# Forecasting Share Prices: A Good Practice Or A Waste of Time

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## INTRODUCTION

Today, financial markets are extremely volatile by nature and hence, the risk factor is an important concern for all the investors who want to invest their money in the stock market. Is there any measure or criteria to forecast the next day stock price? Does any model exist in the market which can forecast the next day stock price exactly? This study is carried out to generate a general, sector wise forecasting model for all the existing BSE 30 companies and examines their price variation pattern with respect to the BSE Index.

## OBJECTIVES OF THE RESEARCH

1. To build a general, sector wise forecasting model for all the BSE 30 companies including BSE Index.
2. To check the forecasting accuracy of the model.
3. To examine variation patterns of different companies with respect to BSE index in different time periods.

## DATA & SAMPLE

Data was collected from BSE database. Period of data collection is 1st January, 2008 to 12th January, 2009. The total sample size is of 259 continuous observations (Close Stock Prices).

## REVIEW OF LITERATURE

Nusrat Ahmad (2009) has studied about the Linkage between stock market and Manufacturing sector. Jadhav A.M. and Chakrapani V.C. (2009), Der-Ann Hsu, Miller R.B. and Wichern D.W. (1974) and Eugene F. Fam (1965) have studied the behavior of the Stock market prices. Yaffee R.A. and Monnie McGee (2000) have written a good book on "Introduction to Time series Analysis and Forecasting with Applications of SAS and SPSS".

## METHODOLOGY

To carry out statistical analysis, spread sheet and SPSS software have been used. To check the consistency of the model, the data set is divided into 7 different time periods like Yearly (01.Jan, 2008 to 15. Jan, 2009), Half Yearly HY1 (01.Jan, 2008 to 04. Jul, 2008), HY2 (07.Jul, 2008 to 15. Jan, 2009)) and Quarterly (Q4-08 (01.Jan, 2008 to 02. Apr, 2008), Q1-09 (03.Apr, 2008 to 04. Jul, 2008), Q2-09 (07.Jul, 2008 to 01. Oct, 2008), Q3-09 (03.Oct, 2008 to 15. Jan, 2009)).

To identify Index based companies (i.e. variation pattern of stock prices of different companies is similar to the variation pattern of the BSE Index), Factor Analysis is carried out on BSE 30 Companies with respect to the BSE Index. After this, companies are divided into three major groups. The group consistency of BSE 30 companies to remain in a same group is also studied with respect to different time periods.

To forecast the share price of BSE 30 companies and BSE Index, Auto Regressive Integrated Moving Average (here after it is referred as ARIMA) models are built. A common 7 days forecasting period is selected for all the companies. These models are compared for their forecasting accuracies. The model accuracies are measured with respect to $R^2$, RMSE, MAPE, and MAE.

## MODEL STATISTICS

## AUTOREGRESSIVE INTEGRATED MOVING AVERAGE (ARIMA)

In statistics, an **autoregressive integrated moving average (ARIMA)** model is a generalization of an

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autoregressive moving average or (ARMA) model. These models are fitted to time series data either to better understand the data or to predict future points in the series. The model is generally referred to as an ARIMA (*p*, *d*, *q*) model where *p*, *d*, and *q* are integers greater than or equal to zero and refer to the order of the autoregressive, integrated, and moving average parts of the model respectively.

## MODEL ACCURACY STATISTICS

## ROOT MEAN SQUARE ERROR (RMSE)

The square root of mean square error is a measure of how much a dependent series varies from its model-predicted level, expressed in the same units as the dependent series.

$$RMSE = \sqrt{ei^2/n} \tag{1.1}$$

## MEAN ABSOLUTE PERCENTAGE ERROR (MAPE)

Mean Absolute Percentage Error. A measure of how much a dependent series varies from its model-predicted level. It is independent of the units used and can, therefore, be used to compare series with different units.

$$MAPE = \frac{100}{n} \sum_{i=1}^{n} \left|\frac{ei}{Xi}\right| \tag{1.2}$$

## MEAN ABSOLUTE ERROR (MAE)

Measures how much the series varies from its model-predicted level.MAE is reported in the original series units.

