

# Revising and Refining Equity Valuation Models for Sensex Stocks in Indian Stock Market – An Empirical Analysis using Machine Learning Approach

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## ABSTRACT

Valuation models used in the stock market is prone to valuation errors. The focus of this paper is to improve accuracy of equity valuations to earn reasonable return using three different equity valuation models. It investigates the significance of three equity valuation models such as Price to Earnings Model, Price to Book Value Model and CAPM based on the valuation precision of Sensex stocks; then revises these three equity valuation models; and refines the same by using machine learning approach to improve their valuation accuracy. A sample of 30 companies that were included in the BSE sensitive index (Sensex) was selected for the study. Valuation accuracy of Sensex stocks were improved by revising and refining the Price to Earnings Model, Price to Book Value Model and CAPM using the machine learning Approach. It was found that all these Models after revision and refinement avoids unprofitable investments of investors and managers in Indian stock market

## Keywords

Sensex Stocks, Equity Valuation Models, Machine Introduction

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## Introduction

Valuation of stock is important for Investors in stock market to make profit. It can be stated that research on valuation models have shown progress over last decade. Valuation experts stated that value of stock has a strong relationship between markets dynamics, economic behavior, bookkeeping standards [1]. There are different equity models used for estimating the intrinsic value of stocks. Theoretically, all the models are mathematically equivalent. [2] studied and its results proved that dividend discount model and abnormal earnings model provide better accuracy than the free cash flow approach. The valuation models gives different Intrinsic Values for a firm due to various reasons like valuation errors in the models' input parameters and differences in investor expectations about market. Root Mean Squared Error (RMSE) is one of the tool used for measuring the valuation accuracy of Sensex stocks for three models used for the study.

Valuation of Sensex stocks is very difficult which has diversity of stocks from different sectors. Different studies on valuation models in different countries given the results. [3] found that

the Price to Cash Flow (P/CF) multiple was the superior among the seven multiples tested to the sample of BSE. For the comparable firms when Return on Equity (ROE) multiples was used as the selection method, the Price to Earnings (P/E), Price to Book Value (P/B), Price to Cash Flow (P/CF) and Price to Total Assets (P/TA) it assured the highest accuracies and Price to Sales (P/S) multiple hints to the least accuracy. [6] constructed a simple strategy based on relative valuation models and found that the resulting abnormal return is statistically significant but not easily explained by transaction costs. Ohlson (1995) found that his model undervalues low book-to-market stocks and the valuation error is so high.

[43] used Capital Asset Pricing Model (CAPM) in the Iran economy found a adverse association between two variables in the currency market and the stock market respectively. They were regular risk and expected return in the currency market, and risk and expected return in the stock market. Moreover there existed a progressive relationship between two variables in the real estate market. [28] found that past earnings were relevant for valuation when earnings have transitory component. Book value

provided significant incremental explanatory power while current and past earnings provided only marginal explanatory power for loss firms. [29] conducted a study for estimating the value of non-publicly traded firms, to expand the list of valuation metrics. The results also helped to identify a wide range of explanatory financial variables to determine the firm value for all non-publicly traded firms. [30] found a significant positive relation between stock prices and stable ownership of firms. [31] found that fundamental models had more concern in explaining the price movements of the overall market. It was also suggested that algorithmic valuation techniques can be taken as starting point for firm valuation that can incorporate non dividend information like earnings or sales figures into fundamental valuation of firms.

[34] studied the importance of PE Ratio in relative valuation and showed that relative P/E ratio valuation could not justify the variances in the expected book return or growth of owners' equity. [35] found that value of the company was determined using the combination of comparable company, comparable transaction and discounted cash-flow methods. [36] presented for the first time on the stock exchange market the methodology of valuing equity of a non-listed company to establish the stock price. The multiple selected was the average of three values of arithmetical mean, median and harmonic mean of price earnings ratio which illustrated the best choice for determining the value of stocks. [8] focused on the estimation of the value of companies in Bulgaria and the risks associated using the relative valuation. This study found that during the period prior to the financial crisis, the average levels of the actual price to earnings and price to book value ratios were considerably higher than the levels suggested by fundamentals in the Bulgarian capital market. [9] indicated that one year earnings were highly volatile and probably mean reverting in Shiller price earnings model. It was found the during the period of high earnings, the one year low P/E stocks were very cheap and in the period of low earnings, high P/E stocks were expensive. [11] found that stock returns gradually got separated from earnings to the point that the earnings yield are no longer workable for predicting future equity returns.

