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HYPOTHESES

RESEARCH METHODOLOGY

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CONTRIBUTIONS TO BOOKS

- Sharma T., Kwatra, G. (2008) Effectiveness of Social Advertising: A Study of Selected Campaigns, Corporate Social Responsibility, Edited by David Crowther & Nicholas Capaldi, Ashgate Research Companion to Corporate Social Responsibility, Chapter 15, pp 287-303.

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- Schemenner, R.W., Huber, J.C. and Cook, R.L. (1987), "Geographic Differences and the Location of New Manufacturing Facilities," Journal of Urban Economics, Vol. 21, No. 1, pp. 83-104.

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FII INVESTMENT FORECASTING: AN INSIGHT INTO FUTURE TREND USING ARIMA MODEL

SURESH KUMAR
ASST. PROFESSOR
SCHOOL OF MANAGEMENT
LOVELY FACULTY OF BUSINESS AND APPLIED ARTS
LOVELY PROFESSIONAL UNIVERSITY
PHAGWARA

UTKARSH SHRIVASTAVA
ASST. PROFESSOR
SCHOOL OF MANAGEMENT
LOVELY FACULTY OF BUSINESS AND APPLIED ARTS
LOVELY PROFESSIONAL UNIVERSITY
PHAGWARA

JASDEEP DHAMI
ASST. PROFESSOR
SCHOOL OF MANAGEMENT
LOVELY FACULTY OF BUSINESS AND APPLIED ARTS
LOVELY PROFESSIONAL UNIVERSITY
PHAGWARA

ABSTRACT

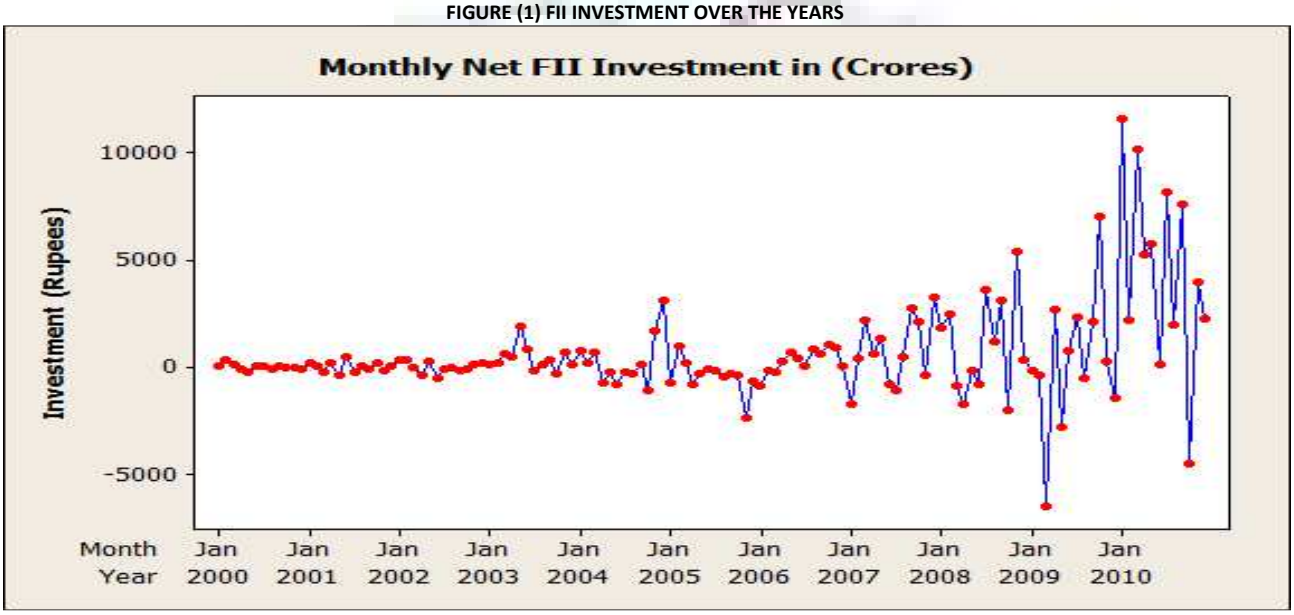
This study mainly focuses on forecasting net investment by foreign institutional investor in Indian Debt and Securities markets. Past studies have concluded that FII investment depends upon recent past investment trend and follows herd behavior in context of Indian markets. Autoregressive and Moving Average Processes have been proven suitable for modeling time series exhibiting such characteristics. ARIMA specification parameters are identified by analysis of ACF and PACF of the time series. Net monthly FII data used to train the model is from jan-2000 till dec-10, while FII flow forecast is done for the year 2011 to check the accuracy of the model specific parameters obtained earlier. Comparison of actual and forecasted results showed that forecast are lying within 95% confidence limits which proves efficiency of these models. Long term forecast depicted continuous downtrend which is the indicator of FII's negative sentiments and calls for policy changes to boost their confidence.