$$MAE = \sum_{i=1}^{n} |ei|/n \tag{1.3}$$

## RESULTS AND DISCUSSION

**Table 1: Forecasting Models for Housing Sector**

| COMPANY | BSE | ACC | Jaiprakash | DLF |
|---|---|---|---|---|
| SECTOR | SENSEX | Housing | Housing | Housing |
| YEARLY DATA | ARIMA(0,1,0)(0,0,0) | ARIMA(0,1,0)(0,0,0) | ARIMA(0,1,1)(0,0,1) | ARIMA(0,1,0)(0,0,0) |
| HY1 | WINTER'S ADDITIVE | ARIMA(0,1,0)(1,0,1) | ARIMA(0,1,0)(1,0,0) | ARIMA(0,1,4)(0,0,0) |
| HY2 | SIMPLE | SIMPLE | SIMPLE SEASONAL | ARIMA(0,1,0)(0,0,0) |
| Q4-08 DATA | ARIMA(0,1,0)(0,0,0) | ARIMA(0,1,0)(0,0,0) | ARIMA(0,1,0)(1,0,0) | ARIMA(0,1,0)(1,0,0) |
| Q1-09 DATA | ARIMA(0,1,0)(0,1,1) | ARIMA(0,1,0)(0,0,0) | WINTER'S ADDITIVE | ARIMA(0,1,0)(0,0,0) |
| Q2-09 DATA | SIMPLE SEASONAL | ARIMA(0,1,0)(0,0,0) | SIMPLE SEASONAL | SIMPLE SEASONAL |
| Q3-09 DATA | ARIMA(0,1,0)(0,0,0) | SIMPLE | SIMPLE SEASONAL | ARIMA(0,1,0)(0,0,0) |

Table 1 shows different ARIMA models built by using data sets of different time intervals in housing sector related companies. In the share market, usually, it is believed that within one sector of companies, they have a similar kind of price variation pattern. By this, one can expect a common model to exist for a particular sector. From the above table 1, it is observed that it is hard to identify or develop a common model for this sector. Even for individual companies, Jaiprakash & DLF, the model is not remaining constant with respect to different time periods except ACC.

Forecasting model for ACC for Yearly and Quarterly remains constant i.e. ARIMA (0,1,0). It shows the consistency and predictability of ACC share price. Hence, it is suggested that one can invest with some future investment plan in ACC.

**Table 2: Identification of Index Based Companies (Housing Sector)**

**Table 2A: KMO and Bartlett's Test**

| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .950 |
|---|---|---|
| Bartlett's Test of Sphericity | Approx. Chi-Square | 18941.963 |
| | Df | 465 |
| | Sig. | .000 |

**Table 2B: Rotated Component Matrix (a)**

| | Component | | |
|---|---|---|---|
| | G1 | G2 | G3 |
| BSE_Close | **.803** | .539 | .192 |
| ACC_Close | **.900** | .261 | .114 |
| JP_Close | **.875** | .307 | .265 |
| DLF_Close | **.901** | .276 | .282 |

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

**Table 2C: Group Membership With Respect To The BSE Index (Housing Sector)**

| | BSE | ACC | Jaiprakash | DLF |
|---|---|---|---|---|
| | **SENSEX** | **Housing Related** | **Housing Related** | **Housing Related** |
| Yearly Data | G1 | G1 | G1 | G1 |
| HY1 | G1 | G1 | G1 | G1 |
| HY2 | G1 | **G2** | G1 | G1 |
| Q4-08 Data | G1 | **G2** | G1 | G1 |
| Q1-09 Data | G1 | G1 | G1 | G1 |
| Q2-09 Data | **G2** | G1 | **G2** | **G2** |
| Q3-09 Data | G1 | G1 | G1 | **G2** |

To identify Index based companies (i.e. variation pattern of stock prices of different companies is similar to the variation pattern of the BSE Index), Factor Analysis is carried out on BSE 30 Companies with respect to BSE Index. From the table 2B, it is observed that three groups exist in the market. It is also inferred from the table 2B that ACC, JP and DLF have the same price variation pattern with respect to BSE index, hence, they fall under the same group G1. Factor analysis is also carried out for the different time periods to study the changes in group membership with respect to change in time period. From the table 2C, it is observed that group membership does not remain same; it changes with different time periods.