[15] studied the association between beta and cross sectional portfolio returns for the risk in holding high beta stocks. It was found that a reliable and important bond between beta and returns for the entire sample, for sub-sample periods, and for monthly data. [16] addressed the validity of the Capital Asset Pricing Model and proved that firm particular factors explained stock returns in Istanbul Stock Exchange. It was also found that book to market and firm size explained stock returns. Market beta had no explanatory power in the model. It also suggested that additional variables like leverage and cash flow price ratio can be included in the analysis. [17] explained the behavior of common stock returns and found that momentum strategies did not represent a real opportunity for investors to earn abnormal returns in the stock market. [18] discussed how stock market returns are determined in a rational expectations model if stock market returns are predictable in nature. Study proved that Inter Temporal Capital Asset Pricing Model (ICAPM) appeared to explain the dynamic of stock market returns better than the CAPM. [19] studied the uses and features of CAPM, ICAPM in detail and found that ownership of assets by diversified investors lowered their expected returns and raises their prices of stock under CAPM.

[20] proved that version of the Capital Asset Pricing Model developed by Sharpe (1964) and Lintner (1965) was never been an empirical success due to some problems. It was found that CAPM was not valid in measuring the performance of mutual funds and other managed portfolios. [21] summarized that most practitioners favored one factor model for estimating expected return of an individual stock and for estimation of portfolio returns; and academics recommended the Fama and French three factor model for the estimation of portfolio returns. [22] empirically tested the quantitative models and proved the usefulness of these models in real world applications in the stock market. [23] examined the non-linearity of the relationship between return and beta. It was found that expected return-beta relationship was linear in nature. [24] predicted future stock returns based on public information. It was found that realized returns were positive when adjusted by the momentum factors as well as by the size, book-to-

market, and past return characteristics. [25] examined a new version of capital assets pricing model which is called Revised Capital Assets Pricing Model (RCAPM) in Tehran Stock Exchange by way of combining CAPM with leverages like financial, operational and economic leverages. It found that Revised CAPM can be used for predicting expected return very accurately in Iran Stock Exchange.

[26] investigated the Arbitrage Pricing Theory (APT) performance in London Stock Exchange for the period of 1980-1993 and developed seven pre-specified macroeconomic variables. It was found that macroeconomic factors had significant effect in the UK stock exchange market and each factor may affect different industry in different manner. [37] found that higher beta did not yields higher return while the slope of the security market line is negative. [38] found some problems associated with the concept of beta and its estimation and advocate for the use of elasticity as an alternative to beta. It was found that some securities that are more sensitive when the market index was at peak level and less sensitive when the market index was at the moderate level. [39] examined the applicability of CAPM in explaining the risk-return relation in the Malaysian stock market for the period of January 1995 to December 2006 and discovered that time varying beta provided better explanatory power. [40] compared the work of Fama and French (1996, 2006) with the performance of CAPM and showed that the three factor model worked well for the United Kingdom Market. So based on all these studies, it was found that Price to Earnings Model, Price to Book Value Model and CAPM can be used as the valuation models to value the sensex stocks in Indian stock market.

Using big data approach on the valuation models to value the stocks is very rarely seen being used for financial Analysis. As Stock Market is suitable for making profit to investors, it is important to know the buy and sell tips of different Sensex stocks using various techniques. There are different techniques used for giving suggestions to the investors on buy and sell actions of stocks. There exists errors in predicting the share price and the buy/sell tips provided by brokers or soft wares to the investors. There is a

need to know the techniques that gives the same suggestions/results refine them to reduce the errors and give accurate suggestions on buy/sell actions.

[49] study shows that Deep Learning & Big Data has strong impact on the Forecast of the stock prices. [50] shows that Big Data has strong impact on the Financial Sectors. Given importance to information stored in diverse sources of semi-structured and unstructured data that can be harvested for text mining of financial sector. [52] evaluated the stock price predictability of SVM, which is a kind of fundamental analysis that predicts the stock price from corporate intrinsic value. [51] present the leading fundamental analysis and stock valuation techniques used by daily equity traders in the selection of stocks in actively traded equity portfolios. [53] are built one for daily prediction and the other one is for monthly prediction. Supervised machine learning algorithms are also used to build the models. This paper focused on refining three revised valuation models using multiple regression machine learning approach or model to improve the valuation accuracy for Sensex stocks in India.

