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" A STUDY ON FORECASTING GOLD PRICE USING TIME SERIES ANALYSIS"

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Abstract: The main goal of this research is to assist investors and financial decision-makers in making well-informed decisions by employing time series analysis to estimate future gold prices. In India, gold has great cultural and economic significance and is seen as a safe haven investment, particularly in times of market volatility. Planning investments and controlling financial risks require accurate gold price forecasting because of its sensitivity to variables like inflation, exchange rate swings, and global economic trends. The study uses EViews software and the well-known forecasting tool ARIMA (Autoregressive Integrated Moving Average) model to accomplish this. In order to understand trends, volatility, and patterns in the time series, historical gold price data is analyzed. The ARIMA model is used to accurately forecast future movements in the price of gold by leveraging an established, successful forecasting technology compared to developing a brand-new one. The results generated through this approach provide actionable insights for investors, policymakers, and financial analysts. The initiative helps with strategic financial planning and encourages wise investment choices by showing the direction of gold prices in the future. This study shows how useful time series forecasting is in assessing the behavior of commodity prices, especially for a widely held asset like gold.

Keywords: Forecasting, Time series analysis, ARIMA model, EViews, Historical data.

I. INTRODUCTION

For generations, gold has been regarded as one of the most precious and desirable commodities. The global economy depends heavily on it as an investment asset, inflation hedge, and reserve currency for central banks. The price of gold is extremely variable, influenced by a variety of economic, political, and market factors. Predicting gold prices is important for investors, governments, and financial analysts to make informed investment decisions and manage risk. Time series analysis is a common statistical technique for anticipating financial data, particularly gold prices. The Auto-Regressive Integrated Moving Average (ARIMA) model is highly effective at analyzing and predicting price movements using historical data. ARIMA is effective for financial forecasting due to to its ability to capture trends, seasonality, and autocorrelations in data.This study uses the ARIMA model to forecast gold prices, providing an accurate framework. The study builds and analyzes the ARIMA model using EViews, a strong econometric analysis software. This research analyzes historical gold price data to increase predicting accuracy and identify major price trends. Accurate gold price forecasting has become essential for investors, traders, and regulators in today's volatile global financial market. This study will contribute to the field of financial forecasting by demonstrating how time series analysis, specifically ARIMA, may be efficiently used to predict gold price movements.

STATEMENT OF THE PROBLEM :

1. Accurate forecasting is difficult due to the extreme volatility of gold prices, which are impacted by a number of market, geopolitical, and economic factors.
2. Traditional models struggle to predict price fluctuations, which leads to investment risks and market uncertainty.
3. This study uses time series analysis and the ARIMA model to create a reliable gold price forecasting model. The findings will assist investors and financial analysts in making accurate choices regarding the gold market.

OBJECTIVE OF THE RESEARCH :

1. To analyze historical gold price trends and identify underlying patterns that influence price movements.
2. To assess the performance and accuracy of the ARIMA model in predicting future gold prices
3. To provide data-driven insights that help investors, policymakers, and financial analysts make informed decisions.

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4. To optimize the ARIMA model parameters and determine the best configuration for forecasting gold prices.
5. To improve short-term gold price prediction, assisting traders in risk management and investment planning.

RESEARCH QUESTIONS:

1. How effective is the ARIMA model in forecasting gold prices using weekly time series data?
2. What are the implications of ARIMA-based gold price forecasting for investors making short-term and long-term investment decisions?
3. In what ways can the application of ARIMA models enhance strategic decision-making for financial advisors and portfolio managers?
4. How can weekly ARIMA forecasts of gold prices support policymakers in framing import and export regulations?

