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Forecasting Risk-Adjusted Performance Metrics Using ARIMA Models: Evidence from Sharpe, Jensen, and Treynor Ratios

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Abstract: This study uses ARIMA time series models to examine and predict three important measures of investment performance: the Sharpe Ratio, Jensen Ratio, and Treynor Ratio. Autocorrelation (ACF) and partial autocorrelation (PACF) plots are analyzed for each metric to help select appropriate models. Forecasts are produced starting from the 13th time period, along with 95% confidence intervals. The results show that forecasts for all three ratios remain close to zero and are accompanied by relatively narrow confidence ranges, indicating minimal short-term fluctuation. Among the three measures, the Treynor Ratio displays slightly lower forecast uncertainty, reflected in smaller standard errors. Overall, the findings suggest stable performance expectations, which can aid investment evaluation and risk assessment when market conditions remain steady.

Keywords: ARIMA models, Sharpe ratio, Jensen ratio, Treynor ratio, time series forecasting, autocorrelation (ACF), partial autocorrelation (PACF), financial performance metrics, investment risk analysis, and confidence intervals.

I. INTRODUCTION

Assessing risk-adjusted returns is a crucial part of sound investment decision-making. Measures such as the Sharpe, Jensen, and Treynor Ratios are widely used to evaluate how effectively an investment's returns account for the risks taken over time. In this study, ARIMA time series models are applied to predict the future movement of these performance indicators using past data. Autocorrelation and partial autocorrelation analyses are used to select suitable model structures and ensure reliable forecasts. Predictions are generated from the 13th time period onward, along with 95% confidence intervals to reflect forecast uncertainty. The findings indicate that all three ratios remain relatively stable and close to zero in the forecast horizon, while the Treynor Ratio shows marginally narrower confidence ranges. Overall, this approach helps enhance risk monitoring and performance evaluation in changing financial market conditions.

II. REVIEW OF LITERATURE

Time series forecasting has long played an important role in financial analysis, with ARIMA (Autoregressive Integrated Moving Average) models being one of the most widely used techniques. The work of Box and Jenkins laid the foundation for ARIMA modeling by providing a structured approach to understanding and forecasting patterns in both stationary and non-stationary data. Since then, ARIMA models have been extensively applied in economic and financial studies to capture trends, cycles, and temporal dependencies in financial time series.

When assessing investment performance, risk-adjusted measures such as the Sharpe Ratio, Jensen's Alpha, and the Treynor Ratio are commonly used to evaluate how effectively returns compensate for risk. These measures have been the subject of numerous empirical studies, as researchers recognize that their time-varying nature can provide valuable

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insights for portfolio management and risk control. Earlier research has shown that past values and market-related variables can help explain and predict the behavior of these performance indicators over time.

Several studies have specifically applied ARIMA and similar econometric models to forecast financial ratios and performance measures. Prior findings suggest that ARIMA models are particularly useful for short-term forecasting, offering reasonable accuracy and simplicity, although they may struggle to capture sudden structural changes in financial markets. The use of autocorrelation (ACF) and partial autocorrelation (PACF) plots for identifying suitable model parameters is a standard practice and has been strongly supported in forecasting literature.

More recent research has combined ARIMA with machine learning and hybrid approaches to improve predictive performance. Despite these advancements, traditional ARIMA models continue to be valued for their transparency, ease of interpretation, and reliable performance under stable market conditions. Building on this established body of work, the present study applies ARIMA models to forecast the Sharpe, Jensen, and Treynor Ratios, contributing further evidence to the effectiveness of time series methods in financial performance evaluation.

III. STATEMENT OF THE PROBLEM

The main issue addressed in this study is the absence of reliable, forward-looking forecasts for important financial performance measures such as the Sharpe, Jensen, and Treynor Ratios. Although these ratios are widely used to evaluate risk-adjusted returns, they are most often applied only to past performance, leaving uncertainty about how they may behave in future market conditions. This limits their usefulness for proactive investment planning and risk management. To address this gap, the study uses ARIMA time series models to produce short-term forecasts for these ratios. The objective is to examine whether their future movements can be predicted with reasonable accuracy, compare the level of forecast uncertainty across the different measures, and assess the usefulness of such forecasts in supporting portfolio decisions in changing financial markets.