## II. Research Methodology

### Objectives of the study

- 1) To empirically test and measure the valuation accuracy of Price to Earnings Model, Price to Book Value Model, CAPM for Sensex stocks in India.
- 2) To revise and refine the Price to Earnings Model, Price to Book Value Model & CAPM using Machine Learning approach for improving the valuation accuracy

### Sources of data

Secondary data is used for this study. Secondary sources include data collected from databases like Centre for Monitoring Indian Economy (CMIE), Official websites of National Stock Exchange (NSE) and Bombay Stock Exchange (BSE), Business Beacon and annual report library services like EBSCO Services. A number of research papers, working papers and financial dailies are also referred for this purpose. Total of 30 stocks, constituting BSE's SENSEX, are

selected for the study. Data was taken for 10 years from 2008-09 to 2017-18.

### Tools used for the study

Root Mean Squared Error (RMSE) between the target bank's calculated intrinsic values with actual market price is used as a measure for calculating the valuation accuracy

#### a) Root Mean Squared Errors

Root Mean Squared error is measures the size of deviation of the intrinsic value (Predicted value) from the actual stock price, regardless of the intrinsic price is lower or higher than the actual price. A low percentage error is regarded as high valuation accuracy, while high percentage error indicates low accuracy. The formula used in determining the valuation accuracy is given below.

$$RMSE = \sqrt{\frac{1}{N} \sum_{i=1}^N (Predicted_i - Actual_i)^2}$$

#### b) Paired 't' test

Paired 't' test is used for comparing the valuation accuracy of *PEPBCAPM* models with that of Refined *PEPBCAPM* Models using Machine Learning Approach.

### Methodology of the Study

The study has followed a systematic procedure to identify, select, revise and refine the equity valuation models for improving the valuation accuracy of bank stocks as detailed below:

- Identifying three equity valuation models- Price to Earnings (Price to Earnings Model), Price to Book Value (P/B) Model and Capital Asset Pricing Model (CAPM) for Sensex stocks in the Indian context.
- Measuring the accuracy of three equity valuation models using Root Mean Squared Errors (RMSE)
- Revising the *PE Model*, *PB* model and *CAPM* by substituting the variables.
- Refining the revised *PE Model*, revised *PB Model* & revised *CAPM* using Machine learning approach.

### Variables in the Study

Table 1.1 shows the variables used in the models

Table 1.1. Variables used in the Models			
Earnings per share (EPS)	EPS Growth	Beta	
Dividend payout ratio (DPR)	Risk Factor (RF)	Market returns (RM)	
Book Value (BV)	Book value per share (BVPS)	Repo	

### Hypothesis of the Study

- Hypothesis to find the difference in the valuation accuracy between PEPBCAPM Models and Refined PEPBCAPM Models using Machine Learning Approach for Sensex Stocks in India.**

**H01: There is no significant difference in valuation accuracy of PEPBCAPM Models and that of Refined PEPBCAPM Models.**

H01a: There is no significant difference in valuation accuracy of Price to Earnings Model and that of Refined Price to Earnings Model using Machine Learning Approach.

H01b: There is no significant difference in valuation accuracy of Price to Book value Model and that of Refined Price to Book value Model using Machine Learning Approach.

H01c: There is no significant difference in valuation accuracy of CAPM and that of Refined CAPM using Machine Learning Approach.

### III.Theoretical Overview & Approach to the study

Valuations of Sensex Stocks are important in Indian Stock Market. There are different equity valuation models such as Relative valuation models, Risk based Models etc. are dominant in the Stock Market used for estimating the intrinsic value of stocks. However, due to the difference in the models' input and expectations & sentiments of market, valuation models may produce different intrinsic values for shares. So investors are testing the valuation accuracy to choose the best models for Sensex stocks in Indian stock market. As a first step, this study tested the



accuracy of three relevant equity valuation models such as Price to Earnings Model, Price to Book Value Model and CAPM for Sensex Stocks in Indian Stock Market. RMSE is used for measuring the valuation accuracy of Sensex stocks.

**Price to Earnings Model:** P/E coefficient is a function of company's beta, growth rate, and payout ratio. Different studies conducted by researchers to know whether high P/E coefficient is better than a lower one or not. Most of the studies indicate that lower P/E coefficient of stock done better than the higher ones. For example, according to Basu's (1977), Dreman (1998), Lakoishok et al (1994) the lower P/E coefficient stock will result positive and the higher P/E coefficient stock will result in abnormal negative return. Intrinsic value estimation using Price to Earnings Model is given below.