KEYWORDS
ARIMA, FII, ACF, PACF, Ljung-Box Test.

INTRODUCTION

Stock markets in the India and other developing countries are becoming attractive place of investment for Foreign Institutional Investors (FII). Investment by FII to the markets has its pros and cons. It helps in increasing the valuations of the domestic firms and brings foreign currency to the country although sudden withdrawal of huge funds from the market adversely affects the environment of the domestic country. Foreign Institutional Investment (FII) generally done by individuals and institutional investors from foreign nations to diversify their international portfolios. In an economy like India FII investment was not an attractive option until pace of liberalization and globalization increased. In the last decade of 19th century FII investment has drastically increased and has made Indian markets highly volatile. Fig(1) clearly depicts the changes in FII investment.

FIGURE (1) FII INVESTMENT OVER THE YEARS



FII investment has been an area of concern for the policy makers in the emerging markets like India. There have been various studies on effect of FII investment on volatility of the market. Wang (2000) concluded that FII and domestic investor trade has more impact on market volatility as compared to inter FII trade on Jakarta Stock Exchange. Government of India is allowing foreign individuals to directly invest in stock markets which earlier they used to do through indirect routes like mutual funds etc. Clark and Berko (1997) emphasize the beneficial effects of allowing foreigners to trade in stock markets as increasing investors would lead to more risk sharing and lesser risk premium. The impact study of FIIs flows on domestic stock market is important from government as well as investor point of view, for example, does the opening up of the market for FII increase speculation in the market and thus make the market more volatile and more vulnerable to foreign shocks Li(2002). Richards (2004) analyze data of six Asian emerging equity markets and found two interesting findings. The trading behavior of foreign investors was largely influenced by the return in global market that is positive feedback trading. The price impact associated with foreign investors trading was much large than estimated earlier. Choe (1999) emphasized on negative effect of FII in the form of herd behavior and destabilization of emerging stock market. Batra (2003) found positive relation between purchase and net flows with returns and the negative relation between sales and returns, signals that the FIIs do not indulge in heavy purchases and sales in the same month. Using both daily and monthly data, she found that FIIs exhibit herding as far as Indian markets are concerned. Herding basically means FII's follow each other and take decision based upon common trend. She further found that herding measure being high for the monthly horizon. Studies have concluded that herd introduces moving average structure yielding and ARIMA model.

ARIMA stands for Autoregressive Integrated Moving Average with each term representing steps taken in the model construction until only random noise remains. These models use co relational techniques and are used to model patters not visible in the plotted data. Box and Jenkins (1976) developed a practical procedure for an entire family of models, the autoregressive integrated moving-average (ARIMA) models. Cleary and Levenbach (1982), Andersen (1980), and Pankratz (1983) point out that the Box-Jenkins approach is a powerful and flexible method for short term forecasting because ARIMA models place more emphasis on the recent past and where structural shifts occur gradually, rather than suddenly.

This study analyzes monthly net FII investment from 2000 till 2010 for presence of ARIMA process in the time series thus obtained. Study analyzes various ARIMA (p,r,q) for different values of p and q to obtain the process which best resembles FII investment time series. FII investment is also forecasted till 2015 to get an estimate of the investment in future. ARIMA models are difficult to identify hence various identification rules are also studied.

FII INVESTMENT FACTS

Foreign Institutional Investors (FIIs) were permitted to invest in all the listed securities traded in Indian capital market for the first time in September, 1992. As per the RBI, Report on Currency & Finance (2003-04), since 1991 there has been continuous move towards the integration of the Indian economy with world economy. From September 14, 1992, with suitable controls, foreign institutional investors (FIIs), nonresident Indians (NRIs), and people of Indian origin (PIOs) can invest in the primary and secondary capital markets in India through the portfolio investment scheme (PIS). Under this scheme, FIIs and NRIs can buy shares and debentures of Indian companies through Indian stock exchanges. Before investment, foreign investors need to register themselves in the country. The Government stipulates certain guidelines and eligibility conditions for registration. The Securities and Exchange Board of India announced the guidelines for registration. Investment through FIIs started flowing from January 1993. To increase and diversify the FII base, the government extended eligible categories of FIIs in the year 1996. They also gradually increased overall investment limits by FIIs, as also the types of instruments in which the FIIs can invest. Initially, FIIs could invest only in stocks, but from 1997 onwards, FIIs can invest in debt instruments having an upper limit of 30% of their investment. FIIs can also declare itself as a 100% debt FII. In March 1998, the Government accepted the L C Gupta Committee Report on Derivatives trading and allowed FIIs to buy and sell derivatives traded on stock exchanges. At the same time, the government simplified registration procedures and took steps to promote better exchange of information. It also allowed FIIs to invest in Commercial Paper from 2001. The FIIs investing in Indian stock need to follow certain quantitative limits. The ceiling for overall investment for FIIs is 24 percent of the paid up capital of the Indian company and 10 percent for NRIs and PIOs. The limit is 20 percent of the paid up capital in public sector banks, including the State Bank of India. Figure below shows the plots of BSE Sensex and FII net investment in India. So as to encourage long term investments in the Indian market, Budget 2003 proposed that investors who buy stocks of listed companies from March 1, 2003 be exempt from paying tax on the gains they make on their investments, provided they hold them for more than one year. This indicates that Indian government is encouraging FII investors. Clearly the movement is in the same direction and both Index and Investment influence each other. After economic down trend of 2008 FII investment reached Rs. 11564 Crore in January 2010 and same year marked positive trend in net FII investment in India while in recent times the maximum selling of funds was observed in March – 2010 and Oct -2010. By the end of 2010 the interest of investors in the markets started decreasing mainly due to corruptions in various government tenders and deals like 2G spectrum sale and rigid polices of the government.