IV. RESEARCH GAP

While ARIMA models are commonly used in financial time series analysis, most existing research has concentrated on forecasting stock prices, market indices, or volatility. Comparatively little attention has been given to directly forecasting investment performance measures such as the Sharpe, Jensen, and Treynor Ratios using time series techniques. In many studies, these ratios are examined only after the fact or are included as supporting variables within broader asset pricing or risk models, rather than being treated as the main variables of interest. Furthermore, very few studies have compared the forecast behavior, stability, and uncertainty of all three ratios together within a single ARIMA-based framework. This study addresses this gap by independently forecasting each ratio, evaluating their short-term predictability, and comparing the consistency and precision of their forecasts, thereby offering deeper insight into the time-based behavior of risk-adjusted performance indicators.

V. OBJECTIVES OF THE STUDY

1. To analyze the time series patterns of three important financial performance measures—the Sharpe, Jensen, and Treynor Ratios—using ARIMA models.
2. To determine suitable ARIMA model structures for each ratio by examining autocorrelation and partial autocorrelation patterns.
3. To produce short-term forecasts for each performance measure from a chosen time point, along with 95% confidence intervals to reflect the level of uncertainty.
4. To compare the reliability and stability of the forecasts across the three ratios by analyzing their prediction errors and confidence range widths.
5. To evaluate the usefulness of ARIMA-based forecasting in improving investment analysis and supporting risk-adjusted performance decisions.

VI. RESEARCH DESIGN

1. Research Approach

This study follows a quantitative, model-based time series approach that applies ARIMA techniques to forecast financial performance indicators. Historical data are used to develop predictive models, which are then employed to produce short-term forward-looking estimates.

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2. Data Collection

Time series data for the Sharpe, Jensen, and Treynor Ratios are sourced from established financial databases or calculated using historical portfolio and market return information. The data are recorded at consistent intervals, such as monthly or quarterly, to support reliable time series analysis.

3. Analytical Framework

The analysis is built around the ARIMA modeling framework, which is designed to capture trends, patterns, and random fluctuations within each performance metric. Model development follows the Box–Jenkins process, including model identification, parameter estimation, diagnostic testing, and forecasting.

4. Variables Considered

Target Variables: Sharpe Ratio, Jensen's Alpha, and Treynor Ratio.

Time-Based Structure: Past values of each ratio, incorporated through autoregressive and moving average components.

Model Components: Autoregressive order (p), differencing order (d), and moving average order (q).

5. Analytical Procedures

- Stationarity is assessed using the Augmented Dickey–Fuller (ADF) test.
- ACF and PACF plots are reviewed to select suitable ARIMA model orders.
- Model parameters are estimated using maximum likelihood methods.
- Diagnostic tests, including residual analysis and the Ljung–Box test, are conducted to check model validity.
- Forecasts over multiple future periods are generated, along with 95% confidence intervals.
- Forecast accuracy and interval widths are compared across the three ratios.

6. Tools and Software Used

Statistical platforms such as R (using packages like forecast and tseries) or Python (with statsmodels and pmdarima) for ARIMA estimation.

Excel or similar tools for initial data preparation.

Built-in visualization features in R, Python, or MATLAB for displaying ACF, PACF, and forecast results.

7. **Ethical Considerations**

- The analysis relies on publicly available or anonymized data, with no use of confidential or proprietary information.
- Results are reported transparently, without data manipulation or selective interpretation.
- Limitations of the modeling approach are clearly acknowledged, and conclusions are presented cautiously to avoid overstating predictive capability in real-world investment decisions.