Price to Earnings Model (Price to Earnings Model)

Predicted P/E =  $\alpha + \beta_1 \text{BETA} + \beta_2 \text{GROWTH} + \beta_3 \text{DPR}$

Intrinsic value = Predicted PE x EPS

**Price to Book Value Model:** Aswath Damodaran (1994) introduced P/B coefficient as a function of Return on equity, Dividend Payout Ratio, EPS growth rate and company's beta. Patricia Fairfield (2010) found that price to book value is positively correlated with future return on book value and price to earnings is positively correlated with growth in earnings. [6] constructed a simple strategy based on relative valuation models and found that the resulting abnormal return is statistically significant. Intrinsic value estimation using Price to Book Value Model is given below.

Price to Book Value Model (Price to Book Value Model)

Predicted P/B =  $\alpha + \beta_1 \text{BETA} + \beta_2 \text{GROWTH} + \beta_3 \text{ROE} + \beta_4 \text{DPR}$

Intrinsic value = Predicted PB x BVPS

**Capital Asset Pricing Model (CAPM):** Capital asset pricing model takes into account sensitivity of stock with market by beta, expected return of the market and return of risk free security. CAPM is used to calculate the expected return and intrinsic value of a stock. [23] found that the

correlation between expected return and beta is linear in nature.

Capital Asset Pricing Model (CAPM)

Expected Return =  $R_f + \text{Beta} (R_m - R_f)$

Intrinsic Value = Last year market price \* Expected Return

### Revising and Refining Equity Models – Machine Learning Approach

Revised PE Model, Revised PB Model, Revised CAPM are trained through machine learning multiple regression models for the refinement purpose.

#### 1. Revising the Equity Models

Price to Earnings Model, Price to Book Value Model & CAPM are revised by substituting the variables and refined it through machine learning multiple regression models to bring valuation accuracy for Sensex stocks in Indian stock market. Revised models are given below.

#### a) Revised Price to Earnings Model

Predicted P/E =  $\beta_0 + \beta_1 \text{EPS} + \beta_2 \text{Repo} + \beta_3 \text{DPR} + \epsilon_i$

Intrinsic value = Predicted PE \* EPS.

(Note: Beta is replaced by Repo)

#### b) Revised Price to Book Value Model

Predicted P/B =  $\beta_0 + \beta_1 \text{EPS} + \beta_2 \text{Repo} + \beta_3 \text{ROE} + \beta_4 \text{DPR} + \epsilon_i$

Intrinsic value = Predicted PB \* BVPS

(Note: Beta is replaced by Repo)

#### c) Revised CAPM

Expected Return =  $R_f + \text{Repo} (R_m - R_f)$

Intrinsic Value = Last year market price \* Expected Return

(Note: Beta is replaced by Repo)

**Table 1.2 Relationship of the variables in three equity valuation models**

Name of Model	PE	PB	CAPM
Dependent Variable	MP	MP	MP
ROE		√	
DPR	√	√	
BETA	√	√	√
EPS GROWTH	√	√	
BVPS		√	
Rf			√
Rm			√
EPS	√		

Symbol  $\sqrt{\phantom{x}}$  means a relation between the independent and dependent variable as used in the actual model

## 2. Refining the Revised Equity Models

Refinement of the models has been done by the following steps.

- I. For refined Price to Earnings Model, input data such as repo rate, EPS Growth rate, dividend payout ratio and EPS from Revised Price to Earnings Model are used as inputs to the system and Market Price as output to predict the stock prices through Machine Learning approach.
- II. For refined Price to Book Value Model, fundamental and market variables such as repo rate, EPS Growth rate, Dividend payout ratio, ROE and BVPS from Revised Price to Book Value Model are used as inputs to the system and Market Price as output to predict the stock prices through Machine Learning approach.
- III. For refined Price to Book Value Model, fundamental and market variables such as repo rate, EPS Growth rate, Dividend payout ratio, ROE and BVPS from Revised Price to Book Value Model are used as inputs to the system to predict the stock prices through Machine Learning approach.

### Analysis

#### Valuation Accuracy Comparison of BASE Models (Price to Earnings Model, Price to Book Value Model and CAPM)

The empirical results of equity valuation for Sensex stocks are based on the following models a) Price to Earnings Model b) Price to Book Value Model c) CAPM which captures value relevance of fundamental accounting factors included in the models. Based on the Root Mean Squared Errors (RMSE), Performance and ranking of Models are given below. The results of the empirical analysis indicate that the Price to Earnings Model and Price to Book Value Model provide more accurate results when compared to CAPM for Sensex stocks in the Indian stock Market.

