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Extrapolation of the Net Asset Values of Select Indian Mutual Funds Using Auto Regressive Integrated Moving Average (Arima)

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Abstract: *A time series modelling approach Auto Regressive Integrated Moving Average (ARIMA) has been used in this study to forecast future returns of Mutual funds. The order of the best ARIMA model was found to be p, d, q (0, 1, 0). Further efforts were made to diagnose the future net asset values for a period up to 105 days by fitting ARIMA (0, 1, 0) model to our time series data.*
Keywords: *Net Asset Value (NAV), prediction, Forecasts, ARIMA*

I. Introduction

Due to the growing popularity of mutual funds as a tool of investment, the investors are relying on fund managers to take care of their investments. Fund manager must predict the expected future return to explain the investor the predicted performance so that the investor could invest in the schemes with expectation that the scheme would yield forecasted return. It is imperative for the mutual fund investors to evaluate the future performance of the various schemes before deciding on investments. Predicting becomes the challenging task for the fund managers. Thus the fund managers try to find the suitable modelling technique to predict the fund returns. Auto regressive integrated moving average model is the most useful extrapolation method for time series data. ARIMA models use to predict the behaviour of a time series from past values. ARIMA models are broadly used for prediction of economic and industrial time series which can be helpful for the investors for better investment decision making.

Growth of Mutual Fund Industry in India

Mutual funds witnessed strong inflows in the last three years leading to strong growth in overall assets managed by mutual fund asset management companies. Table 1 shows the growth of Mutual fund industry and the Graph 1 ,the top ten mutual funds companies holding more than 70% of the assets under management.

Table1 Growth of Mutual Fund Industry as on December 31st 2016

Year (As on 31st December)	Sales	Redemption	Assets under management
2007	19,38,592	18,44,512	3,26,388
2008	44,64,376	43,10,575	5,05,152
2009	54,26,353	5,454,650	417,300
2010	10,019,023	9,935,942	613,979
2011	8,859,515	8,908,921	700,538
2012	6,819,679	6,841,702	664,792
2013	7,267,885	7,191,346	816,657
2014	9,768,401	9,714,318	905,120
2015	1,10,86,260	1,09,82,972	11,88,690
2016	12,636,128	12,322,286	1,693,339

Source: AMFI

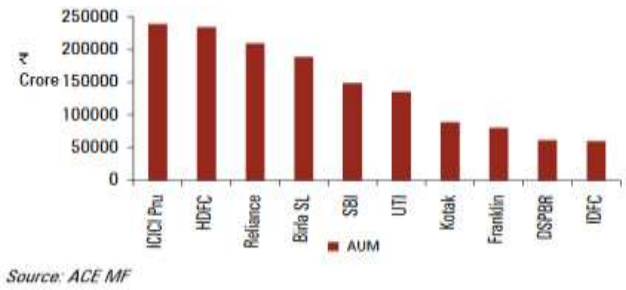

Fig1: Assets Under Management by Top AMC's

II. Review of Related Literature

M.Gowri & Malabika Deo (2015) used the ARMA model for estimation of fund of funds returns and tested the validity using the future NAV returns of the fund of mutual funds with that of forecasted. The historical data for the 7 years period since 2007 to 2014 were taken into account for analysis. The Box Jenkins methodology was used to identify the model. The schemes selected were four of fund of funds. The future forecasts of each scheme for the next 201 days also were highlighted in this paper. In this paper useful information provided to investors dealing with portfolio constructions and risk return management related issues by modelling the returns.

Sanjeev Gupta and Sachin Kashyap (2014) used the Box Jenkins approach to forecast exchange rate in India. Using ARIMA, the pattern was identified for each variable on the basis of past values and then the pattern was used to predict future. The process generated forecasts for US dollar, Euro, Japanese Yen, GBP.