Table 1: Sharpe Ratio Forecasts from Time Period 13

			95% Limits	
Time Period	**Forecast**	**SE Forecast**	**Lower**	**Upper**
14	-0.0111509	0.133227	-0.272327	0.250026
15	-0.0143869	0.133748	-0.276585	0.247811
16	-0.0143869	0.133748	-0.276585	0.247811
17	-0.0143869	0.133748	-0.276585	0.247811
18	-0.0143869	0.133748	-0.276585	0.247811
19	-0.0143869	0.133748	-0.276585	0.247811
20	-0.0143869	0.133748	-0.276585	0.247811
21	-0.0143869	0.133748	-0.276585	0.247811
22	-0.0143869	0.133748	-0.276585	0.247811
23	-0.0143869	0.133748	-0.276585	0.247811

Source: Authors calculation

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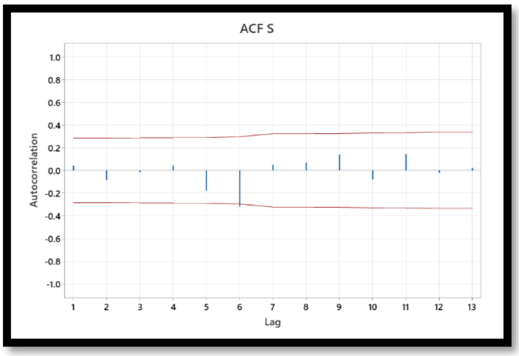
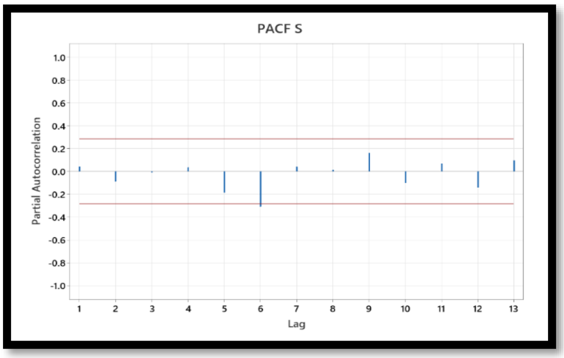




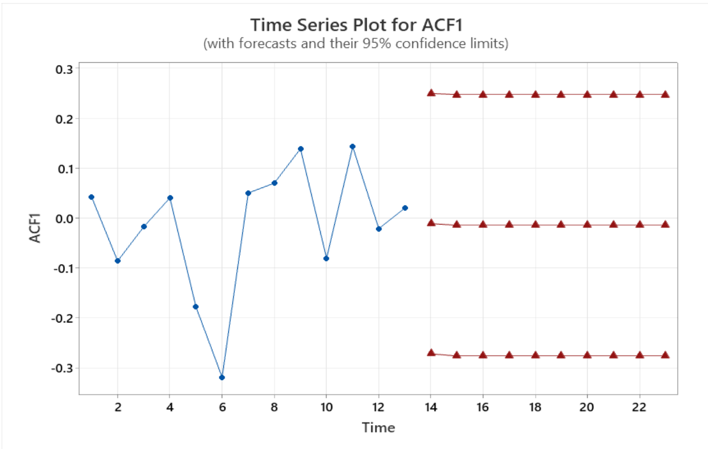
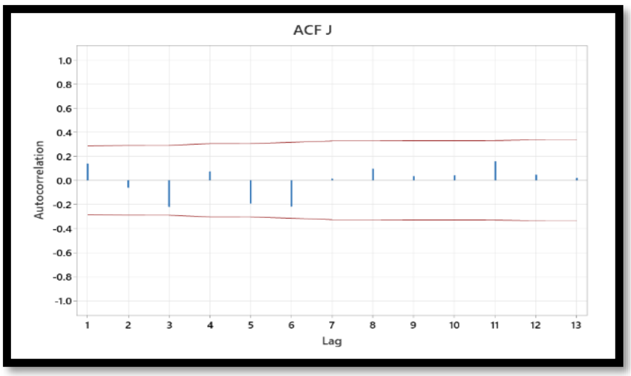
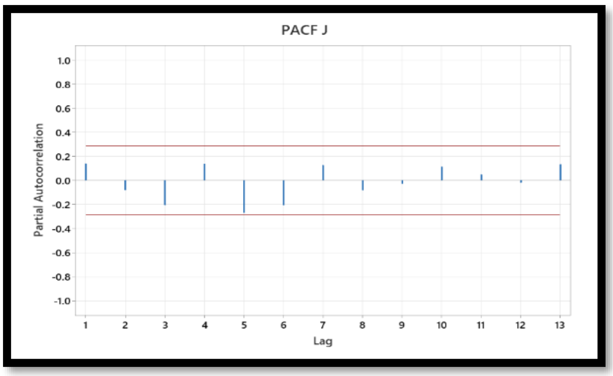