FII INVESTMENT NATURE AND IMPORTANCE

Now days, a significant portion of Indian corporate sector's securities are held by Foreign Institutional Investors, such as pension funds, mutual funds and insurance companies. Using a monthly data set for the period May 1993 to December 1999, Chakrabarti (2001) found that FII flows to India have steadily grown in importance since the beginning of liberalization. He analyzed these flows and their relations with other macroeconomic features and arrived at the following major conclusions. While there may exist correlation between fund flows and stock returns in India, they are more likely to be the result than the cause of these returns. (2) FIIs are no at an informational disadvantage in India relative to local investors. (3) The Asian crisis marked a regime shift in the determinants of FII flows to India with the domestic stock returns becoming the sole driver of these flows since the crisis. Mukherjee, Bose and Coondoo (2002) studied Indian stock markets and FII flow from January 1999 to May 2002 and concluded that FII net investment influences Indian stock market but FII buying is unaffected by the market performance. Gordon and Gupta (2003) found that both global and domestic reasons are important in deciding FII flows. They analyzed monthly data and found that among external factors LIBOR and stock market returns and lagged stock returns and credit ratings are domestic factors which influence funds flow.

Han and Wang (2004) concluded that these investors are sophisticated investors as these institutional investors are better informed and better equipped to process information than individual investors. Tesar and Werner (1995) explained the policymakers increasing concern about the factors determining international investment, the performance of foreign capital investments, and the impact of foreign investment on local turnover and on the volatility of stock prices. The investment pattern of FII is undeterminable by using a single factor. However, FII investment patter exhibit herding Choe (1999). In this case herding refers to dependence in the strategies used by agents based on conditional public information. Such type of herding is called concurrent herding. For examples in case of FII if a renowned FII decides to invest in India due to positive outlook it may encourage other FII to follow it. Such herd introduces moving average structure yielding an ARIMA model. This study models monthly FII investment using ARIMA models and checks their efficiency in forecasting the flow of FII.

TIME SERIES MODELING USING ARIMA MODELS

These are special type of regression model where dependent variable is considered to be stationary and independent variable is lags of dependent variable and lags of errors. An ARIMA process is a combination of an Auto regressive and a Moving Average Process. Box and Jenkins (1976) first introduced ARIMA models. A time series can follow an ARIMA process only when it is stationary. A time series is said to be stationary only when it exhibits mean reversion around a constant long run mean, has a finite variance and decreasing correlogram as lag length increases. Stationarity is important because if the series is non-stationary then all the typical results of the classical regression analysis are not valid.

AUTOREGRESSIVE MODEL

An autoregressive model of order p is represented as :

$$Y_t = \phi_1 Y_{t-1} + \phi_2 Y_{t-2} + ...\phi_p Y_{t-p} + u_t \quad \text{---------- (1)}$$

Where, $|\phi| < 1$ and u_t is a gaussian (white noise) error term. For the AR (p) model to be stationary is that the summation of the p autoregressive coefficients should be less than 1:

$$\sum_{i=1}^{p} \phi_i < 1$$ ---------- (2)

If the observations are generated by an AR(p) process then the theoretical partial autocorrelations will be high and significant for up to p lags and zero for lags beyond p. This rule is generally utilized to define which process the series is following and is incorporated in the ARIMA model.

