

PREDICTION OF THE NET ASSET VALUES OF INDIAN MUTUAL FUNDS USING AUTO- REGRESSIVE INTEGRATED MOVING AVERAGE (ARIMA)

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ABSTRACT

Mutual funds are fast emerging as India's investment vehicle of choice. As there are a variety of investors in all types of fund schemes, the competition is very intense in the present scenario. ARIMA method is one of the most sophisticated extrapolation methods for forecasting. In this paper, some of the mutual funds in India had been modeled using Box-Jenkins autoregressive integrated moving average (ARIMA) methodology. Validity of the models was tested using standard statistical techniques and the future NAV values of the mutual funds have been forecasted.

Keywords: Auto Correlation Function (ACF), Partial Autocorrelation Function (PACF), Net Asset Value (NAV), Forecasts, Stationarity.

1. INTRODUCTION

The mutual funds have come a long way since its inception in 1964. Due to the growing popularity of mutual funds as a tool of investment, Indian capital market has been maturing of late. With the returns from fixed income reaching the bottom and the impending risk present in the equity market, the retail investors are relying on mutual funds to take care of their investments. Also the Indian market has also drawn the attention of global investors. At this juncture, it is imperative for the mutual fund investors to evaluate the future performance of the various schemes before deciding on investments.

2. FORECASTING WITH ARIMA MODEL

Auto Regressive Integrated Moving Average (ARIMA) is one of the popular linear models in time series forecasting during the past three decades which was popularized by George Box and Gwilym Jenkins in the early 1970s; as a result, ARIMA processes are sometimes known as Box-Jenkins models. ARIMA processes have been a popular method of forecasting because they have well-developed mathematical structure.

3. ARIMA METHODOLOGY

The art of ARIMA modeling involves the following steps:

(a)Model Identification: The foremost step in ARIMA modeling is to check for stationarity of the series. A cursory look at the graph of the data and the structure of autocorrelation and partial autocorrelation may provide clues for the presence of stationarity. If the model is found to be non-stationary, stationarity can be achieved by differencing the series. ARIMA(p,d,q) model is given by the equation

$$Y_t = \Phi_0 + \Phi_1 y_{t-1} + \Phi_2 y_{t-2} + \dots + \Phi_p y_{t-p} + \varepsilon_t - w_1 \varepsilon_{t-1} - w_2 \varepsilon_{t-2} - \dots - w_q \varepsilon_{t-q}$$

The next step in the identification process is to find the initial values for the orders of parameters p, q. They could be obtained by looking for significant autocorrelations and partial autocorrelation coefficients. The autocorrelation function (ACF) and partial ACF (PACF) are very important for the definition of the internal structure of the analyzed series. Theoretically, both an AR (p) process and an MA (q) process should be associated with well-defined patterns of ACF and PACF.

(b)Estimation: At the identification stage, one or more models are tentatively chosen that seem to provide statistically adequate representation of the available data. Then we attempt to obtain precise estimates of the model by least squares as advocated by Box &Jenkins.

(c)Diagnostics: Different models can be obtained for various combinations of AR and MA individually and collectively. For the models obtained, perform diagnostic tests using

(1) Residual ACF (2) Box pierce Chi-square tests

(d)Forecasting: ARIMA models are developed basically to forecast the corresponding variable.

There are two kinds of forecasts-sample forecasts and post sample forecasts. The former are used to develop confidence in the model and the latter to generate genuine forecasts for future planning. ARIMA model can be used to yield both these kinds of forecasts.

4. Data analysis: The data for analysis is taken from five of the top ten Indian Mutual Funds as rated by valueresearch, India. ARIMA models were created for the data and the future NAV were forecasted using SPSS package.

(1)Tata Mutual Fund: ARIMA(0,1,1) model

Name of the scheme: Tata Balanced Fund - Growth.

Sample period: 3/4/2006 to 15/9/2009.