Devi et al., (2013) applied Box Jenkins methodology for forecasting stock trend of NIFTY mid cap-50 from January 2007 to December 2011 using mean absolute percentage error and mean absolute deviation as performance measure. The result of the study highlighted that ARIMA model was best in capturing the variations in the stock market. Fernando Garcia et al., (2012) used the econometric model for estimation of both returns and conditional volatility in financial assets. They made a comparison of traditional approach with Back Propagation neural network. They used Ibex-35 stock market index and proved that neural network achieved significantly better performance in predicting conditional volatility, but not so different results when predicted the financial returns. Divakar Chitturi (2010) used fixed window prediction and Moving Window prediction methodologies for the forecasting S & P 500 index, for various time intervals to identify the patterns in different periods. E.Priyadarshini and Dr.A.Chandra Babu(2011) showed for selected 5 of the top ten mutual funds rated by value research, India. ARIMA models were created for the data and the future NAV were forecasted using SPSS package and concluded that the models fit the past data well, plots of actual versus predicted are good. R Square is very high for all the models.

Mark M. Carhart (2000) showed for equity mutual funds the last day returns are positive and the following day is negative effect. Andrea Frazzini ET, al., (2008) used mutual funds flows as a measure of individual investors' sentiment for different stocks and found that high sentiment predicts low future returns. They showed high sentiment stock tend to be growth stocks and also associated with high corporate issuance. They concluded that the higher returns earned at the short horizon are not effectively captured by individual investors.

An empirical analysis about factor based non parametric risk management for hedge funds and fund of funds was done by T.R.J. Goodworth and C.M. Jones (2007). They described about factor based analysis of hedge fund re-turns to form a risk evaluation framework that should estimate tail risk. They concluded the quantitative portfolio construction and to ensure maximum portfolio diversification, time dependent factor exposure, implied risk profiles, active style analysis and standard deviation based on VAR measures. Kartik Patel (2007), examined fund of funds as a function of the number of fund manager in the portfolio, the risk underperformed the benchmark. They used two methods like naïve diversification and strategy diversification. They found that the objective beat the bench mark with a high confidence and a diversified fund of funds with an absolute return mandated.

T.Colon ET, al., (2007) explained the random matrix the-ory and fund of funds portfolio optimization with various hedge fund Indices. They accustomed to cleaned correlation matrix leads to a 35 % development between the realized and predicted risk of portfolio. Emily Denvir and Elaine Hutson (2004) they examined the performance and diversification benefits of fund of hedge funds. They examined the most fund of hedge funds distributions are not negatively skewed. Lee Hee Soo, (2012) investigated risk and return in hedge funds and fund of hedge funds: A cross sectional approach. This study examined risk return measure through cross sectional distinction in hedge funds and fund of hedge funds returns.

Noel. Amenc, et.al., (2003) investigated the predictability in hedge funds returns. They provided evidence of predictability in hedge funds and discussed the implication of dynamic style-allocations, explore a multi-style, multi-class combination for an equity-oriented portfolio. William J.Bertin and laurie prather (2008) analysed management structure and the performance of fund of hedge funds. They analysed performance of fund of funds in terms of fund management structure and gives a systematic ap-proach for selecting the best fund of funds. Mila Getman- sky (2004) analysed net flows into individual funds are affected by past fund performance, current performance, past flows, past standard deviation of return and past as-sets. Linear relationship between current flows and past fund performance was projected and analysed. Review of literature reveals that there is death of studies on modeling of Fund of Funds returns. Hence attempt has been made explore the same in this study. The objectives of the study to apply an accurate model to suit the NAV price of the Birla Sun Life Mutual Fund and To Analyse the trend of the NAV prices of Birla Sun Life Mutual Fund

III. Methodology

The data was collected for Birla Sun Life Mutual fund schemes as it is one among the top performing mutual fund companies. The data comprised of compounded annual growth rate returns of ten Birla schemes from April 2008 to January 20, 2017. Trend analysis was conducted followed by Box-Jenkins Autoregressive Integrated Moving Average (ARIMA). Time series modelling has been used for modelling the data. SPSS package was used for the analysis and calculation of the data.