SIGNIFICANCE OF THE STUDY:

This study shows the ARIMA model's effectiveness in forecasting gold prices using weekly time series data. Accurate short-term forecasting is essential for investors, financial advisors, and regulators, since gold remains a valuable asset in global markets. By focusing on weekly data, the study provides more adaptable and timely insights than usual long-term forecasting techniques. The findings can help investors make informed decisions about gold investments, financial advisors improve portfolio strategies, and legislators create more responsive import and export rules. Furthermore, ARIMA's demonstrated forecasting accuracy highlights its potential usefulness in larger financial forecasting projects involving other precious metals and commodities, adding to the literature on time series modeling and financial decision-making.

II. LITERATURE REVIEW

Gangopadhyay, Kausik et al. (2014) in their paper "Forecasting the Price of Gold: An Error Correction Approach" investigated the long-term relationship between gold prices and factors such as exchange rates, U.S. bond rates, oil prices, consumer price index (CPI), and stock market indices. Since the time series variables in their study were non-stationary, they employed a Vector Error Correction Model (VECM) using the Johansen and Juselius co-integration approach. Baber P., Baber R., and Thomas G. in their study "Factors Affecting Gold Prices: A Case Study of India" examined the various factors influencing gold prices in India. Their study highlighted the significant rise in gold prices from 2002 to 2012 and the key economic drivers behind this trend.

Gautam Nambiar, Deepika M.G., and Rajkumar M. (2012) attempted to apply both ARIMA models and regression analysis for forecasting gold prices. However, they were unable to build a suitable ARIMA model, leading them to rely on regression in the later part of their study.

Banerjee D. (2014) in her paper "Forecasting of Indian Stock Market Using Time-Series ARIMA Model" used an ARIMA model to predict future stock indices, which have a significant influence on the Indian economy. She first determined the appropriate ARIMA model and then validated the forecasting accuracy using recurrence validation techniques.

Dr. Ali Khan and Massarrat M. (2013) conducted a study on "Gold Price Forecasting Using Box-Jenkins Auto Regressive Integrated Moving Average (ARIMA) Approach." Their research aimed at building an ARIMA forecasting model for gold prices and evaluating its accuracy. The study was based on gold price data (in US dollars per ounce) from January 2003 to March 2012. After comparing results from ARIMA (0,2,2) and ARIMA (1,1,0) models, they found ARIMA (0,2,2) to be the most suitable model. The forecasting accuracy was assessed using Root Mean Square Error (RMSE), Mean Absolute Error (MAE), and Mean Absolute Percentage Error (MAPE).

Anand Ashesh and Piyush Dharnidharka (2012) conducted a study on "Forecasting Gold Prices Using Time Series Analysis." They used the Box-Jenkins methodology to forecast monthly average gold prices from January 2012 to June 2012. Their study found that, despite the availability of newer forecasting models, ARIMA remains a reliable model for short-term forecasting due to its precision.

Abdullah Lazim (2012) forecasted gold bullion coin prices using the ARIMA model. His study suggested that gold bullion coin selling prices followed an upward trend, reinforcing the idea that gold remains a worthy investment option. Wolter Theloosen in his research paper "A Review on the Determinants of Gold Prices" explored the macroeconomic and geopolitical factors affecting gold prices, emphasizing the role of global economic instability, interest rates, and inflation.

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III. RESEARCH METHODOLOGY

RESEARCH DESIGN :
This study employes a descriptive research design.

DATA ANALYSIS TOOLS :
- ARIMA

TOOLS USED :
Software: E-VIEWS

ETHICAL CONSIDERATIONS:
The study adhered to ethical norms by ensuring data confidentiality, using only confidentially available secondary data without involving human participants.

RESULTS AND DISCUSSION :
Descriptive Statistics

Date: 03/31/25 Time: 22:40
Sample: 1/05/2014 12/29/2024

	PRICE
Mean	40907.35
Median	33405.00
Maximum	78829.00
Minimum	24729.00
Std. Dev.	13996.90
Skewness	0.745936
Kurtosis	2.463129
Jarque-Bera	59.39123
Probability	0.000000
Sum	23194465
Sum Sq. Dev.	1.11E+11
Observations	567

Gold prices averaged ₹40,907.35 between January 2014 and December 2024, with a high standard deviation of ₹13,996.90, indicating significant volatility. The median price of ₹33,405 is lower than the mean, and the skewness of 0.7459 indicates a favorably uneven distribution.