**Table 3: A Measure of Forecasting Model Accuracy (Housing Sector):**

| TIME PERIOD | ERROR | ACC | Jaiprakash | DLF |
|---|---|---|---|---|
| | RMSE | 17.928 | 9.373 | 22.46 |
| | MAPE | **2.253*** | 4.499 | 3.701 |
| | MAE | 13.572 | 7.061 | 16.991 |
| **YEARLY DATA** | R SQUARE | 0.984 | 0.992 | 0.991 |
| | RMSE | 17.372 | 13.446 | 27.045 |
| | MAPE | **1.771*** | 3.893 | 2.925 |
| | MAE | 13.016 | 10.217 | 20.307 |
| **HY1** | R SQUARE | 0.973 | 0.975 | 0.981 |
| | RMSE | 16.999 | 6.679 | 18.249 |
| | MAPE | **2.539*** | 5.138 | 4.276 |
| | MAE | 12.983 | 5.325 | 14.362 |
| **HY2** | R SQUARE | 0.943 | 0.978 | 0.976 |
| | RMSE | 18.934 | 19.691 | 38.981 |
| | MAPE | **1.779*** | 4.969 | 3.769 |
| | MAE | 14.302 | 14.971 | 30.615 |
| **Q4-08 DATA** | R SQUARE | 0.942 | 0.95 | 0.949 |
| | RMSE | 10.927 | 7.557 | 15.826 |
| | MAPE | **1.281*** | 2.751 | 2.352 |
| | MAE | 8.523 | 5.867 | 12.696 |
| **Q1-09 DATA** | R SQUARE | 0.987 | 0.967 | 0.971 |
| | RMSE | 14.017 | 7.088 | 18.325 |
| | MAPE | **1.856*** | 3.575 | 3.076 |
| | MAE | 10.647 | 5.584 | 14.34 |
| **Q2-09 DATA** | R SQUARE | 0.823 | 0.879 | 0.878 |
| | RMSE | 19.512 | 6.176 | 17.41 |
| | MAPE | **3.212*** | 6.556 | 5.36 |
| | MAE | 15.24 | 4.946 | 13.798 |
| **Q3-09 DATA** | R SQUARE | 0.884 | 0.817 | 0.847 |

* Minimum Values

To check the model forecasting accuracy, the authors have calculated the RMSE, MAPE, MAE and R-square. Out of these model accuracies, the authors have selected MAPE as model performance criterion. MAPE provides an indication of how large the forecast errors are in comparison to actual values of the series. From the table 3, it is inferred that ACC has the lowest (2.253) MAPE. It is also found that with respect to different time slots, the MAPE for ACC remains the lowest in this sector. Jaiprakash has the highest (4.499) MAPE in this sector.

**Table 4: Forecasting Models For THE FMCG Sector**

| **COMPANY** | **BSE** | **ITC** | **HUL** |
|---|---|---|---|
| **SECTOR** | **SENSEX** | **FMCG** | **FMCG** |
| YEARLY DATA | ARIMA(0,1,0)(0,0,0) | ARIMA(1,1,1)(1,0,1) | SIMPLE |
| HY1 | WINTER'S ADDITIVE | ARIMA(0,1,0)(0,0,0) | ARIMA(0,1,0)(0,0,0) |
| HY2 | SIMPLE | SIMPLE SEASONAL | ARIMA(0,1,0)(0,0,0) |
| Q4-08 DATA | ARIMA(0,1,0)(0,0,0) | ARIMA(0,1,0)(0,0,0) | SIMPLE |
| Q1-09 DATA | ARIMA(0,1,0)(0,1,1) | WINTER'S ADDITIVE | ARIMA(0,1,0)(1,0,0) |
| Q2-09 DATA | SIMPLE SEASONAL | ARIMA(0,1,0)(0,0,0) | WINTER'S ADDITIVE |
| Q3-09 DATA | ARIMA(0,1,0)(0,0,0) | SIMPLE SEASONAL | SIMPLE SEASONAL |

From the table 4 it is observed that it is hard to identify or develop a common model for this sector. For the individual companies ITC & HUL, the model does not remain constant with respect to different time periods.

**Table 5: Identification of Index Based Companies (FMCG Sector)**

**Table 5A: KMO and Bartlett's Test**

| **Kaiser-Meyer-Olkin Measure of Sampling Adequacy.** | | **.950** |
|---|---|---|
| Bartlett's Test of Sphericity | Approx. Chi-Square | 18941.963 |
| | Df | 465 |
| | Sig. | .000 |

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

**Table 5B :Rotated Component Matrix(a)**

| | **Component** | | |
|---|---|---|---|
| | **G1** | **G2** | **G3** |
| BSE_Close | **.803** | .539 | .192 |
| ITC_Close | **0.652** | 0.626 | -0.157 |
| HUL_Close | -0.094 | 0.025 | **-0.931** |