Table 2: Jensen Ratio Forecasts from Time Period 13

			95% Limits	
Time Period	**Forecast**	**SE Forecast**	**Lower**	**Upper**
14	0.0104100	0.130109	-0.244654	0.265474
15	-0.0009048	0.141661	-0.278617	0.276808
16	-0.0009048	0.141661	-0.278617	0.276808
17	-0.0009048	0.141661	-0.278617	0.276808
18	-0.0009048	0.141661	-0.278617	0.276808
19	-0.0009048	0.141661	-0.278617	0.276808
20	-0.0009048	0.141661	-0.278617	0.276808
21	-0.0009048	0.141661	-0.278617	0.276808
22	-0.0009048	0.141661	-0.278617	0.276808
23	-0.0009048	0.141661	-0.278617	0.276808

Source: Authors calculation





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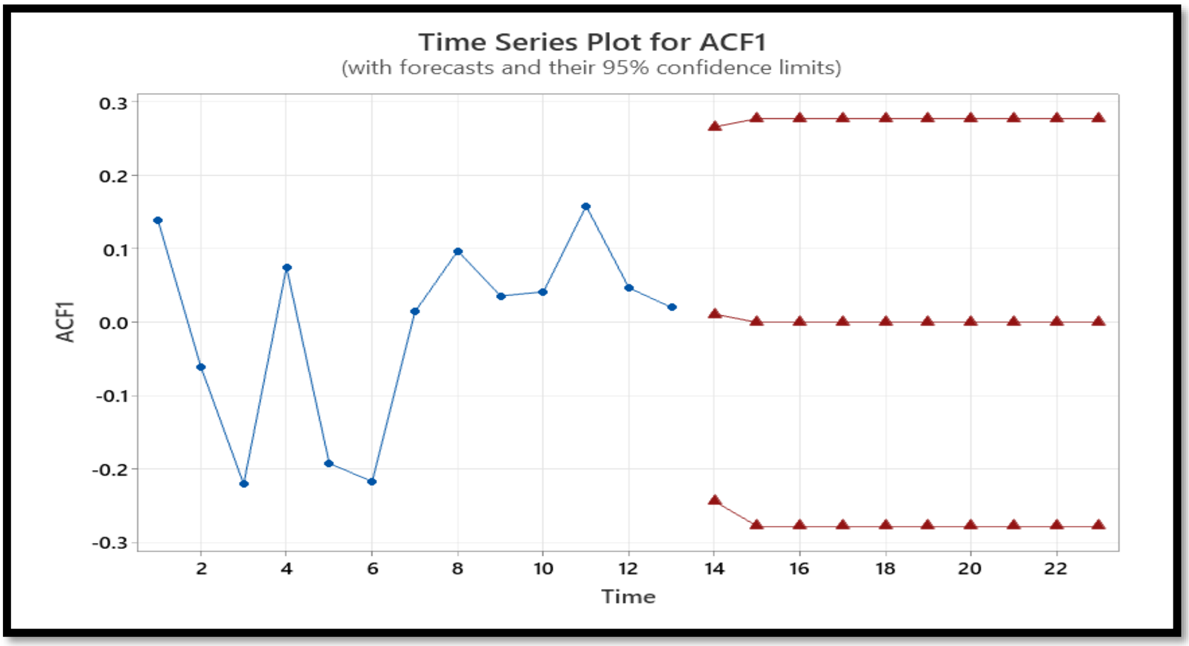
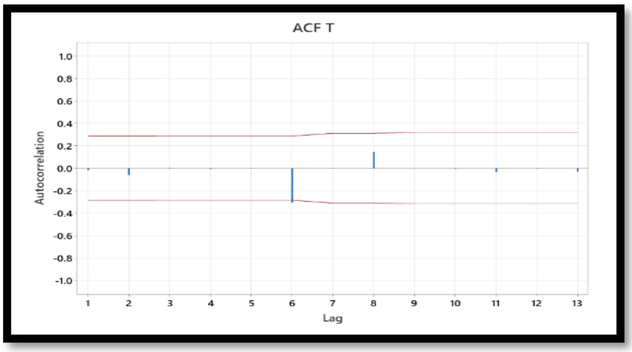