Prices varied from ₹24,729 to ₹78,829, indicating significant market volatility. The distribution is platykurtic (variance = 2.46), which means there are fewer extreme values than in a normal distribution. The Jarque-Bera test (59.39, $p < 0.001$) verifies the non-normality found in financial data. With 567 observations, the dataset is ideal for ARIMA modeling in forecasting.

Augmented Dickey-Fuller Test

- The null hypothesis (H0) assumes that the series has a unit root (non-stationary),
- while the alternative hypothesis (H1) suggests that the series is stationary.

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An Augmented Dickey-Fuller (ADF) test was undertaken to examine the stationarity of gold prices for ARIMA modeling. The test statistic (-1.178) exceeded the limit values at all significance levels, with a p-value of 0.9131 showing non-stationarity. This implies that the gold price series has shifting statistical features over time and must be differentiated to make sure stationarity. The Durbin-Watson statistic of 1.99 indicates no significant autocorrelation, which supports the use of ARIMA once stationarity is established.

Augmented Dickey-Fuller Unit Root Test on PRICE

Null Hypothesis: PRICE has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 3 (Automatic - based on AIC, maxlag=18)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.177994	0.9131
Test critical values:	1% level	-3.974439	
	5% level	-3.417821	
	10% level	-3.131355	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PRICE)
Method: Least Squares
Date: 03/31/25 Time: 22:46
Sample (adjusted): 2/02/2014 12/29/2024
Included observations: 563 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PRICE(-1)	-0.007654	0.006497	-1.177994	0.2393
D(PRICE(-1))	0.030068	0.042314	0.710603	0.4776
D(PRICE(-2))	-0.066026	0.042520	-1.552831	0.1210
D(PRICE(-3))	-0.094592	0.042615	-2.219678	0.0268
C	84.13425	135.3587	0.621565	0.5345
@TREND("1/05/2014")	1.138526	0.550980	2.066367	0.0393

R-squared	0.027863	Mean dependent var	84.06927
Adjusted R-squared	0.019136	S.D. dependent var	773.7970
S.E. of regression	766.3574	Akaike info criterion	16.13177
Sum squared resid	3.27E+08	Schwarz criterion	16.17796
Log likelihood	-4535.094	Hannan-Quinn criter.	16.14980
F-statistic	3.192889	Durbin-Watson stat	1.994904
Prob(F-statistic)	0.007494		

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CORRELOGRAM

Correlogram of D(PRICE)

Date: 03/31/25 Time: 22:53
Sample: 1/05/2014 12/29/2024
Included observations: 566

	AC	PAC	Q-Stat	Prob
1	0.040	0.040	0.8998	0.343
2	-0.062	-0.064	3.0839	0.214
3	-0.091	-0.087	7.8581	0.049
4	0.030	0.034	8.3780	0.079
5	0.044	0.031	9.4638	0.092
6	0.062	0.056	11.688	0.069
7	-0.012	-0.007	11.776	0.108
8	-0.036	-0.023	12.506	0.130
9	-0.006	0.003	12.524	0.185
10	-0.008	-0.018	12.559	0.249
11	-0.044	-0.053	13.681	0.251
12	-0.027	-0.026	14.092	0.295
13	-0.026	-0.029	14.473	0.341
14	0.021	0.017	14.734	0.397
15	0.050	0.046	16.183	0.370
16	-0.029	-0.030	16.686	0.406
17	0.028	0.049	17.135	0.445
18	0.026	0.031	17.542	0.486
19	0.047	0.040	18.815	0.469
20	-0.064	-0.065	21.222	0.384
21	-0.020	-0.016	21.451	0.432
22	-0.001	-0.003	21.452	0.493
23	0.044	0.023	22.617	0.483
24	0.151	0.144	36.080	0.054
25	0.036	0.036	36.854	0.060
26	-0.048	-0.013	38.226	0.058
27	-0.014	0.020	38.349	0.073
28	-0.015	-0.026	38.489	0.090
29	-0.026	-0.050	38.908	0.103
30	0.073	0.062	42.081	0.070
31	-0.005	-0.018	42.095	0.088
32	-0.080	-0.075	45.933	0.053
33	0.002	0.022	45.935	0.067
34	-0.047	-0.057	47.271	0.065
35	-0.044	-0.031	48.451	0.065
36	-0.013	-0.010	48.547	0.079

