fluctuations in exchange rate movements.

The main objective of this study is to model and forecast the weekly USD/UZS exchange rate using the ARIMA framework. The analysis is based on historical data covering the period from September 2017 to October 2025. The study begins with testing for stationarity using the Augmented Dickey–Fuller (ADF) test, followed by identifying the most appropriate ARIMA specification through examination of autocorrelation and partial autocorrelation functions. After estimating the model parameters, diagnostic checks are conducted to evaluate the adequacy of the model and ensure that the residuals satisfy the assumptions of white noise. Finally, the model is used to forecast future exchange rate values for a short-term horizon.

The remainder of this paper is organized as follows. Section 2 reviews relevant literature on exchange rate modeling and forecasting, emphasizing previous applications of the ARIMA model and identifying research gaps related to the Uzbek foreign exchange market. Section 3 explains the research methodology, including data selection, stationarity testing, model identification, and diagnostic procedures. Section 4 presents the empirical results, discussing model estimation, diagnostic tests, and short-term forecasts of the USD/UZS exchange rate. Finally, Section 5 concludes the study by summarizing the key findings, outlining policy implications, and suggesting directions for future research.

Literature review

Forecasting exchange rates has long been a central theme in empirical international finance and applied econometrics because of its direct policy relevance and practical importance for trade and financial planning. Univariate time-series approaches such as the Autoregressive Integrated Moving Average (ARIMA) family remain widely used for short-term forecasting due to their relative simplicity, interpretability, and ability to capture autocorrelation and persistence in single-series data. Several recent applied studies confirm the continued utility of ARIMA models for short-horizon exchange-rate prediction, showing that properly specified ARIMA models often yield competitive point forecasts when the aim is to exploit serial dependence in the series itself rather than structural economic relationships. For instance, studies that applied ARIMA to major currency pairs (e.g., USD/EUR, JPY/USD) report adequate in-sample fit and acceptable short-term forecast errors when the model is chosen through ADF tests, ACF/PACF inspection, and information criteria or automated selection routines. (Lakhal, 2024; Nirmala, 2021).

Nevertheless, the literature reveals mixed evidence when ARIMA is compared to more complex alternatives. Several comparative studies find that machine-learning and hybrid approaches (e.g., Random Forest, neural networks, LSTM, and combined ARIMA–ML hybrids) can outperform pure ARIMA in out-of-sample forecasting accuracy for some currency series, especially when nonlinearities or structural breaks are present (Xu & Li, 2017). Recent papers that compare ARIMA with modern approaches often show that while ARIMA retains competitive performance for short horizons and small data requirements, advanced algorithms typically reduce forecast error in large samples or when nonlinear dynamics are important. These comparative findings motivate practitioners to use ARIMA either as a baseline or as a component in hybrid frameworks.

A parallel strand of the literature examines whether modeling conditional variance (using ARCH/GARCH family models) improves forecasting of exchange-rate volatility or even mean forecasts. Multiple studies in emerging markets and commodity-linked currencies show that volatility clustering is common and that GARCH-type specifications capture time-varying variance and produce superior density forecasts or improved prediction intervals relative to homoskedastic ARIMA residuals (Min & Li, 2017). However, for point forecasts of the conditional mean, ARIMA and ARIMA–GARCH comparisons show mixed results: while GARCH improves estimated uncertainty and interval forecasts, it does not always improve the point forecast of the level or returns relative to a well-specified ARIMA. Consequently, many researchers recommend ARIMA for mean forecasting and reserve GARCH for volatility modeling or for generating more accurate predictive intervals.

Country- and region-specific studies show both the applicability of ARIMA and the importance of local market structure. For Uzbekistan, empirical work has tended to focus on both mean and volatility dynamics. Earlier studies (covering the 2000s through the 2010s) applied ARIMA and ARCH family models to UZS exchange rates, documenting that the nominal and real exchange rates exhibit persistence and episodes of elevated volatility, with some studies recommending volatility modeling for risk management and policy design (Berdinazarov et al., 2019). More recent local research emphasizes volatility clustering in UZS/USD, using ARCH-GARCH frameworks to quantify persistence and shock decay in the post-2017 liberalized market environment. These Uzbekistan-specific investigations demonstrate that univariate ARIMA models can be informative for short-run forecasting, but that volatility remains a salient feature in daily and higher-frequency series, motivating careful diagnostic checking after mean-model estimation.