Table 2 Returns of the Birla Mutual fund Schemes

Year	Birla Sunlife Savings Plan Growth	Birla Sunlife Mip 25 Wealth Plan Gro1.46wth	Birla Sun Life Income Plan Growth	Birla Sun Life Dividend Yield Plus Dividend	Birla Sunlife Index Fund Dividend	Birla Sunlife Mid Cap Fund Plan A Dividend
2008-09	0.68	-0.98	-2.32	-2.24	-3.33	-5.94
2009-10	0.34	1.46	0.9	3.42	3.61	5.14
2010-11	0.49	0.27	0.5	0.1	0.33	-1.91
2011-12	0.68	3.6	1.16	-0.47	-0.62	-0.16
2012-13	-0.36	0.45	0.5	-0.74	-0.19	-0.61
2013-14	0.73	0.77	0.42	4.44	0.84	0.48
2014-15	0.69	1.7	1.24	1.56	-2.64	2.86
2015-16	0.61	-0.08	0.5	-1.95	-5.54	-1.82
2016-17	0.63	1.24	0.94	1.31	0.59	1.32

Source : Calculations

Fund managers of mutual fund schemes must forecast or predict the future net asset value of mutual funds for the benefit of the investor for investment purpose.

IV. ARIMA Methodology

In this study ARIMA model was used and identified the significant parameters using Box-Jenkins methodology. The ARIMA (p d q) model is churn of autoregressive (AR) and moving average (MA) models show that there is a relation between observed value and expected value and residuals respectively. The Box-Jenkins methodology was applied for time series data identified best ARIMA models and their residual analysis used MAPE analysis. For evaluating the adequacy of AR, MA and ARIMA process, various consistent measures like and Bayesian Information Criterion (BIC) were used.

The time series data follows the Box-Jenkins (1970) methodology for modeling, generally known as ARIMA. Let Yt be a discrete time series variable which takes different variable over a period of time. The corresponding AR (p) model of series, which is the generalization of the autoregressive model, is expressed as;

AR (p); = $\alpha + \alpha Y + \alpha Y$ ……$+\alpha Y + \mu$ ---------(1)

MA (q) is moving average process. It is simply a linear combination of white noise error terms.

MA (q); $Yt = \alpha - \mu - \mu -$…… $\mu + \mu$ ------- (2)

The general form of ARIMA model (p d q) is

$Yt = \alpha + \alpha Y + \alpha Y$ ……$+\alpha Y - \mu - \mu -$…… $\mu + \mu$

LJung-Box Q-statistic

It is a type of statistical test of whether of any of a group of autocorrelations of a time series are different from zero. Instead of testing randomness at each distinct lsg, it tests the overall randomness based on a number of lags and is therefore a portmanteau test. The test is sometimes known as the LJung –Box Q test, and it is closely connected to the Box-Pierce test.

Mean Absolute Percentage Error (MAPE)

This value is computed as the average of the PE Values. Mean Absolute Percentage error a mean percentage error near zero can be produced by large positive and negative percentage errors that cancel each other out.

V. Results And Discussions

The data for analysis is taken from six of the top Birla Sun Life Mutual Funds as rated by value research, India. ARIMA models were created for the data and the future NAV were forecasted using SPSS package. Birla Sun Life savings scheme appear like bullish market so investors for holding the scheme can hold for another 3 months and investors who are planning to invest in mutual funds can invest in this fund. Birla Sun

Life MIP 25 wealth plan appear like bullish market, with the help of ARIMA model it is predicted that NAV of the fund will reach Rs38, so investors for holding the scheme can book profit at Rs38. The Birla Dividend funds look more volatile than the growth funds. Researchers can further study the behaviour of index fund and other high market capitalisation of mutual funds using other forecasting methods like Artificial Neural networks, exponential smoothing methods.