Forecast period: 16/9/2009 to 28/2/2010(total of 107 days)

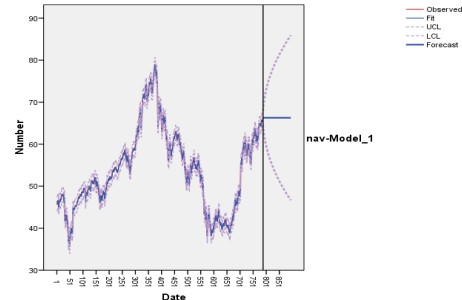
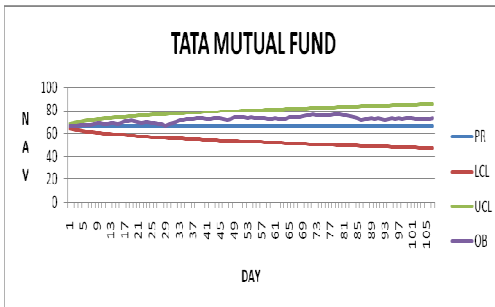


Fig 1: Actual and Predicted NAV and 95% fund confidence limits(CL) of Tata mutual fund Fig 2: Forecast of NAV of Tata mutual fund

2) Sahara Mutual Fund : ARIMA(0,1,1) model

Name of the scheme: Sahara Fund-Growth.

Sample period: 1/2/2003 to 15/9/2009.

Forecast period: 16/9/2009 to 28/2/2010(total of 107 days)

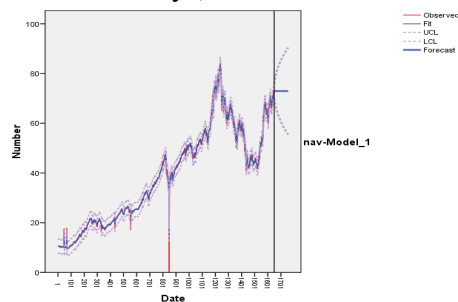
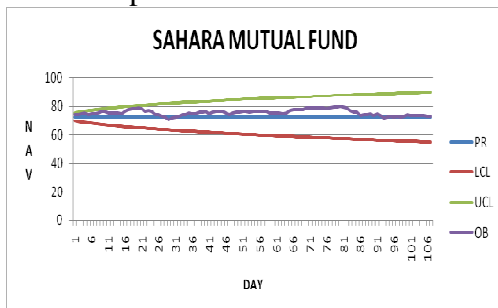


Fig 3: Actual and Predicted NAV and 95% fund confidence limits(CL) of Sahara mutual fund Fig 4: Forecast of NAV of Sahara mutual fund

(3)Reliance Mutual Fund: ARIMA(1,1,0) model

Name of the scheme: Reliance Regular Savings -Equity

Sample period: 9/6/2005 to 15/9/2009.

Forecast period: 16/9/2009 to 28/2/2010(total of 107 days)

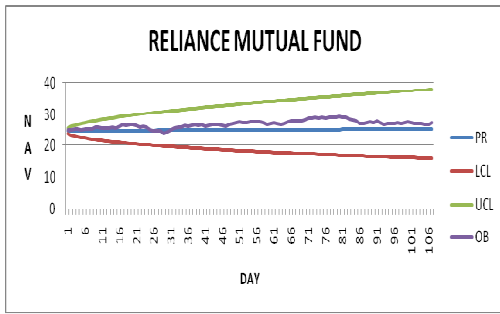


Fig 5: Actual and Predicted NAV and 95% mutual fund confidence limits(CL) of Reliance mutual fund

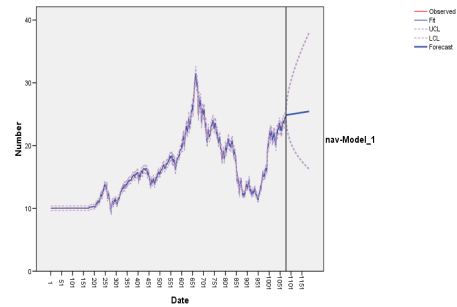


Fig 6: Forecast of NAV of Reliance mutual fund

(4) UTI Mutual Fund :ARIMA(0,1,1) model

Name of the scheme: UTI dividend yield fund-Growth.

Sample period: 1/6/2005 to 15/9/2009.