Methodologically, the literature converges on a set of robust procedures for applied ARIMA forecasting: (i) pre-testing for unit roots (ADF/Phillips–Perron) and differencing to attain stationarity; (ii) identification of candidate p and q orders via inspection of ACF and PACF plots and use of information criteria (AIC, BIC); (iii) estimation by maximum likelihood or conditional sum of squares; (iv) diagnostic checking of residuals for serial correlation (Ljung–Box / Q-test), heteroskedasticity (ARCH tests) and distributional assumptions (skewness/kurtosis tests); and (v) forecast evaluation using hold-out samples and error metrics such as RMSE, MAE and MAPE. When model diagnostics indicate remaining autocorrelation or heteroskedasticity, researchers typically either adjust the ARIMA order, include seasonal terms, or complement the mean model with a volatility model (GARCH) or move to hybrid approaches. This stepwise approach underlies the empirical strategy used in this study and aligns with best practices in the literature.

Despite the broad applicability of ARIMA, two important research gaps remain relevant to the present thesis. First, many comparative studies concentrate on major currency pairs or on alternative forecasting techniques, while fewer studies focus on weekly frequency modeling for smaller or recently liberalized markets such as Uzbekistan where market microstructure, policy changes, and external shocks may shape short-term dynamics. Second, although volatility modeling for UZS has appeared in recent local literature, there is limited systematic work that reports cleanly the performance of ARIMA-only mean forecasts at weekly horizons for USD/UZS over the 2017–2025 period. This gap motivates the current analysis: a careful univariate ARIMA study using weekly data, thorough diagnostic checking, and transparent short-term forecasting (10 weeks ahead) to inform local policy discussions and provide a baseline for future ARIMA–GARCH or hybrid modeling.

Research Methodology

This section describes the data, econometric tools, and estimation procedures employed in the study. The methodological framework follows the standard Box–Jenkins (1976) approach to univariate time series modeling, which consists of four main stages: identification, estimation, diagnostic checking, and forecasting.

Data Description

The analysis is based on weekly data of the Uzbek soum (UZS) to U.S. dollar (USD) exchange rate covering the period from September 2017 to October 2025. The data were obtained from the Google Finance database and converted into a weekly frequency to capture short-term movements in the exchange rate. The total number of observations after transformation is 426, providing sufficient data for both model estimation and validation.

Stationarity Testing

Before estimating an ARIMA model, it is essential to ensure that the time series is stationary, meaning that its mean, variance, and autocovariance remain constant over time. Non-stationary data can lead to unreliable and spurious regression results, so testing for stationarity is a necessary preliminary step in time series modeling. To test whether the exchange rate series contains a unit root, the Augmented Dickey–Fuller (ADF) test was applied. The general form of the ADF regression equation is expressed as:

$$\Delta Y_t = \alpha + \beta t + \gamma Y_{t-1} + \sum_{i=1}^{p} \delta_i \, \Delta Y_{t-i} + \varepsilon_t$$

Where:

$\Delta Y_t = Y_t - Y_{t-1}$represents the first difference of the series;

α –is the constant term;

βt – captures a deterministic trend (if included);

γ –is the coefficient that determines the presence of a unit root;

ρ–denotes the number of lagged differences included to correct for autocorrelation;

ε_t –is the white noise error term.

The null hypothesis (H_0) of the test states that $\gamma = 0$, indicating that the series has a unit root and is non-stationary. The alternative hypothesis (H_0) is that $\gamma < 0$, implying that the series Y_t is stationary. The results of the ADF test revealed that the exchange rate series is **non-stationary in levels** but becomes **stationary after first differencing.** This finding indicates that the variable is integrated of order one, denoted as **I(1).** Consequently, a first difference term (d=1) was included in the ARIMA model to achieve stationarity and ensure valid parameter estimation.