Table 3: Descriptive Statistics of Birla Mutual Funds

S No	Mutual Funds	Mean	SE	SD	Range	Minimum	Maximum
1	Birla Sun Life Dividend Yield Plus Dividend	13.323	0.226	2.328	9.930	7.620	17.550
2	Birla Sunlife Mip 25 Wealth Plan Growth	21.569	0.608	6.255	22.500	12.370	34.870
3	Birla Sunlife Index Fund Dividend	95.959	3.406	35.063	124.960	39.080	164.040
4	Birla Sunlife Mid Cap Fund Plan A Dividend	23.937	0.577	5.937	24.790	11.380	36.170
5	Birla Sun Life Income Plan Growth	43.081	1.178	12.127	49.780	26.160	75.940
6	Birla Sunlife Savings Plan Growth	214.909	4.403	45.333	153.570	151.470	305.040

Table4: ARIMA model for best six Birla Mutual funds

S No	Mutual Funds	Model (p,d,q)	Correlation	R-squared	MAPE	Normalized BIC	Ljung-Box QStatistics
1	Birla Sunlife Savings Plan Growth	0,1,0	0.987	1.00	0.2	-0.98	12.088
2	Birla Sunlife Mip 25 Wealth Plan Growth	0,1,0	0.962	0.99	2.39	-0.78	18.551
3	Birla Sun Life Income Plan Growth	0,1,0	0.938	1.00	1.25	-0.70	22.38
4	Birla Sun Life Dividend Yield Plus Dividend	0,1,0	0.647	0.90	3.98	-0.51	23.946
5	Birla Sunlife Index Fund Dividend	0,1,0	-0.195	0.94	3.84	0.41	28.674
6	Birla Sunlife Mid Cap Fund Plan A Dividend	0,1,0	0.683	0.94	4.86	1.01	25.127

From the models created using ARIMA for the six mutual funds, it can be seen from the below figures. The models fit the past data well. The plots of the schemes observed and fit are almost equal and moving in the same direction i.e., the plots of the actual values and predicted values are good and at the same time R^2 is very high for all the models and normalized BIC is low as the ARIMA fits when R^2 is high and BIC is low. MAPE, which is a prominent measure of the sample period forecast's accuracy, is good indicating that forecasting inaccuracy is low. These models can be used by investors for forecasting the future values of stock prices, net asset values, exchange rates.