MOVING AVERAGE MODEL

A moving average model of order q can be written as

$$Y_t = u_t + \theta_1 u_{t-1} + \theta_2 u_{t-2} + \ldots + \theta_q u_{t-q}$$ ---------- (3)

Moving Average MA (q) process is an average of q stationary white noise process, hence it is always stationary as long as q has a finite value. A time series is said to be invertible if it can be represented bya finite order MA or convergent autoregressive process. Invertiblity is an important property for identifying the order of MA process using Autocorrelation and Partial Auto Correlation Function as in this case it is assumed that Y_t sequence is well approximated by auto regressive model. An MA (1) process can be inverted to an infinite order AR process with geometrically declining weights if the necessary condition $|\theta| < 1$ is met. The mean of the MA process will be clearly equal to zero as it is the mean of white noise terms. For a MA (q) model correlogram (ACF) is expected to have q spikes for k = 0 and then go down immediately. Auto covariance of a MA process is equal to zero.

ARMA MODELS

These models are combinations to two processes and usually represented by ARMA (p, q). The general form of ARMA (p, q) models is represented by :

$$Y_t = \phi_1 Y_{t-1} + \phi_2 Y_{t-2} + \ldots + \phi_p Y_{t-p} + u_t + \theta_1 u_{t-1} + \theta_2 u_{t-2} + \ldots + \theta_q u_{t-q}$$ ---------- (4)

The equation can be rewritten as :

$$Y_t = \sum_{i=1}^{p} \phi_i Y_{t-i} + u_t + \sum_{i=1}^{q} \theta_j u_{t-j}$$ ---------- (5)

For stationarity of ARMA process only AR part of the model need to be stationary as MA part by default is stationary.

INTEGRATED PROCESSES AND THE ARIMA MODELS

ARMA models can only be applied on a stationary time serie. If a series is not stationary then stationarity need to be induced into it by differencing it such that differenced time series ΔY_t is represented by:

$$\Delta Y_t = Y_t - Y_{t-1}$$ ---------- (6)

Generally time series need to be difference atleast once to make them stationary. After differencing once the series hence obtained is said to integrated to order one and denoted by I(1). Hence a series which needs to be differenced d times to make it stationary and then follows ARMA(p,q) model then the series is said to be following ARIMA(p,d,q) process.

METHODOLOGY

As discussed earlier FII have shown herding behavior in context of Indian markets and herd induces Moving Average structure as explained by ARIMA models. FII net monthly investment in the Indian Markets will be modeled as ARIMA process. Identification of the values of parameters p,d and q is done on basis of ACF and PACF analysis. Data analyzed in the study is monthly net FII investment in Crore Rupees from Jan-2000 till Nov-2011. Data from Jan 2000 till Dec 2010 is used to train the structural models while next twelve months data is used to test the accuracy of the model forecast. Table (1) describes the data used in the analysis. Total numbers of observations are 132, i.e net monthly investment of 132 months from Jan-2000 till Dec-2010 is taken into account.

First and foremost step before fitting the model is making the time series stationary. If time series is not stationary then it has to be transformed to make it stationary. Generally time series is differenced to make it stationary. Plots of ACF and LBQ test statistics will be used to check the stationarity of the model

Steps involved in ARIMA estimation includes identifying the model, estimating the parameters, checking model adequacy, and forecasting, if desired. Stationarity of the time series data is determined by observing the plots of ACF and using LBQ test statistics. A stationary series exhibits insignificant ACF over all lags LBQ test statistics is generally less than the critical value of 37.65 at 95% confidence interval. If times series is not stationary then it has to be differenced to make it stationary. Number of times the series has to be differentiated determines the value of parameter d in ARIMA (p,d,q). An auto regressive process with an order p will have its PACF zero at lag p + 1 while an moving average process with order q will have ACF value equal to zero at lag q + 1. Hence through the analysis of various charts and plots, the order of AR and MA process for the series would be determined. Finally after fitting the appropriate order ARIMA model the residuals will be analyzed for any serial correlation in them. Ideally the residuals should not be correlated with each other if the ARIMA (p,d,q) model has been successfully fitted on the give time series data.

OBSERVATION ANALYSIS

From Fig. (2) it can be seen that except for ACF of lags 2, 4 and 6 rest ACF values are within standard limits and series doesn't show any significant autocorrelation. However on differentiating the series the ACF goes negative on lag 2 which is an indication of over differencing. Table (2) shows the comparison of ACF and LBQ test statistics of FII and FII' (series obtained by taking first difference). LBQ test statistics should be lower than critical value of 37.65 at 95 percent confidence level for autocorrelation to not exist but as evident from table (2) LBQ test statistic for FII' are highly significant and are indicating over differencing of the time series. Hence the series is assumed to be stationary and exhibits autoregressive nature without differencing and the value of parameter d in the analysis is equal to 0.