1.1 ARIMA Model Identification

The Autoregressive Integrated Moving Average (ARIMA) model, developed by Box and Jenkins, is used to capture both the autoregressive (AR) and moving average (MA) structures in time series data. The general ARIMA(p, d, q) process is expressed as:

$$Y_t = \mathrm{c} + \sum_{i=1}^{p} \phi_i Y_{t-i} + \sum_{j=1}^{q} \theta_j \, \varepsilon_{t-j} + \varepsilon_t$$

where:

p – order of the autoregressive part;

d – number of differencing operations;

q –order of the moving average part;

ε_t – white noise error term.

After differencing the series once, the Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) plots were examined to determine suitable values for p and q.

1.2 Model Diagnostics with the Ljung–Box Q Test

After estimating the ARIMA model, it is essential to verify its adequacy by checking whether the residuals behave as white noise. A well-specified ARIMA model should capture all serial dependencies in the data, leaving residuals that are uncorrelated and have constant variance. To test this property, the Ljung–Box Q statistic was employed. The Ljung–Box Q statistic tests the joint hypothesis that all autocorrelations up to a specified lag m are equal to zero. It is calculated as:

$$Q = n(n+2) \sum_{k=1}^{m} \frac{r_k^2}{n-k}$$

Where the Ljung-Box test statistic is Q, r_i represents the estimated autocorrelation at lag i and the degrees of freedom depend on the number of lags tested. The null hypothesis H_0 states that there is no autocorrelation in the series up to the specified lag. According to the results of the Ljung-Box Q-test, where the null hypothesis H_0 states that all autocorrelations up to a given lag are greater than 0.05, the p-values for the exchange rate return series are greater than 0.05 across all tested lags. This indicates no statistically significant autocorrelation. Therefore, we fail to reject the null hypothesis, and conclude that the exchange rate returns exhibit no evidence of serial correlation.

Inverse Roots Analysis

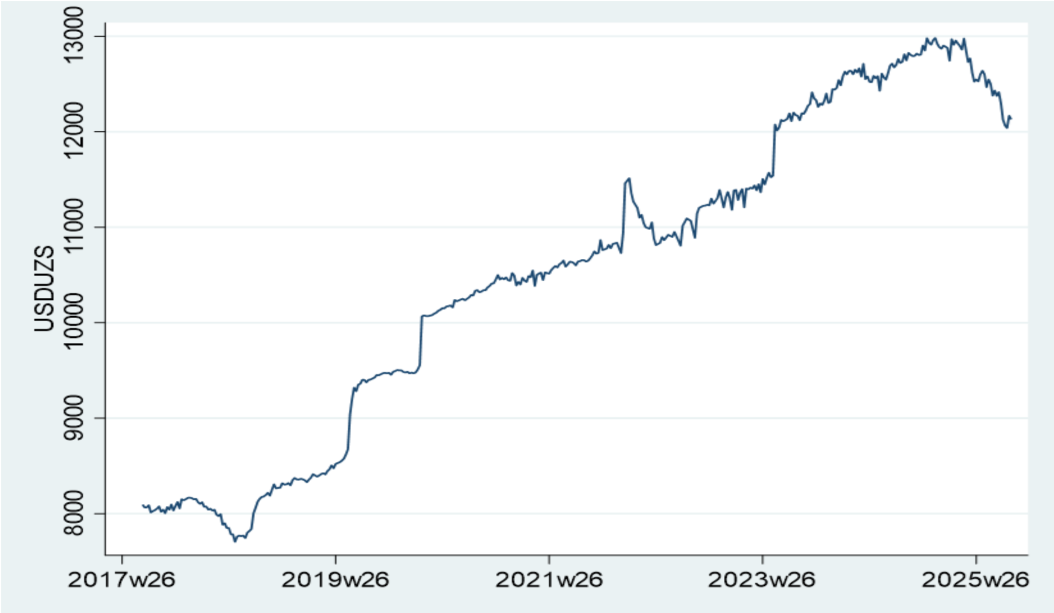
To further validate the stability and adequacy of the estimated ARIMA model, an inverse roots analysis was conducted. This diagnostic test evaluates whether the estimated autoregressive (AR) process satisfies the stability condition required for reliable forecasting. Stability in ARIMA modeling ensures that shocks or disturbances in the series dissipate over time rather than persist indefinitely.