**Table 5C: Group Membership With Respect To The BSE Index (FMCG Sector)**

| | **BSE** | **ITC** | **HUL** |
|---|---|---|---|
| | **SENSEX** | **FMCG** | **FMCG** |
| YEARLY Data | G1 | G1 | **G3** |
| HY1 | G1 | G2 | G3 |
| HY2 | **G1** | G2 | G2 |
| Q4-08 Data | G1 | G1 | **G2** |
| Q1-09 Data | G1 | G1 | G1 |
| Q2-09 Data | **G2** | G1 | G1 |
| Q3-09 Data | **G1** | G3 | G3 |

From the table 5B it is observed that three groups exist in the Market. It is also inferred from the table 5B that ITC has the same price variation pattern with respect to BSE index, hence, they fall under the same group G1, but HUL has no same price variation pattern with respect to BSE index. From the table 5C it is observed that group membership does not remain the same, it changes with different time periods.

**Table 6: A Measure of Forecasting Model Accuracy (FMCG Sector)**

| TIME PERIOD | ERROR | ITC | HUL |
|---|---|---|---|
| | RMSE | 4.717 | 5.714 |
| | MAPE | 1.895 | **1.879*** |
| | MAE | 3.585 | 4.311 |
| **YEARLY DATA** | R SQUARE | 0.936 | 0.872 |
| | RMSE | 5.169 | 5.469 |
| | MAPE | 1.99 | **1.927*** |
| | MAE | 4.048 | 4.305 |
| **HY1** | R SQUARE | 0.846 | 0.889 |
| | RMSE | 4.214 | 4.445 |
| | MAPE | 1.83 | **1.39*** |
| | MAE | 3.208 | 3.333 |
| **HY2** | R SQUARE | 0.867 | 0.862 |
| | RMSE | 5.555 | 6.686 |
| | MAPE | **2.191*** | 2.473 |
| | MAE | 4.409 | 5.326 |
| **Q4-08 DATA** | R SQUARE | 0.796 | 0.779 |
| | RMSE | 4.347 | 3.827 |
| | MAPE | 1.586 | **1.237*** |
| | MAE | 3.297 | 2.89 |
| **Q1-09 DATA** | R SQUARE | 0.892 | 0.923 |
| | RMSE | 3.817 | 3.431 |
| | MAPE | 1.523 | **1.446*** |
| | MAE | 2.797 | 2.721 |
| **Q2-09 DATA** | R SQUARE | 0.782 | 0.929 |
| | RMSE | 4.285 | 6.773 |
| | MAPE | **1.988*** | 2.128 |
| | MAE | 3.354 | 5.057 |
| **Q3-09 DATA** | R SQUARE | 0.709 | 0.653 |

* Minimum Values

From the table 6 it is inferred that HUL has the lowest (1.879) MAPE. It is also found that with respect to different time slots, the MAPE for HUL remains the lowest except in the last period i.e. Q3-09 in this sector.

From the table7 it is observed that it is hard to identify or develop a common model for this sector. Even for individual companies ONGC & RIL, the model does not remain constant with respect to different time periods.

From the table 8B it is observed that three groups exist in the market. It is also inferred from the table 8B that ONGC and RIL have the same price variation pattern with respect to BSE index, hence they fall under the same group G1. From the table 8C it is observed that group membership of ONGC remains the same with respect to different time periods.

From the table 9 it is inferred that ONGC has the lowest (2.262) MAPE. It is also found that with respect to different time slots, the MAPE for ONGC remains the lowest in this sector, except in the period HY1 & Q4-08.

**Table 7: Forecasting Models For Oil & Gas Sector**

| COMPANY | BSE | ONGC | RIL |
|---|---|---|---|
| **SECTOR** | **SENSEX** | **Oil & Gas** | **Oil & Gas** |
| YEARLY DATA | ARIMA(0,1,0)(0,0,0) | ARIMA(0,1,0)(1,0,1) | ARIMA(1,1,0)(0,0,0) |
| HY1 | WINTER'S ADDITIVE | ARIMA(0,1,3)(0,0,0) | ARIMA(0,1,4)(0,0,0) |
| HY2 | SIMPLE | ARIMA(0,1,0)(1,0,1) | SIMPLE SEASONAL |
| Q4-08 DATA | ARIMA(0,1,0)(0,0,0) | ARIMA(0,1,0)(0,0,0) | ARIMA(0,1,0)(0,0,0) |
| Q1-09 DATA | ARIMA(0,1,0)(0,1,1) | ARIMA(0,1,0)(0,0,1) | SIMPLE SEASONAL |
| Q2-09 DATA | SIMPLE SEASONAL | SIMPLE SEASONAL | SIMPLE SEASONAL |
| Q3-09 DATA | ARIMA(0,1,0)(0,0,0) | ARIMA(0,1,0)(0,0,0) | ARIMA(0,1,0)(0,0,0) |