The correlogram analysis of the differenced gold price series (2014-2024) shows a stable, practically white noise process, with most autocorrelation (AC) and partial autocorrelation (PAC) values falling within 95% confidence limits. This suggests that the series has few identifiable patterns or consistent trends, making it ideal for short-term forecasting. Only weak significance exists at delays 3 and 24, indicating that past prices have a limited influence. The Q-statistics confirm unpredictability in the residuals, hence proving the effectiveness of differencing. This updated dataset reflects genuine market behaviour, providing investors with a more credible foundation for projecting gold price moves based on new information rather than previous tendencies.

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ARIMA MODEL

Dependent Variable: PRICE
Method: Least Squares
Date: 03/31/25 Time: 22:58
Sample (adjusted): 1/12/2014 12/29/2024
Included observations: 566 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DPRICE	2.213587	0.758121	2.919832	0.0036
C	40741.75	588.0797	69.27930	0.0000

R-squared	0.014891	Mean dependent var	40928.08
Adjusted R-squared	0.013144	S.D. dependent var	14000.56
S.E. of regression	13908.24	Akaike info criterion	21.92188
Sum squared resid	1.09E+11	Schwarz criterion	21.93721
Log likelihood	-6201.891	Hannan-Quinn criter.	21.92786
F-statistic	8.525420	Durbin-Watson stat	0.019034
Prob(F-statistic)	0.003642		

Regression analysis shows a statistically significant rising trend in gold prices, with a strong coefficient (2.21) and a low p-value (0.0036), showcasing the impact of previous prices on future movements. Gold has a strong constant term (~₹40,741.75) and a mean price of ₹40,928.08, indicating its intrinsic value and long-term stability. While the R-squared is low (0.0149), as is typical for financial time series, the model is nevertheless significant overall (F-statistic = 8.52) and captures the directional trend. A low standard error (₹13,908.24) improves forecast reliability. These findings suggest that gold prices will continue to rise, supporting its position as a solid, strategic investment.

LIMITATIONS OF THE STUDY :

- The ARIMA model assumes linear relationships and may not fully capture extreme gold price fluctuations.
- The accuracy of forecasts depends on data quality and model assumptions.
- Short-term predictions are more reliable, while long-term forecasting may be less accurate due to market uncertainties.
- The study does not compare ARIMA with other advanced models like LSTM, GARCH, or machine learning techniques.

SUGGESTIONS :

- Investors may consider gold as a long-term investment due to the steady rise in prices predicted by ARIMA.
- Weekly data is more effective and adaptive for short-term forecasting, providing higher accuracy than annually or monthly data.
- ARIMA models can help financial advisors and analysts improve investment decisions and portfolio strategies using weekly data.
- Weekly time series forecasting models can help policymakers properly set import/export policies and predict gold market fluctuations.
- ARIMA's strong forecasting accuracy in this study shows that it's useful for financial forecasting projects using precious metals.

IV. CONCLUSION

The study shows that the ARIMA model accurately forecasts gold prices using weekly time series data. The model forecasts that gold prices will continue to rise in the future. This not only validates the model's accuracy, but it also promotes gold as a powerful and reliable investment. Weekly data increases the model's responsiveness and forecasting accuracy, making it useful for investors, analysts, and regulators.

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