Once the model was validated, it was used to generate forecasts for 10 future weekly periods beyond the sample range. The forecasting procedure was implemented in Stata.

Research methodology

4.1. Data Description

Picture 1 illustrates the movement of the USD/UZS exchange rate over the period from 2017 to 2025, based on weekly data. The exchange rate exhibits a clear upward trend, indicating a sustained depreciation of the Uzbek soum against the U.S. dollar during the sample period.



Picture 1. Historical Weekly USD/UZS Exchange Rate (2017w37–2025w43).

From 2017 to mid-2019, the exchange rate remained relatively stable, fluctuating around 8,000 UZS per USD. However, beginning in late 2019, a sharp increase is observed, reflecting a significant adjustment in the foreign exchange market. This upward trajectory continued steadily through subsequent years, with occasional short-term fluctuations. Between 2020 and 2023, the exchange rate showed a gradual yet consistent rise, reaching levels above 12,000 UZS per USD. Notably, there were periods of abrupt movements—possibly reflecting external shocks, policy adjustments, or shifts in global market conditions. After reaching its peak around early 2024, the exchange rate experienced a mild downward correction, suggesting temporary appreciation of the Uzbek soum in 2025.

Overall, the visual pattern indicates that the series is non-stationary, with a pronounced long-term trend and multiple structural changes, thereby justifying the need for differencing and ARIMA modeling to achieve stationarity and produce reliable forecasts.

4.2 Stationarity Testing

Table 1 presents the results of the Dickey–Fuller (DF) test applied to the USD/UZS exchange rate series in order to determine its stationarity properties. The null hypothesis (H_0) of the test assumes that the series follows a random walk, implying the presence of a unit root and, therefore, non-stationarity. The alternative hypothesis (H_1) suggests that the series is stationary, meaning that shocks to the series are temporary and the process reverts to a constant mean over time.

```
Dickey-Fuller test for unit root          Number of obs  = 395
Variable: Y                               Number of lags =   0

H0: Random walk with or without drift
```

	Test statistic	Dickey-Fuller critical value 1%	5%	10%
Z(t)	**-1.220**	**-3.984**	**-3.424**	**-3.130**

MacKinnon approximate *p*-value for Z(t) = **0.9064**.

Table 1. Results of the Dickey–Fuller Test for the First-Differenced USD/UZS

Exchange Rate Series

The test was conducted using 395 observations with zero lags included in the model. The computed test statistic value of –1.220 is notably higher (in absolute terms, smaller) than the corresponding Dickey–Fuller critical values at the 1%, 5%, and 10% significance levels (–3.984, –3.424, and –3.130, respectively). Moreover, the MacKinnon approximate p-value of 0.9064 is considerably greater than the conventional significance thresholds of 0.01, 0.05, and 0.10. These results indicate that the null hypothesis of a unit root cannot be rejected, confirming that the USD/UZS exchange rate series is non-stationary in its current form. In practical terms, this suggests that the exchange rate follows a random walk process, implying that past values have limited predictive power for future movements. Consequently, shocks or fluctuations in the USD/UZS exchange rate tend to have persistent, long-term effects rather than dissipating over time.

Table 2 presents the results of the Dickey–Fuller (DF) test applied to the first-differenced USD/UZS exchange rate series (Y_t). The purpose of this test is to verify whether differencing the original non-stationary series has successfully removed the unit root, thereby achieving stationarity. The null hypothesis (H_0) posits that the series follows a random walk (i.e., it has a unit root), while the alternative hypothesis (H_1) suggests that the series is stationary.

```
Dickey-Fuller test for unit root          Number of obs  = 384
Variable: D.Y                             Number of lags =   0

H0: Random walk without drift, d = 0
```

	Test statistic	Dickey-Fuller critical value 1%	5%	10%
Z(t)	**-20.541**	**-3.449**	**-2.875**	**-2.570**

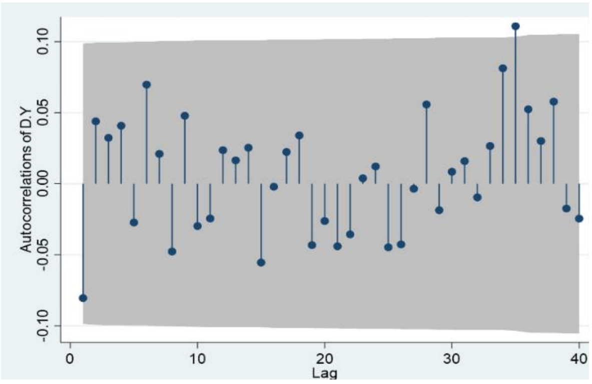
MacKinnon approximate *p*-value for Z(t) = **0.0000**.