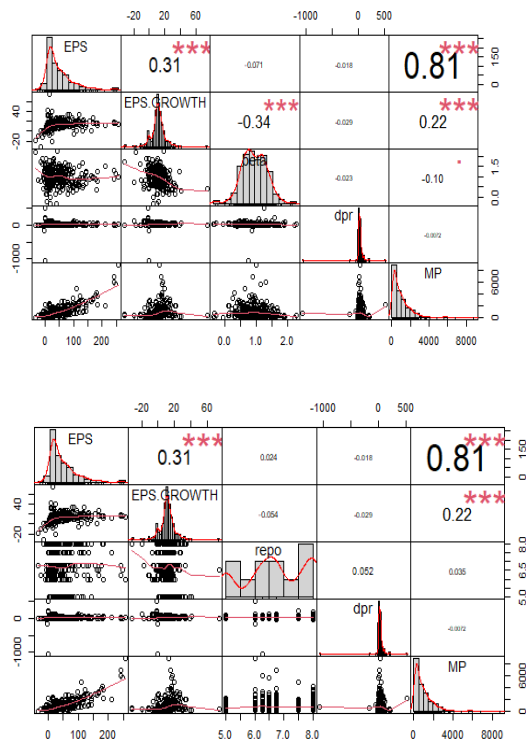
**Table 1.3. Ranking of Models based on RMSE**

Equity Model	RMSE	Rank
Price to Book Value Model	6.48	1
Price to Earnings Model	6.65	2
CAPM	11.58	3
<i>Note: Results computed using R 4.0.2</i>		

### Revising & Refining Equity Models

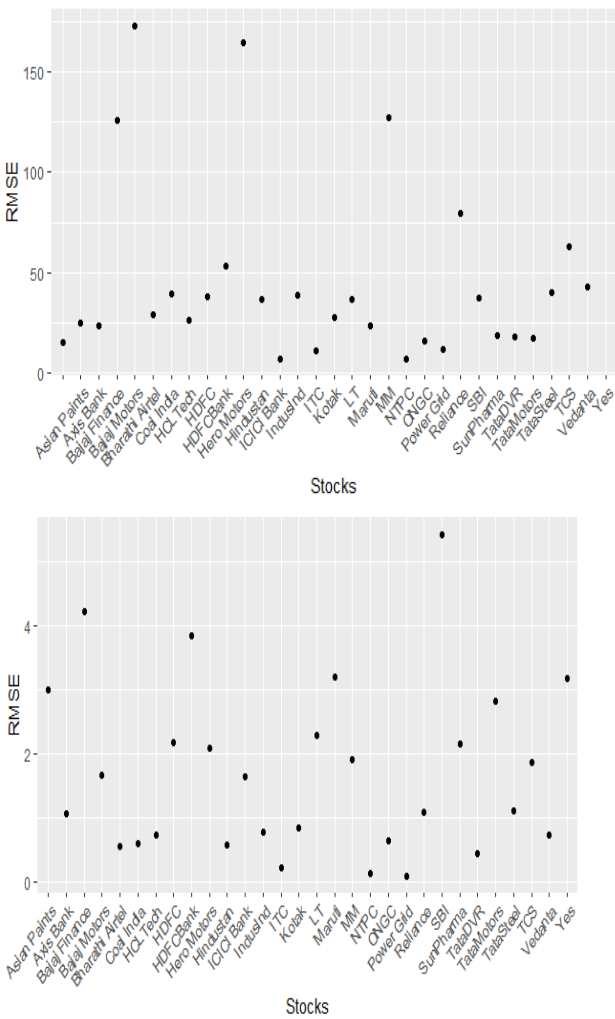
The study used machine learning multiple regression approach for revising & refining the Price to Earnings Model, Price to Book Value Model & CAPM with appropriate training. Root Mean Squared Errors (RMSE) obtained for training session of the models were recorded through refinement. In this study, three refined models are used for the empirical investigation. The inputs to the refined models contained fundamental and market based variables.

**Refined Price Earnings Model** – For refined Price to Earnings Model, input data such as repo rate, EPS Growth rate, dividend payout ratio and EPS from Revised Price to Earnings Model are used as inputs to the system to predict the stock prices through machine learning approach. Beta was replaced by repo rate in the Price to Earnings Model and model has been revised and refined respectively. Relationship & Significance of Variables in the Price to Earnings Model & Refined PE Model are given below.