From the figure (2) below its evident that there is no significant correlation in the time series and as far as order of moving average component q is considered, the ACF becomes 0 at the lag 6 which indicates the series might follow MA (5) process but due to computational constraints this consideration is ignored hence the value of parameter q is taken as 0. From figure (3) the plot of PACF it can be seen that its value becomes zero at lag 5 which means that series might be following AR(4) process. Hence initially the suitable model diagnosed according to time series data under consideration is ARIMA (4, 0, 0). To confirm the goodness of fit residuals will be analyzed and after this forecast for the year 2011 will be made. Table(3) and Table(4) represents fit related characteristics and contains parameters values. Parameter values obtained after fitting ARIMA (4,0,0) model over the data are stored in table (3). LBQ test statistics from table (4) indicates no significant auto correlation in the residuals for lag 48. Figure(4) shows the ACF of residuals obtained after fitting ARIMA(4,0,0) model to the monthly net FII investment data and depicts that ACF is not significant and residuals are mostly uncorrelated and random which shows the success of ARIMA (4,0,0) model in explaining variations in time series data. Table (5) below further depicts the comparison of forecast using ARIMA (4,0,0) model and actual observed flow along with 95% confidence interval upper and lower limits and it can be seen than actual results lie within the stipulated limits.

TABLE (1) DESCRIPTIVE STATISTICS OF FII INVESTMENT

Mean	SE Mean	StDev	Variance	Minimum	Q1	Median	Q3	Maximum
818	209	2529	6398311	-6482	-248	135	1189	11565

TABLE (2) ACF ANALYSIS OF FII AND FII'(FIRST DIFFERENCE OF FII)

	FII			FII'		
Lags	ACF	T-Statistic	LBQ	ACF	T-Statistic	LBQ
1	0.081461	0.93591	0.8960	-0.692540	-7.92649	64.279
2	0.428088	4.88604	25.8305	0.321145	2.62600	78.209
3	0.206672	2.02145	31.6873	-0.178859	-1.39113	82.563
4	0.283311	2.68905	42.7789	0.123189	0.94429	84.645
5	0.147627	1.33023	45.8142	-0.150502	-1.14589	87.777
6	0.272933	2.42701	56.2715	0.218293	1.64561	94.419
7	0.017598	0.14994	56.3154	-0.179417	-1.32543	98.942
8	0.077251	0.65808	57.1666	0.014377	0.10481	98.971
9	0.111752	0.94888	58.9625	0.060981	0.44453	99.502
10	0.022333	0.18835	59.0348	-0.118449	-0.86215	101.523
11	0.169008	1.42497	63.2104	0.241407	1.74724	109.984
12	-0.149657	-1.24284	66.5117	-0.216813	-1.53389	116.866