Table 2. Results of the Dickey–Fuller Test for the First-Differenced USD/UZS

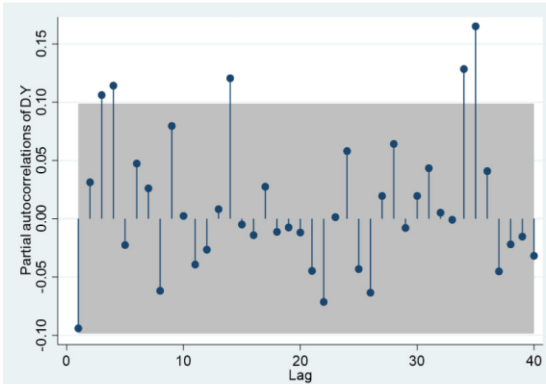
Exchange Rate Series

The test statistic value of –20.541 is substantially lower (more negative) than the Dickey–Fuller critical values at the 1%, 5%, and 10% significance levels (–3.449, –2.875, and –2.570, respectively). Furthermore, the MacKinnon approximate p-value of 0.0000 is far below any conventional significance threshold. These results provide strong statistical evidence to reject the null hypothesis of a unit root. Therefore, the first-differenced USD/UZS exchange rate series is stationary. In other words, while the level series of the exchange rate (Table 1) followed a non-stationary random walk process, differencing once successfully stabilized its mean and variance over time.

Picture 2 (a) illustrates the autocorrelation function (ACF) of the first-differenced USD/UZS exchange rate series (Y_t). The ACF measures the correlation between observations in the series separated by various lag lengths. The grey region represents the 95% confidence interval for statistical significance; spikes that extend beyond this region indicate significant autocorrelation at the corresponding lag. Picture 2 (b) presents the partial autocorrelation function (PACF) for the same differenced series. The PACF isolates the correlation of each lag with the current value after removing the effects of intermediate lags, thereby providing a clearer indication of the order of the autoregressive (AR) process.



(a)



(b)

Picture 2. (a) Autocorrelation Coefficients of the First-Differenced USD/UZS Exchange Rate Series. (b) Partial Autocorrelation Function (PACF) of the First-Differenced USD/UZS Exchange Rate Series

As shown in Picture 2 (a), the majority of autocorrelation coefficients fall within the confidence bands, suggesting that most lag correlations are statistically insignificant. However, there is a noticeable spike at lag 1, followed by a rapid decay of subsequent autocorrelations that fluctuate closely around zero. This pattern is characteristic of a stationary series, confirming the earlier Dickey–Fuller test result that differencing successfully eliminated the unit root. From a model identification perspective, the ACF pattern—with a significant first lag and rapidly diminishing correlations—suggests that the series exhibits a short-memory process and may be well represented by a first-order autoregressive (AR) model.

In Picture 2 (b), the PACF shows a significant spike at lag 1, while subsequent lags fall within the 95% confidence bounds and are statistically insignificant. This sharp cutoff after the first lag is a classic signature of an AR(1) process. The absence of a gradual decay pattern in the PACF implies that higher-order AR terms are unnecessary. In other words, the first lag of the differenced series explains most of the short-term dependence, and additional lags do not contribute meaningfully to the model's explanatory power.

Combining the insights from the ACF and PACF plots with the results of the unit root tests, the appropriate model for the USD/UZS exchange rate series can be specified as ARIMA(1,1,0).