**Figure 1.1 Significance of Variables in Price to Earnings Model and Refined Price to Earnings Model**

Figure 1.1 shows the correlation and significance of variables for both models. Based on the evaluation of the data that are available in both of the models given above, there is a significant relationship between the EPS, EPS Growth with Market Price in Price to Earnings Model and Refined Price to Earnings Model. The earnings per share and EPS growth rate is positively and significantly correlated to market price. This correlation supports that EPS has more value relevance in explaining the stock price movement. Dividend pay-out ratio is not significantly correlated with stock price in the model. Beta is negatively and significantly correlated to market price in Price to Earnings Model. But the Repo rate is positively correlated to Market Price in the Refined Price to Earnings Model. So the variable beta is replaced by the Repo rate in Price to Earnings Model(Revised Model).The revised model was then refined through machine learning ,multiple regression algorithm, to improve the valuation accuracy. So the results and comparison of the Price to Earnings Model and Refined Price to Earnings Model are given below in Figure 1.2.



**Figure 1.2 Valuation Accuracy Comparison for Price to Earnings Model and Refined Price to Earnings Model**

Figure 1.2 shows the valuation accuracy comparison of Price to Earnings Model and Refined Price to Earnings Model. This shows the importance of Machine learning multiple regression approach in improving the valuation accuracy for Sensex stocks in Indian Stock Market.

Refined Price to Book value Model - For refined Price to Book Value Model, fundamental and market variables such as repo rate, EPS Growth rate, dividend payout ratio, ROE and BVPS from Revised Price to Book Value Model are used as inputs to the system to predict the stock prices through Machine Learning regression Approach. Beta was replaced by repo rate in the Price to Book Value Model and model has been revised

and refined respectively. Relationship & Significance of Variables in the Price to Book Value Model & Refined Price to Book Value Model are given below.

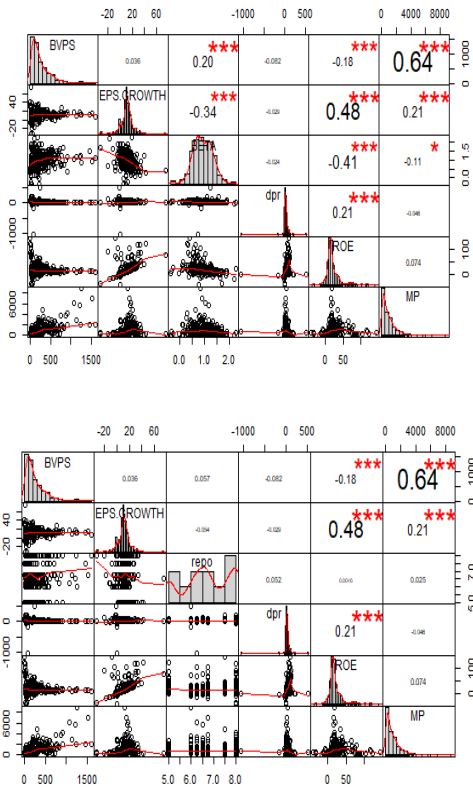


Figure 1.3. Significance of Variables in Price to Book Value Model and Refined Price to Book Value Model

Book value per share is positively and significantly correlated to market price of bank stocks in BSE Bankex. This correlation indicates that BVPS have more significance in explaining the stock prices. EPS growth rate is also positively correlated with stock prices in Sensex.