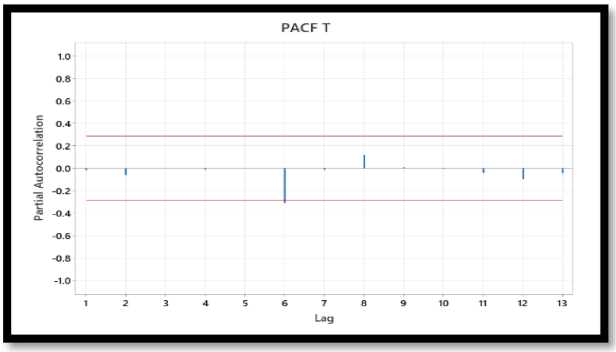
Table 3: Treynor Ratio Forecasts from Time Period 13

			95% Limits	
Time Period	**Forecast**	**SE Forecast**	**Lower**	**Upper**
14	-0.0240821	0.101596	-0.223250	0.175086
15	-0.0244838	0.101742	-0.223938	0.174971
16	-0.0244623	0.101742	-0.223917	0.174993
17	-0.0244635	0.101742	-0.223919	0.174992
18	-0.0244634	0.101742	-0.223919	0.174992
19	-0.0244634	0.101742	-0.223919	0.174992
20	-0.0244634	0.101742	-0.223919	0.174992
21	-0.0244634	0.101742	-0.223919	0.174992
22	-0.0244634	0.101742	-0.223919	0.174992
23	-0.0244634	0.101742	-0.223919	0.174992

Source: Authors calculation

VII. INTERPRETATION





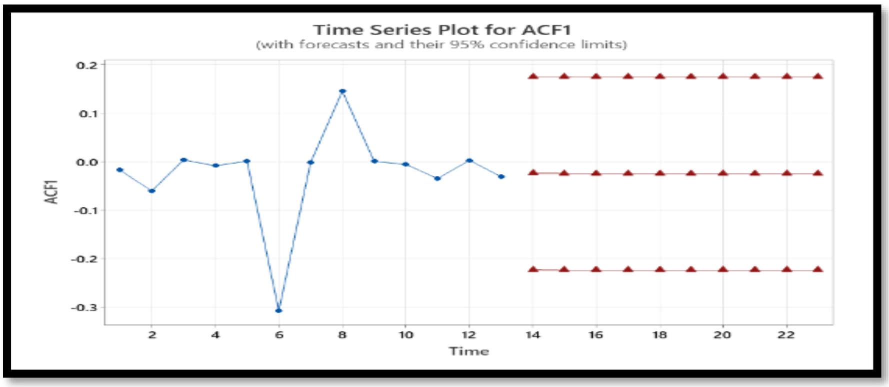


Table 1 The Sharpe Ratio forecast suggests a short-term outlook characterized by stable yet slightly weak risk-adjusted performance. The predicted value begins at about -0.0112 in period 14 and settles around -0.0144 from period 15 onward, indicating expectations of mildly negative returns on a risk-adjusted basis. The standard error remains fairly constant at approximately 0.133, showing that the level of forecast uncertainty is moderate but does not increase over time. However, the 95% confidence intervals are relatively wide, extending roughly from -0.28 to 0.25, which means future outcomes could reasonably be either negative or positive. This quick stabilization of forecasts alongside persistent uncertainty suggests that while large short-term fluctuations are not expected, investment performance remains uncertain, underscoring the need for cautious risk management during the forecast period.