Forecast period: 16/9/2009 to 28/2/2010 (total of 107 days)

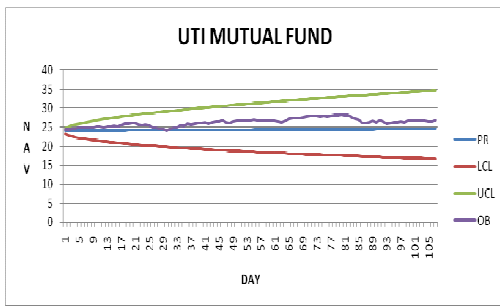


Fig 7: Actual and Predicted NAV and 95% mutual fund confidence limits(CL) of UTI mutual fund

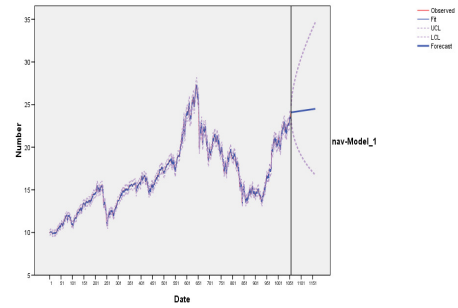


Fig 8: Forecast of NAV of UTI mutual fund

(5)HDFC Mutual Fund : ARIMA(0,1,2) model

Name of the scheme: HDFC top 200 fund-Growth plan

Sample period: 20/6/2003 to 15/9/2009.

Forecast period: 16/9/2009 to 28/2/2010(total of 107 days)

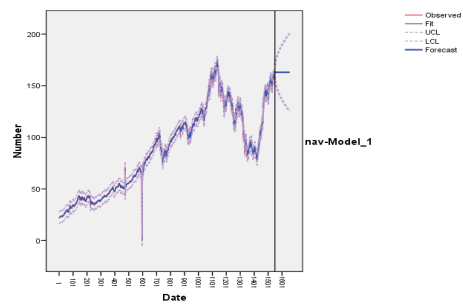
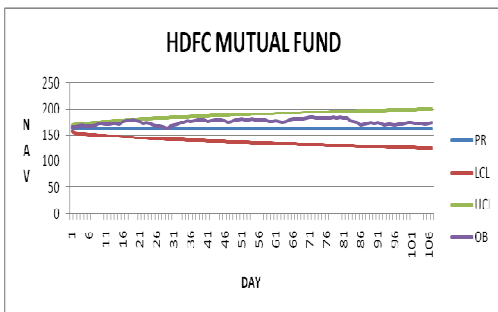


Fig 9: Actual and Predicted NAV and 95% mutual fund confidence limits(CL) of HDFC mutual fund Fig 10: Forecast of NAV of HDFC mutual fund

TABLE.1 The Model Parameters of the five Mutual Funds

MODEL PARAMETERS	TATA ARIMA(0, 1,1)	SAH ARIMA(0, 1,1)	REL ARIMA(1, 1,0)	UTI ARIMA(0, 1,1)	HDFC ARIMA(0, 1,2)
RMSE	0.84	1.46	0.33	0.29	2.87
MAPE	1.11	1.61	1.17	1.10	1.46
MAE	0.59	0.64	0.20	0.19	1.31
LJUNG-BOX QSTAT	24.9	21.4	26.2	25.7	10.5
BIC	-0.35	0.76	-2.2	-2.4	2.11

5. CONCLUSIONS

From the models created using ARIMA for the five mutual funds, it can be seen from the above figures

- (1) The models fit the past data well.
- (2) Plots of actual versus predicted are good.
- (3) R^2 is very high for all the models.
- (4) RMSE is very low compared with the other models.
- (5) MAPE, which is an important measure of the sample period forecasts' accuracy is good indicating that forecasting inaccuracy is very low.
- (6) The residuals are white noise, or they have no patterns denoting model deficiencies.
- (7) Bayesian Information Criteria are lower than those of other models.
- (8) These models can be used by investors for forecasting the future exchange rates. The models can be used by investors for forecasting the future NAV of the mutual funds. However, it should be updated from time to time with incorporation of current data. ARIMA model offers a robust technique for predicting the magnitude of any variable and is suitable for any time series with any pattern of change. Its limitations include its requirement of a long time series. Although this technique does not guarantee perfect forecasts, it can be successfully used for forecasting long time series data.

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