FIGURE (2) ACF OF NET FII INVESTMENT

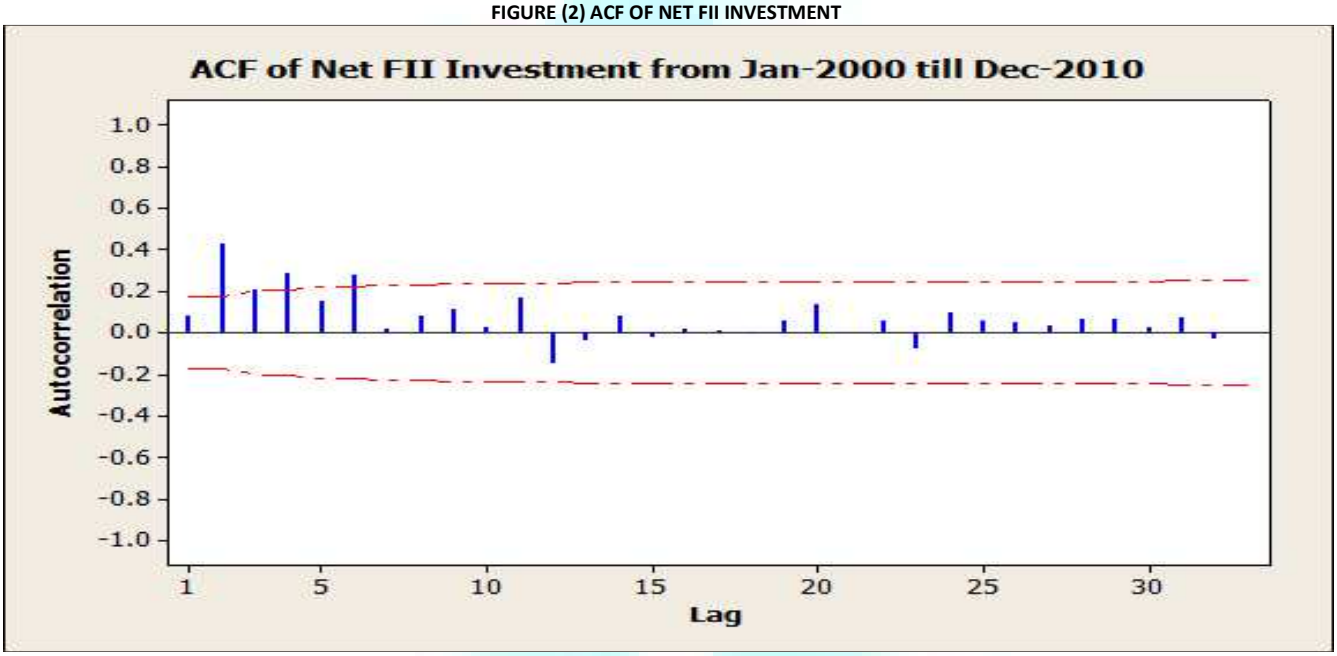


FIGURE (3) PACF OF NET FII INVESTMENT

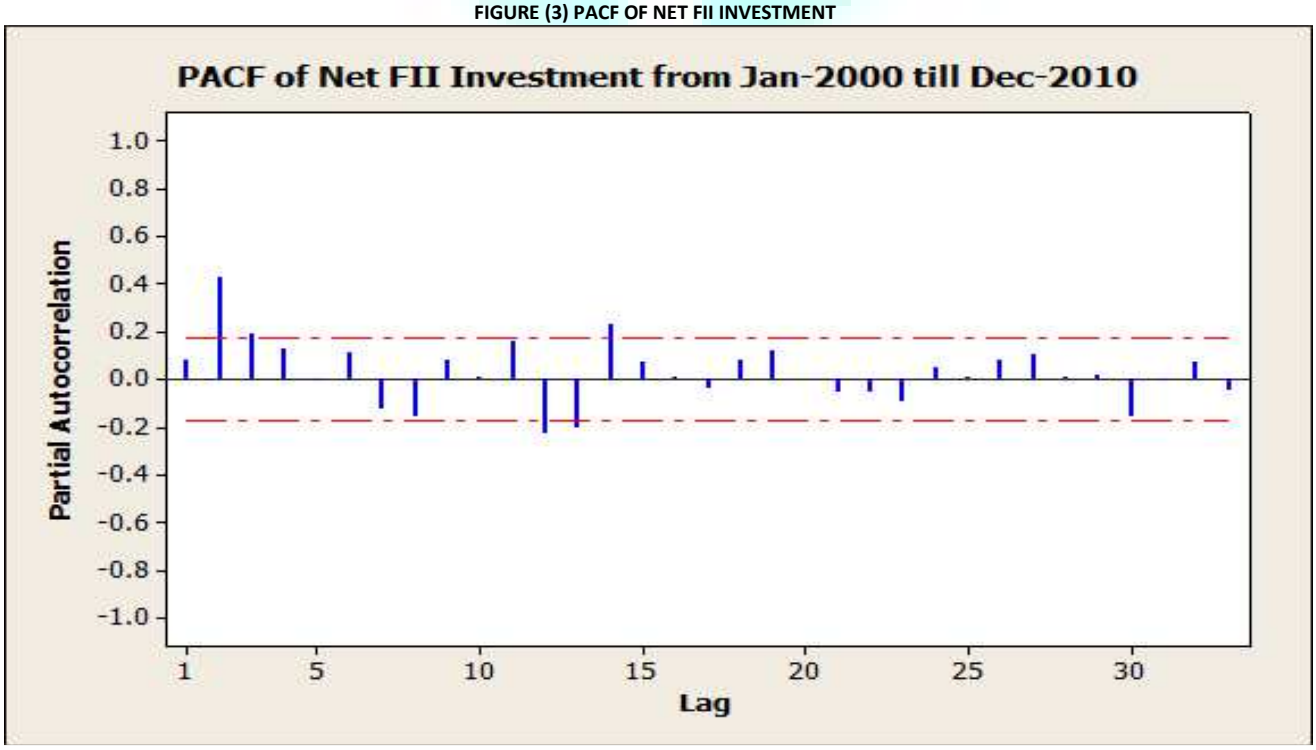


TABLE (3) FINAL ESTIMATES OF PARAMETERS

Type	Coefficient	SE Coef.	t-statistics	p-value
AR 1	-0.0523	0.0887	-0.59	0.557
AR 2	0.3670	0.0878	4.18	0.000
AR 3	0.1845	0.0907	2.04	0.044
AR 4	0.1346	0.0951	1.42	0.159
Constant	251.1	176.8	1.42	0.158

TABLE (4) MODIFIED BOX-PIERCE (LJUNG-BOX) CHI-SQUARE STATISTIC OF RESIDUALS

Lag	12	24	36	48
Chi-Square	24.9	47.5	55.6	58.5
DF	7	19	31	43
P-Value	0.001	0.000	0.004	0.057