4.3 ARIMA Model

Table 3 presents the estimation results of the ARIMA(1,1,0) model applied to the weekly USD/UZS exchange rate series over the period 2017w37 to 2025w43, comprising 395 observations. The ARIMA(1,1,0) specification, as identified from the autocorrelation and partial autocorrelation functions, implies that the first difference of the exchange rate depends linearly on its immediately preceding value, with no moving-average component.

ARIMA regression

Sample: **2017w37** thru **2025w43**, but with gaps

Number of obs = **395**
Wald chi2(**1**) = **5.90**
Prob > chi2 = **0.0152**

Log likelihood = **-2277.646**

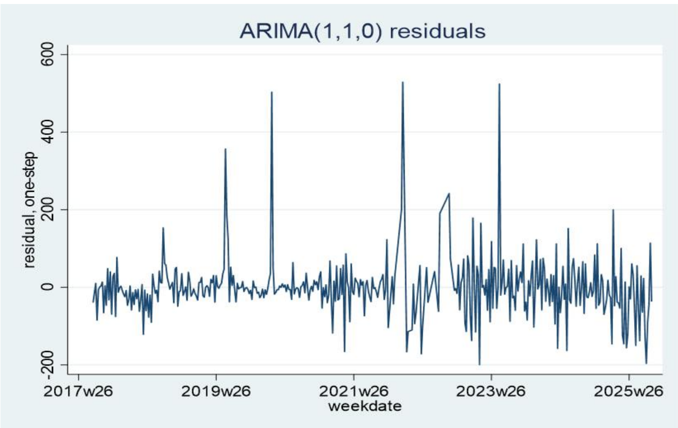
D.Y	Coefficient	OPG std. err.	z	P>|z|	[95% conf. interval]	
Y						
_cons	10.71559	4.468924	2.40	0.016	1.956655	19.47452
ARMA						
ar L1.	-.0994311	.0409424	-2.43	0.015	-.1796768	-.0191854
/sigma	77.25602	1.264404	61.10	0.000	74.77784	79.73421

Table 3. Results of ARIMA Model Estimation for the USD/UZS Exchange Rate

The model estimation yields a log-likelihood value of –2277.646, indicating the goodness of fit under the assumed structure. The overall model significance is supported by a Wald chi-square statistic of 5.90 with a p-value of 0.0152, confirming that the explanatory component of the model is jointly significant at the 5% level. The estimated autoregressive coefficient (AR(1)) is –0.0994, with a standard error of 0.0409 and a corresponding z-value of –2.43. The associated p-value of 0.015 indicates statistical significance at the 5% level. The negative sign of the AR(1) parameter suggests a mild inverse relationship between consecutive changes in the exchange rate, implying that a positive change in one period tends to be followed by a slight downward adjustment in the next period. This reflects short-term mean-reverting dynamics in the differenced series rather than persistent directional trends. The model's constant term (intercept) is estimated at 10.7156, which is positive and statistically significant (p = 0.016). This indicates that, after accounting for autoregressive effects, the average weekly change in the USD/UZS exchange rate over the study period is approximately 10.7 UZS. The estimated standard deviation of the residuals (/sigma) is 77.2560, with an extremely small p-value (p < 0.001), showing that residual variations are highly significant but reasonably contained around the model's fitted values. Substituting the estimated parameters obtained from the regression results yields the following empirical model:

$$Y_t = 10.7156 - 0.0994\Delta Y_{t-1} + \varepsilon_t$$

Picture 4 displays the one-step-ahead forecast residuals from the ARIMA(1,1,0) model. The residual series fluctuates randomly around zero with no evident pattern or persistent structure, indicating that the model has successfully captured the systematic components of the USD/UZS exchange rate dynamics.



Picture 4. Residual Plot of the ARIMA(1,1,0) Model for the USD/UZS Exchange Rate

Although a few large residual spikes appear during certain periods (notably around 2019w26, 2021w26, and 2023w26), these are likely associated with short-term shocks or irregular market adjustments rather than model misspecification. Overall, the residual behavior confirms that the fitted ARIMA(1,1,0) model is well-specified and suitable for forecasting purposes.

Table 4 presents the results of the Portmanteau (Q) test, which is used to examine whether the residuals from the ARIMA(1,1,0) model behave as white noise — that is, whether they are serially uncorrelated and have constant variance over time. The test output reports a Portmanteau (Q) statistic of 11.6006 with 24 lags and an associated p-value of 0.9840.

