An hybrid approach for forecasting the Net Asset Values of Indian Mutual Funds

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Abstract

In this paper, the advantages of the ARIMA models and the computational power of ANN models has been combined to give the time series prediction for the hybrid ANN-ARIMA model. The Net Asset Values of five of the Indian Mutual Funds were predicted using hybrid modeling after eliminating the redundant variables using PCA; their performances were evaluated using standard error estimate.

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1 Introduction

In many decision processes, the accuracy of the time series forecasting is of vital importance. To deal with the different characteristics of time series, a wide range of research has been undertaken in
fields of statistics, neural networks, fuzzy sets, wavelets, chaos theory etc. Due to the complexity of real problems, any single model is not able to give accurate forecasts. In such cases, hybrid models can be used to improve the forecasting performance. A number of hybrid models have been proposed using ANN-ARIMA, Fuzzy-ANN, Chaos ANN, wavelet analysis ANN and principal component analysis ANN[5]. Also it has been suggested that two or more computational models can be synergically combined to give a better approach for prediction problems [6].

Since there are hundreds of financial and macroeconomic variables available for analysis, the selection of input data is an important decision that can greatly affect the model performance. Also many of the variables may be redundant to the prediction of stock returns. To overcome this problem, Principal component analysis (PCA) which is a variable reduction procedure is used in data processing and dimensionality reduction.

2 Data for Analysis

The Net Asset Values of four of the top ten Indian Mutual Funds namely Sahara Mutual Fund-Growth option (equity), HDFC Mutual Fund - Top 200 (equity), ING Mutual Fund - Dividend Yield Growth option (equity), ICICI Mutual Fund - prudential Growth option (equity), Reliance Mutual Fund - Regular savings (equity) were modeled using ANN for a period of five years between 2010 and 2015 (Source: amfiindia).

Based on the literature review, regarding the data access restriction and on consultation with Chartered Financial Analyst, 13 macroeconomic and financial variables were selected as input variables for the Indian Mutual Funds.

3 Obtaining Relevant Variables using PCA

The collinearity statistics of the inputs clearly shows that the Variance Inflation Factor (VIF) for most of the inputs is greater than 5, indicating potential multi-collinearity problem. In order to iden-
tify relevant variables and redundant or irrelevant variables, PCA (Principal Component Analysis) technique is used. High value of KMO (0.804 > .05) indicates that a factor analysis is useful for the present data. The next step in the process is to decide about the number of factors to be derived. The rule of thumb is applied to choose the number of factors for which 'Eigen values' are greater than unity. The Component matrix so formed is further rotated orthogonally using Varimax algorithm which is the standard rotation method. Among the two factors identified, about 80% of the total variance was explained. The Scree plot obtained for the components best explains the prominence of the two factors. Using these two factors identified by PCA, the mutual funds are modeled using Artificial Neural Network [2,3].

In order to use components analysis technique, SPSS 17 software is used. Among the two factors identified, about 80% of the total variance was explained. The Scree plot obtained for the components best explains the prominence of the two factors. Using these two factors identified by PCA, the five mutual funds are modeled using Artificial Neural Network [4].

4 Hybrid Model of ANN and ARIMA (ANN-ARIMA)

The hybrid model consists of integrating ANN and ARIMA model in sequential manner. The procedure for developing the proposed hybrid model is as follows:

a Firstly, Non linear components \( \{Y_i, i = 1, 2, 3, \cdots \} \) are fitted using ANN to produce a series of forecast defined as \( \{E_i, i = 1, 2, 3, \cdots \} \). A series of linear components \( \{e_i\} \) is obtained by comparing the actual value \( \{Y_i, i = 1, 2, 3, \cdots \} \) and the forecasted value of the nonlinear components, \( \{E_i, i = 1, 2, 3, \cdots \} \). Hence \( e_i = Y_i - E_i \).

b Secondly, the generated linear series \( e_t \) are fitted using ARIMA. Before using ARIMA, normality tests are conducted on the series. A series of forecasts of linear components \( L_t \) is generated in this process. This step can be considered as a process of error generation of time series prediction.
Thirdly, integrating the above two components, the final forecast is obtained as $\hat{Y}_i = E_i + L_i$. The effectiveness of the hybrid model can be verified by comparing it with ARIMA and ANN modeling [1].

5 Error Estimates of the models

The current research attempted to study whether a hybrid model achieves better results than an individual model. Hybrid model was developed using techniques of ANN and ARIMA and comparison is also made between the conventional ARIMA, ANN and proposed hybrid approach using ANN, ARIMA based on the error estimate of Mean Absolute Percentage Error (MAPE).

Table 1: Estimate of the predicted NAV of Indian Mutual Fund

<table>
<thead>
<tr>
<th>Mutual Funds</th>
<th>ARIMA</th>
<th>ANN</th>
<th>ANN-ARIMA</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAHARA</td>
<td>5.1002</td>
<td>5.4087</td>
<td>3.2081</td>
</tr>
<tr>
<td>ICICI</td>
<td>4.3573</td>
<td>3.8451</td>
<td>3.367</td>
</tr>
<tr>
<td>ING</td>
<td>4.5328</td>
<td>4.3551</td>
<td>3.578</td>
</tr>
<tr>
<td>RELIANCE</td>
<td>5.7394</td>
<td>5.5396</td>
<td>4.9323</td>
</tr>
<tr>
<td>HDFC</td>
<td>4.4687</td>
<td>3.7374</td>
<td>1.8734</td>
</tr>
</tbody>
</table>

6 Conclusion:

From the models developed using the hybrid of ANN and ARIMA for the NAV of the five Mutual Funds namely SAHARA Mutual Fund, ICICI Mutual Fund, ING Mutual Fund, Reliance Mutual Fund and HDFC Mutual Fund, it has been observed that the hybrid predictions agree with the actual values reasonably well for all the five schemes. The maximum value of bias is 0.829 for ICICI otherwise it is small for the rest of the mutual fund. The plot of actual rates versus predicted rates indicates that the model fits the given data well. The scatter plots of predicted and actual values for the five mutual funds confirms this. Also it can be observed from the table that of all the mutual funds, the error estimate for HDFC is the least indicating that hybrid modeling gives fairly accurate predictions for this fund during that time period.
References