FIGURE (4) ACF OF RESIDUALS

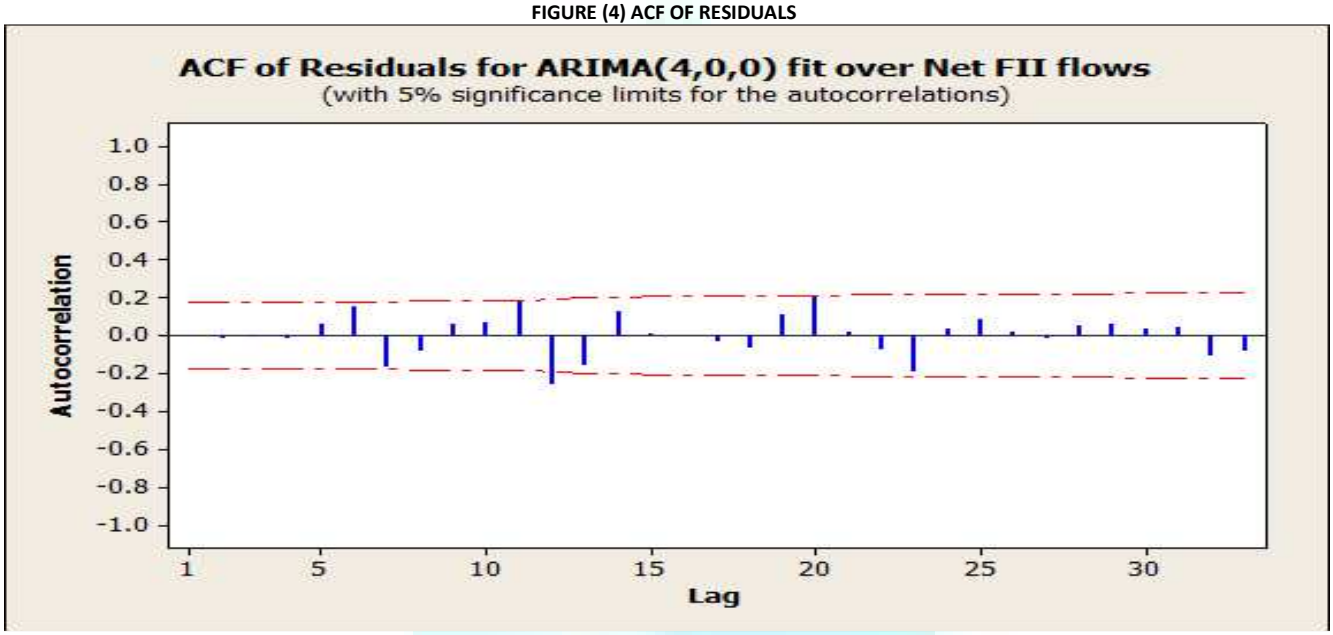


TABLE (5) COMPARISON OF ACTUAL AND FORECASTED NET FLOWS FOR YEAR 2011

Month	Actual	Lower Limit (95% CI)	Forecast	Upper Limit (95% CI)
Jan-11	11086.4	-2194.05	1782.43	5758.90
Feb-11	-1775.2	-2858.83	1123.07	5104.98
Mar-11	2302.1	-2440.79	1803.84	6048.46
Apr-11	-458.3	-3078.31	1205.85	5490.01
May-11	2648.1	-3103.50	1297.16	5697.82
Jun-11	1308.3	-3309.32	1109.83	5528.99
Jul-11	2664.7	-3332.74	1134.39	5601.53
Aug-11	2888.8	-3482.34	1000.75	5483.83
Sep-11	-1251.8	-3509.17	994.47	5498.11
Oct-11	1189.4	-3587.96	925.08	5438.11
Nov-11	971.5	-3617.96	905.04	5428.04