**Table 8: Identification of Index Based Companies: (Oil & Gas Sector)**

**Table 8A: KMO and Bartlett's Test**

| **Kaiser-Meyer-Olkin Measure of Sampling Adequacy.** | | **.950** |
|---|---|---|
| Bartlett's Test of Sphericity | Approx. Chi-Square | 18941.963 |
| | Df | 465 |
| | Sig. | .000 |

**Table 8B: Rotated Component Matrix (a)**

| | Component | | |
|---|---|---|---|
| | G1 | G2 | G3 |
| BSE_Close | **.803** | .539 | .192 |
| ONGC_Close | **0.839** | 0.241 | -0.260 |
| RIL_Close | **0.747** | 0.625 | 0.090 |

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

**Table 8C: Group Membership With Respect To The BSE Index (Oil & Gas Sector)**

| | BSE | ONGC | RIL |
|---|---|---|---|
| | **SENSEX** | **Oil & Gas** | **Oil & Gas** |
| **YEARLY DATA** | G1 | G1 | G1 |
| **HY1** | G1 | G1 | G1 |
| **HY2** | G1 | G1 | G1 |
| **Q4-08 DATA** | G1 | G1 | G1 |
| **Q1-09 DATA** | G1 | G1 | G1 |
| **Q2-09 DATA** | G2 | G1 | G2 |
| **Q3-09 DATA** | G1 | G1 | G1 |

**Table 9: A Measure of Forecasting Model Accuracy (Oil & Gas Sector)**

| TIME PERIOD | ERROR | ONGC | RIL |
|---|---|---|---|
| | RMSE | 27.576 | 67.695 |
| | MAPE | **2.262*** | 2.849 |
| | MAE | 20.54 | 54.186 |
| **YEARLY DATA** | R SQUARE | 0.971 | 0.985 |
| | RMSE | 30.956 | 62.949 |
| | MAPE | 2.173 | **1.995*** |
| | MAE | 21.491 | 48.896 |
| **HY1** | R SQUARE | 0.934 | 0.937 |
| | RMSE | 24.114 | 63.192 |
| | MAPE | **2.217*** | 3.304 |
| | MAE | 18.961 | 50.589 |
| **HY2** | R SQUARE | 0.978 | 0.98 |
| **Q4-08 DATA** | RMSE | 34.656 | 73.684 |
| | MAPE | 2.527 | **2.254*** |

| | | | |
|---|---|---|---|
| | MAE | 26.519 | 56.711 |
| **Q4-08 DATA** | R SQUARE | 0.918 | 0.934 |
| **Q1-09 DATA** | RMSE | 16.849 | 52.441 |
| | MAPE | **1.379*** | 1.719 |
| | MAE | 12.609 | 40.918 |
| | R SQUARE | 0.961 | 0.928 |
| **Q2-09 DATA** | RMSE | 24.63 | 54.049 |
| | MAPE | **1.872*** | 2.09 |
| | MAE | 18.895 | 43.845 |
| | R SQUARE | 0.877 | 0.814 |
| **Q3-09 DATA** | RMSE | 23.316 | 66.876 |
| | MAPE | **2.523*** | 3.849 |
| | MAE | 18.489 | 50.306 |
| | R SQUARE | 0.94 | 0.874 |

* Minimum Values

## FINDINGS

The findings of the study are as follows:

1. In the Housing sector, forecasting model for ACC is performing well. It is also found that the model is consistent across the different time periods.
2. No consistent model could be developed in the FMCG and Oil & Gas sector.
3. HUL and ONGC have good model accuracy (MAPE) in FMCG and Oil & Gas sectors respectively.
4. It is easy to build an individual model with good accuracy, but it is very hard to develop a sector wise common model.

## CONCLUSION

From this study, it is concluded that it is very difficult to develop a common model for a particular sector, which can be applied to any company that exists in this sector. Through this study, the researchers have demonstrated that the accuracy of the forecasting model is largely affected by selection of time period and length. Researchers who are working in this area (forecasting) should focus on "sufficient length and appropriate time period of forecasting model such that their MAPE will be minimum".

## FUTURE RESEARCH

One possible solution of the above discussion would be partitioning the data base and developing a part wise model and then selecting the model which has minimum forecasting error.

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