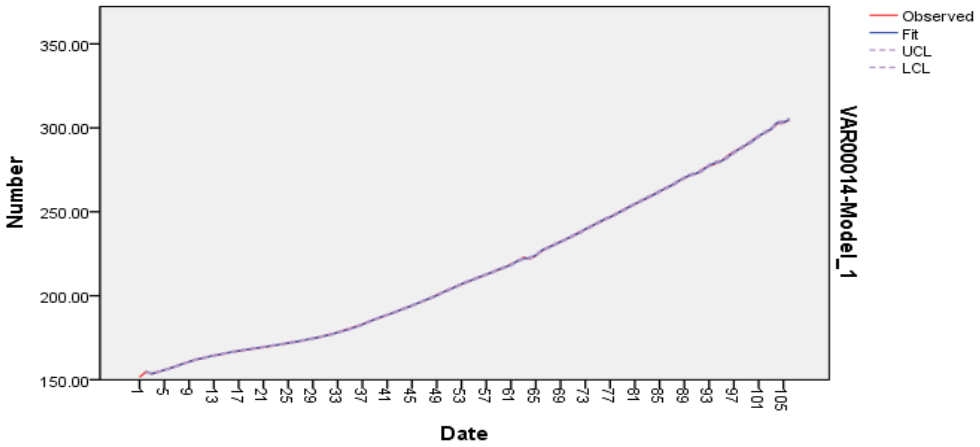

Fig2: Fitted model of Birla Sun Life Savings Plan- Growth

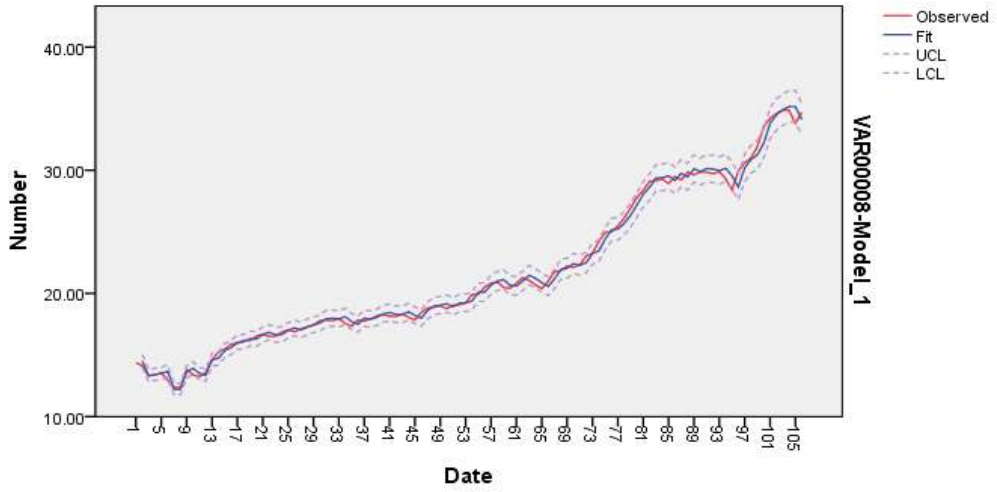

Fig3: Fitted model of Birla Sun Life MIP 25 Wealth plan Growth

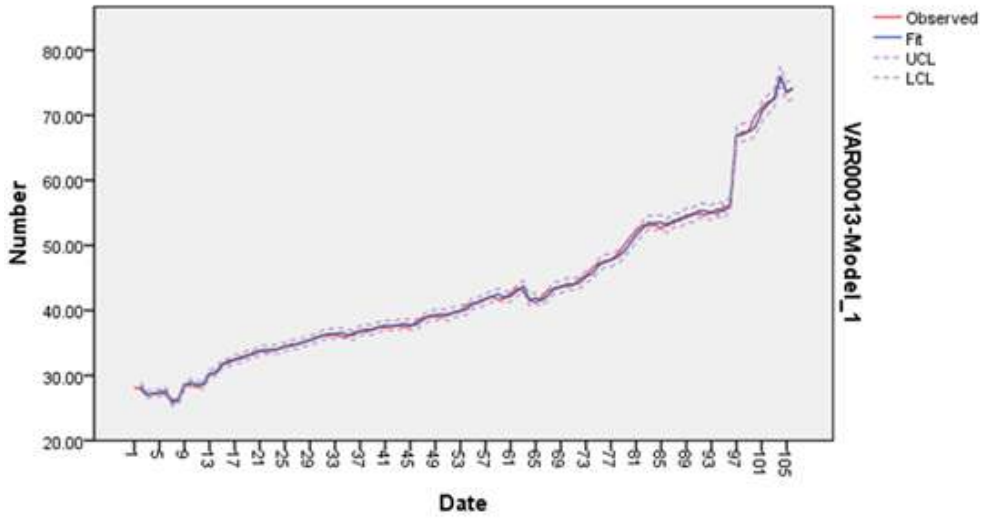

Fig4: Fitted model of Birla Sun Life Income plan Growth

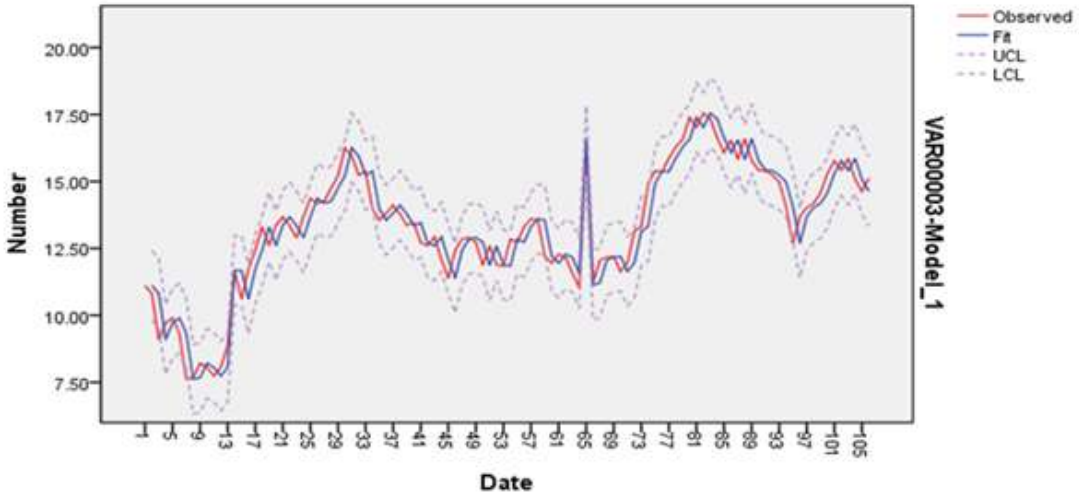

Fig5: Fitted model of Birla Sun Life Dividend Yield plus fund:

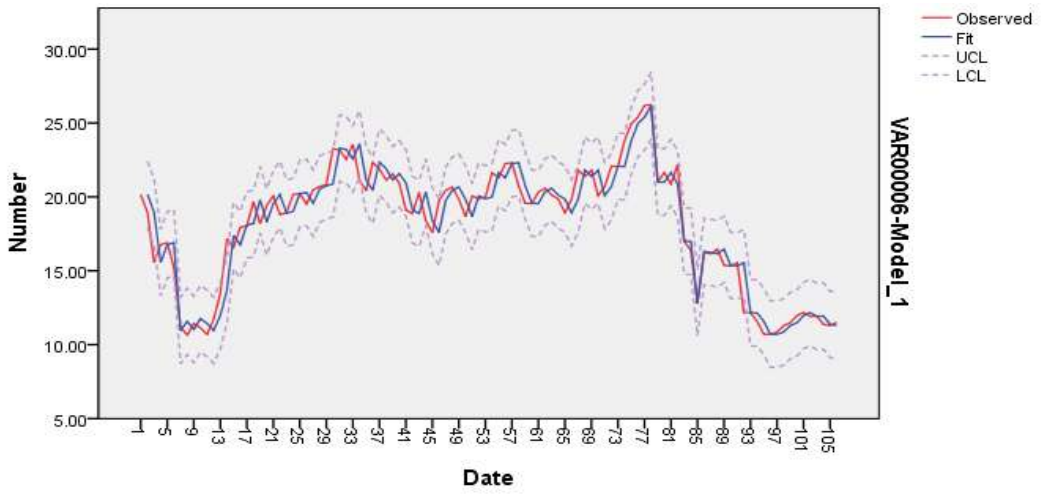

Fig6: Fitted model of Birla Sun Life Index Fund Dividend

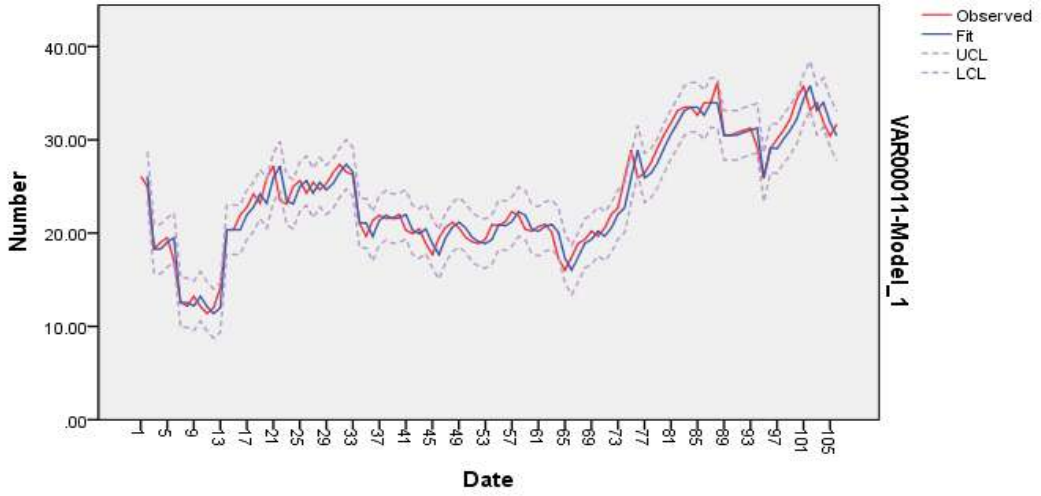

Fig7: Fitted model of Birla Sun Life Mid Cap Fund Plan a Dividend

VI. Conclusions

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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