Model Diagnostics with the Ljung–Box Q Test

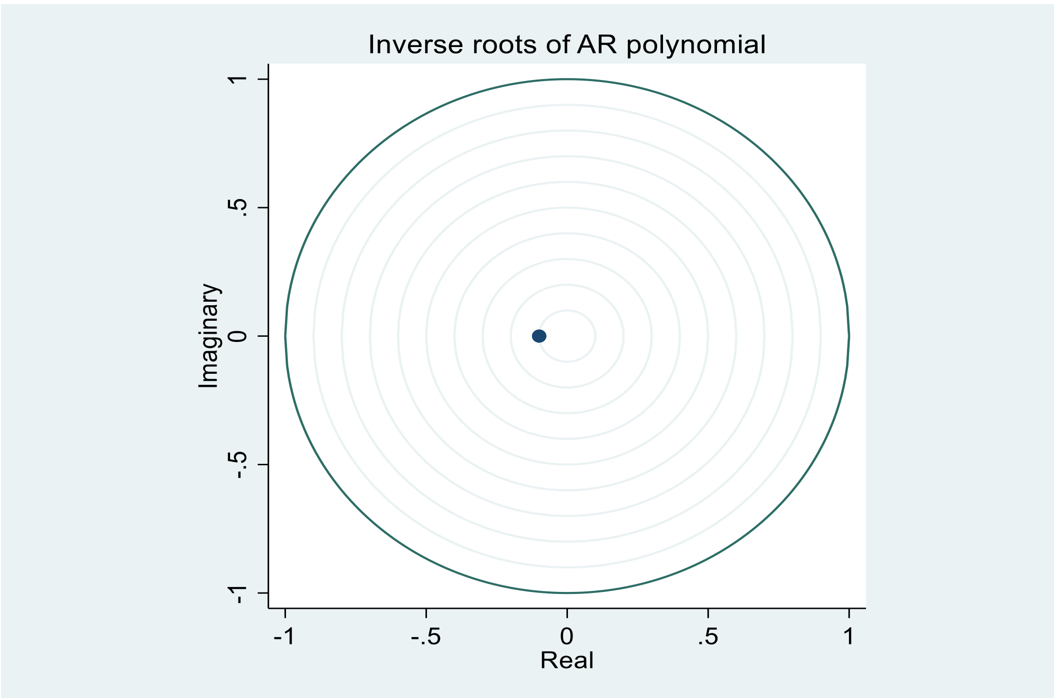
```
Portmanteau test for white noise
---------------------------------------
 Portmanteau (Q) statistic =    11.6006
 Prob > chi2(24)           =     0.9840
```

Table 4. Results of the Ljung–Box Q-Test for Autocorrelation in the ARIMA(1,1,0) Model Residuals

The null hypothesis (H_0) of the Portmanteau test states that the residuals are independently distributed (white noise), whereas the alternative hypothesis (H_1) suggests that residual autocorrelations are present. Given that the p-value (0.9840) is far greater than the 0.05 significance level, we fail to reject the null hypothesis. This implies that the residuals exhibit no significant autocorrelation up to 24 lags, confirming that the ARIMA(1,1,0) model has effectively captured the dynamic structure of the series. In other words, the model's residuals behave as white noise, suggesting that the model is statistically adequate.

Inverse Roots Analysis

Picture 5 displays the inverse roots of the autoregressive (AR) polynomial, which serve as a graphical diagnostic for assessing the stability and stationarity of the ARIMA(1,1,0) model. In this plot, the unit circle represents the boundary of the stationary region in the complex plane. For an ARIMA model to be stable, all inverse roots must lie within the unit circle.



Picture 5. Inverse Roots of the AR Characteristic Polynomial for the ARIMA(1,1,0) Model.

As shown in the figure, the single AR root (depicted by the blue dot) is clearly located inside the unit circle, both on the real and imaginary axes. This indicates that the ARIMA(1,1,0) model satisfies the stationarity condition and that the estimated parameters produce a dynamically stable process. The absence of any roots near or outside the unit circle confirms that the model is invertible and well-specified, implying that future forecasts generated from this model will not diverge or exhibit explosive behavior.