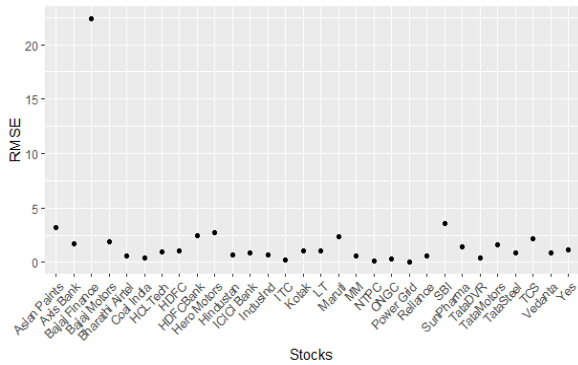
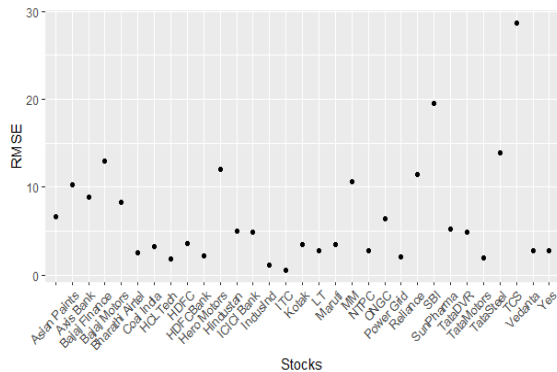
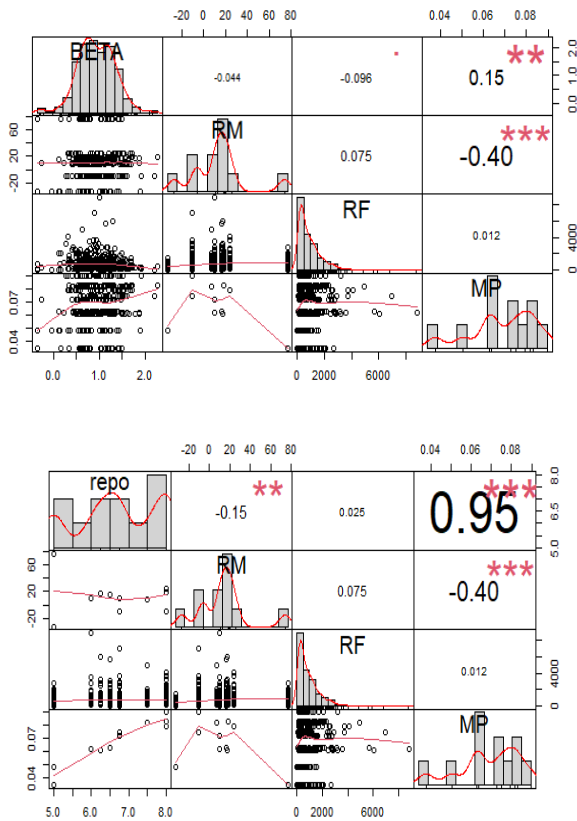


Figure 1.4 Valuation Accuracy Comparison for Price to Book Value Model and Refined Price to Book Value Model

Figure 1.4 shows the valuation accuracy comparison of Price to Book Value Model and Refined Price to Book Value Model. This shows the importance of Machine learning multiple regression approach in improving the valuation accuracy for Sensex stocks in Indian Stock Market.

**Refined CAPM**– For refined CAPM, input data such as repo rate,  $R_m$ ,  $R_f$  from Revised CAPM are used as inputs to the system to predict the stock prices through machine learning approach. Beta was replaced by repo rate in the CAPM and Model has been revised and refined respectively. Relationship & Significance of Variables in the CAPM & Refined CAPM are given below.





**Figure 1.5 Significance of Variables in CAPM and Refined CAPM**

**Table 1.4 Paired *t*- test between Base Models and Refined Models using Machine Learning Approach**

Tests	Dr	t-Stat	P value	Conclusion
H01a= PE with Refined PE	161	1.235	.034	Refined PE >PE
H01b= PB with Refined PB	161	2.124	.013	Refined PB>PB
H01c= CAPM with Refined CAPM	161	2.245	.002	Refined CAPM>CAPM

*Note: Results computed using R 4.0.2*

Table 1.4 shows the 't' test results for comparing the valuation accuracy between Base models and Refined Models. As the p value is less than 0.05, the null hypothesis,  $H_{01a}$  is rejected. Thus, there is significant difference between the valuation accuracy of Price to Earnings model and Refined Price to Earnings Model using Machine Learning. As per 't' statistics, the valuation accuracy of Refined Price to Earnings Model is higher than Price to Earnings Model. As the p value < 0.05, the null hypothesis,  $H_{01b}$  is rejected. Thus, there is significant difference between the valuation accuracy of Price to Book Value Model and Refined Price to Book Value Model. As the p value is less than 0.05, the null hypothesis,  $H_{01c}$  is

rejected. Thus, there is significant difference between the valuation accuracy of CAPM and Refined CAPM using Machine Learning Multiple regression approach. This proved that refined models produced more accurate results in Indian stock market.