FIGURE (5) COMPARISON OF FORECAST AND OBSERVED RESULTS FOR 2011 AND 95% UPPER AND LOWER CONFIDENCE LIMITS

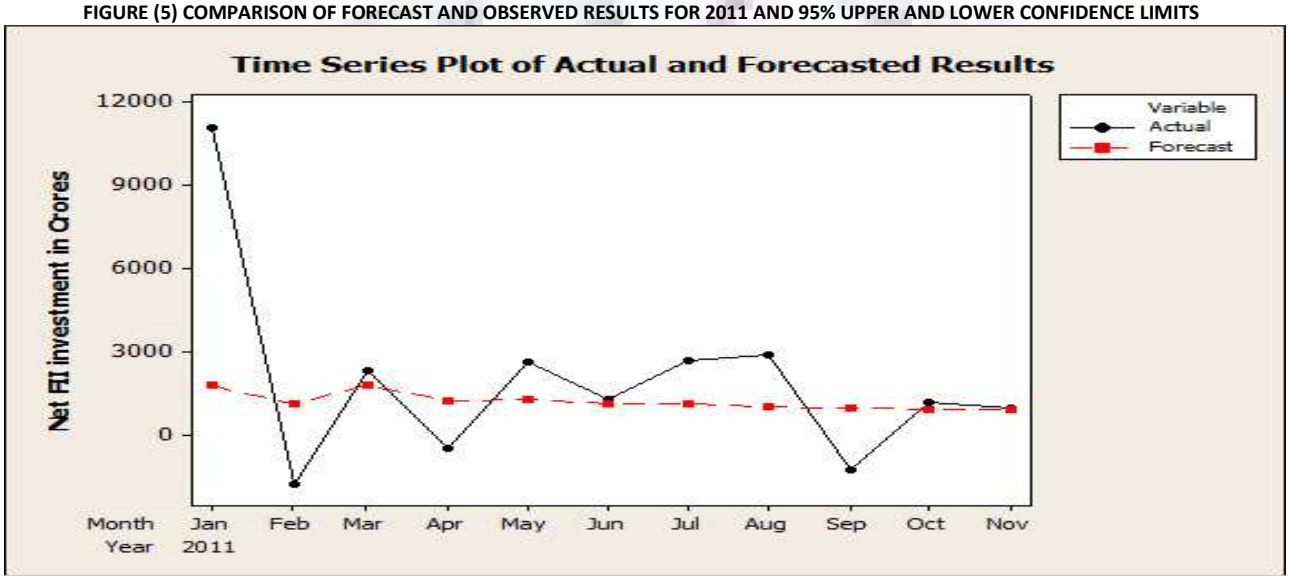
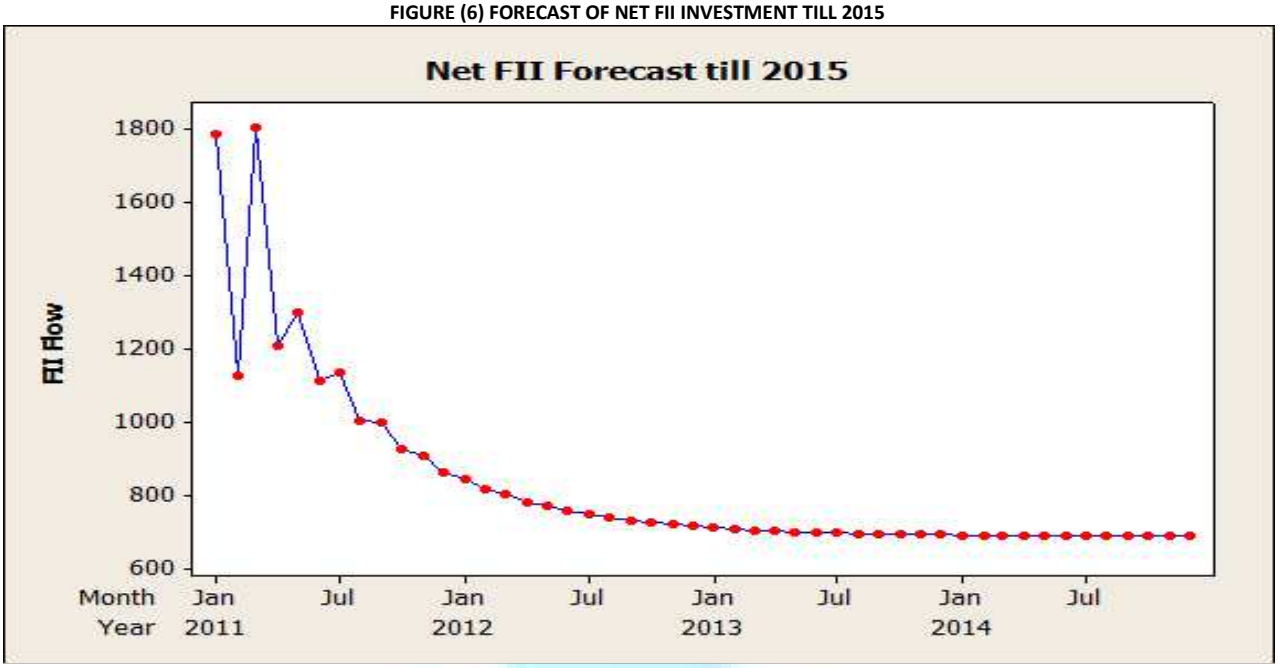


FIGURE (6) FORECAST OF NET FII INVESTMENT TILL 2015



CONCLUSION

After analyzing time series of monthly net flow of fii funds in Indian Market, it's observed that time series is stationary without differencing as evident from LBQ test statistics and first differencing leads to over differencing of series. ACF and PACF analysis shows ARIMA (4, 0, 0) process is followed by the time series. Residuals of the model fit showed no correlation which confirmed efficiency of these models in explaining the variability in time series. All month forecast for year 2011 strictly lies in the 95 % confidence interval upper and lower and model was successful in prediction. If forecast is extended then it's observed that FII investment is going through a decreasing phase and is indicative of the negative sentiments prevailing in the FII flow

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