The table 5 presents the short-term forecasts generated by the ARIMA(1,1,0) model for the USD/UZS exchange rate, covering the period from week 44 of 2025 (2025w44) to week 1 of 2026 (2026w1).

Year	week	USD/UZS Exchange Rate	Year	week	USD/UZS Exchange Rate
2025	44	12145.54	2025	49	12198.68
2025	45	12155.78	2025	50	12209.4
2025	46	12166.54	2025	51	12220.12
2025	47	12177.25	2025	52	12230.83
2025	48	12187.97	2026	1	12241.55

Table 5. Forecasted Weekly Values of the USD/UZS Exchange Rate (2025w44–2026w1).

The model predicts a gradual increase in the exchange rate from 12145.54 UZS in week 44 of 2025 to 12241.55 UZS in week 1 of 2026. This suggests a moderate upward trend in the USD/UZS rate over the forecast horizon. The relatively small standard errors (ranging between approximately 0.12 and 0.97) indicate high forecast precision, implying that the model’s short-term predictions are reliable and stable.

Conclusion

This study examined the dynamics of the USD/UZS exchange rate and developed a time-series forecasting model using the ARIMA framework. Preliminary analysis of the historical data revealed a clear upward trend in the nominal exchange rate, indicating that the series was non-stationary at its level form. The Augmented Dickey–Fuller test confirmed the presence of a unit root, while the first-differenced series achieved stationarity, making it suitable for ARIMA modeling. Model identification based on the autocorrelation and partial autocorrelation functions suggested an ARIMA(1,1,0) specification as the most appropriate representation of the data. The estimated parameters were statistically significant, and diagnostic tests—including the residual plots, Ljung–Box Q-test, and inverse roots analysis—verified that the model residuals behaved like white noise and that the model satisfied both stability and invertibility conditions. The short-term forecasts derived from the ARIMA(1,1,0) model indicated a relatively stable trajectory of the USD/UZS exchange rate over the projection period (2025w44–2026w1). The forecast results suggest that the Uzbek soum is expected to maintain a moderate and steady depreciation path against the U.S. dollar, consistent with historical tendencies and current market fundamentals. Overall, the findings demonstrate that the ARIMA(1,1,0) model provides a statistically sound and empirically robust tool for short-term exchange rate forecasting in the Uzbek context. However, as the ARIMA model relies solely on past values, future research could enhance forecasting accuracy by incorporating exogenous macroeconomic variables or hybrid models combining machine learning and econometric techniques.

References

1. Lakhal, S. (2024). Forecasting the EUR/USD exchange rate using ARIMA and machine learning models. Data and Metadata. https://doi.org/10.56294/dm2024.368
2. Xu, M., & Li, W. (2017). Research on exchange rate forecasting model based on ARIMA model and artificial neural network model. In Proceedings of MSMEE 2017 (Vol. 123). Atlantis Press.
3. Berdinazarov, Z., Dodoev, K., Mamasalaev, J., & Fakhodjonov, J. (2019). Determinants of exchange rate fluctuations of Uzbek sum. [Journal name].
4. Escudero, P., Alcocer, W., & Paredes, J. (2021).

Recurrent neural networks and ARIMA models for Euro/Dollar exchange rate forecasting. Applied Sciences, 11(12), 5658. https://doi.org/10.3390/app11125658

5. Perveen, N., Tariq, K., & Ahmad, H. S. (2024). Comparative studies of hybrid ARIMA and artificial neural network (ANN) techniques for predicting exchange rate in Pakistan. Bulletin of Business and Economics. https://doi.org/10.61506/01.00372

6. Forecasting Economics. (2021, May 22). Time series forecasting in Stata: ARIMA models (Part 1, 2, 3) [Video]. YouTube. https://www.youtube.com/

7. Vika, B., Sevrani, K., & Vika, I. (2016). The usefulness of artificial neural networks in forecasting exchange rates. Academic Journal of Interdisciplinary Studies, 5(1), 73. https://doi.org/10.5901/ajis.2016.v5n1p73