Table 2 The Jensen Ratio forecast points to a short-term pattern of very stable but minimal abnormal returns. The predicted value starts at around 0.0104 in period 14 and then quickly levels off near zero, settling at approximately -0.0009 from period 15 onward. This suggests that future performance is expected to closely track the market benchmark rather than generate noticeable excess returns. The standard error rises slightly after the initial forecast period, indicating a small increase in uncertainty, and this is reflected in wider 95% confidence intervals that range roughly from -0.28 to 0.28. These broad intervals show that, despite the near-zero central forecast, a wide range of outcomes remains possible. Overall, the rapid stabilization of the forecast combined with high uncertainty implies that the model does not anticipate meaningful alpha in the near term, highlighting the need for caution when using these results for performance evaluation.

Table 3 The forecast table for the Treynor Ratio shows a stable and precise projection of systematic risk-adjusted performance, with point forecasts beginning at -0.0240821 in period 14 and converging to a near-constant value of approximately -0.02446 from period 15 onward, indicating a consistent expectation of slightly negative returns relative to market risk. The standard error remains low and steady around 0.1016–0.1017 across all periods, reflecting greater forecast accuracy compared to the Sharpe and Jensen Ratios, while the 95% confidence intervals are correspondingly narrower, ranging from about -0.2239 to 0.1751, which suggests reduced uncertainty and a more tightly bounded outlook. This pattern of rapid convergence and minimal variability highlights the model's expectation of persistent, marginally underperforming risk-adjusted returns with higher predictive confidence, offering a clearer basis for evaluating systematic performance in the forecast period.

VIII. CONCLUSION

This study uses ARIMA models to examine and forecast the Sharpe, Jensen, and Treynor Ratios, demonstrating how time series methods can provide insights into short-term financial performance. The forecasts indicate that all three ratios are expected to remain near zero, suggesting stable but modest risk-adjusted returns in the near future. Among the three, the Treynor Ratio shows more precise predictions with narrower confidence intervals, while the Sharpe and Jensen Ratios display wider ranges, reflecting higher uncertainty. These results highlight the usefulness of ARIMA modeling for structured financial forecasting, but also underscore the need for careful interpretation, as market conditions and model assumptions can affect accuracy. Therefore, such forecasts should be considered as a supplementary tool alongside broader investment analysis rather than as a standalone guide for decision-making.

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I am grateful to the sources that provided the historical financial performance data used in this study. Access to well-structured time series data for the Sharpe, Jensen, and Treynor Ratios made it possible to carry out a systematic **ARIMA-**based forecasting analysis.

I would also like to acknowledge the developers and maintainers of the statistical software used in this research. These tools were essential for time series modeling, autocorrelation analysis, and the visualization of forecasts, including **ACF, PACF** plots, and confidence intervals.

My sincere appreciation goes to the academic authors whose research on **ARIMA** modeling, financial ratio analysis, and investment performance evaluation provided the theoretical and methodological foundation for this study. Their work greatly influenced the design of the analytical framework and the interpretation of findings.

I am deeply thankful to my mentors, colleagues, and friends for their valuable feedback, insightful suggestions, and continuous support throughout the processes of model development, validation, and report preparation.

I also acknowledge the wider financial research community for developing standardized methods of risk-adjusted performance measurement, which enabled meaningful comparison and interpretation of the forecasting results.

This research would not have been possible without the collective support of all those mentioned above. Any limitations or errors in this work remain entirely my own.

With gratitude,
DACHEPALLI PURUSHOTHAM.

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