This study analyzed the valuation accuracy of 30 Sensex stocks using RMSE for all Equity Valuation Models (Price to Earnings Model, Price to Book Value Model, CAPM, Refined Price to Earnings Model, Refined Price to Book Value Model, and Refined CAPM). This section also ranks the valuation models based on valuation accuracy of models using RMSE (Root Mean Squared Error) for Six Equity models (Base Models & Refined Models). Study introduced

ranking of valuation models to investigate their forecasting performance to predict Sensex stocks.

**Table 1.5. Root Mean Squared Errors (RMSE) of BASE Models & Refined Models of 30 SENSEX Stocks from 2008-09 to 2018-19**

Name Of Bank	P/E Model	Refined Price to Earnings Model	Price to Book Value Model	Refined Price to Book Value Model	CAPM	Refined CAPM
Asian paints	10.21	3.01	10.18	3.18	22.80	10.20
Axis bank	8.82	1.07	13.31	1.74	10.23	3.28
Bajaj auto	8.26	1.66	8.08	1.93	22.08	2.54
Bajaj finance	12.97	4.21	12.79	22.40	28.70	2.54
Bharathi Airtel	2.52	0.55	2.78	0.62	4.05	0.44
Coal India	3.17	0.60	3.21	0.42	2.98	0.60
HCL Tech	1.80	0.73	1.44	0.95	8.67	0.90
HDFC	3.61	2.18	3.62	1.07	15.81	2.10
HDFC Bank	2.12	3.86	2.04	2.44	15.57	4.68
Hero motor	12.04	2.09	11.63	2.72	26.10	4.86
Hindustan Unilever	4.95	0.58	4.93	0.69	9.18	3.05
ICICI	4.83	1.63	8.24	0.92	8.05	3.26
IndusInd	1.10	0.78	1.86	0.69	10.15	4.88
ITC	0.56	0.22	0.48	0.20	3.01	0.40
Kotak Bank	3.44	0.85	3.48	1.10	9.12	4.88
L&T	2.81	2.28	4.56	1.10	14.89	1.46
M&M	10.59	1.91	11.56	0.56	43.23	2.14
Maruti	3.46	3.19	4.10	2.33	4.06	16.59
NTPC	2.75	0.13	2.58	0.13	1.79	0.19
ONGC	6.36	0.64	5.20	0.32	5.04	1.91
PowerGrid	1.99	0.09	1.70	0.06	1.58	0.37
Reliance	11.39	1.09	12.46	0.58	11.41	1.42
SBIN	19.52	5.43	25.05	3.54	16.23	6.41
Sun Pharma	5.22	2.16	5.80	1.44	9.35	1.72
Tata Motors	1.99	2.83	1.82	1.58	2.18	1.04
Tata Motors DVR	4.86	0.45	3.28	0.40	5.79	0.62
Tata steel	13.87	1.11	17.19	0.90	5.07	2.68
TCS	28.67	1.87	3.11	2.16	20.43	4.94
Vedanta	2.74	0.73	3.17	0.88	2.80	0.47
YES Bank	2.78	3.18	4.67	1.14	6.96	3.87
<b>Average RMSE</b>	<b>6.65</b>	<b>1.70</b>	<b>6.48</b>	<b>1.94</b>	<b>11.58</b>	<b>3.15</b>

Valuation errors of Refined Price to Earnings Model kept at very low level of 1.70 as compared to other models. This study also indicates that Refined Price to Earnings Model is more accurate for ITC, Bharathi Airtel and Coal India. Refined Price to Book Value Model reduced the valuation errors to 1.94 of RMSE for SENSEX stocks. This was achieved by training the three models using Machine Learning Approach. Refined Models produced more correct value approximations for Sensex stocks on Indian market tells about the importance of machine learning multiple regression models. It was also inferred that, Price to Book Value Model is more accurate than Price to Earnings Model & CAPM for valuing Sensex Stocks due to the importance of book value in Indian Stock Market.

**Table 1.6. Ranking Valuation Models based on RMSE**

Name of Model	RMSE	Ranks
Refined Price to Earnings Model	1.70	1
Refined Price to Book Value Model	1.94	2
Refined CAPM	3.15	3
Price to Book Value Model	6.48	4
Price to Earnings Model	6.65	5
CAPM	11.58	6
<i>Note: Results computed using R 4.2</i>		

### V- Directions for Future Research

This study mainly focused on developing accurate equity valuation model using machine learning approach. Based on this study, several research questions arise and could be addressed by future researchers. This study has revised & refined the BASE models for Sensex stocks in India. Future studies can focus on testing the refined models in other stock market. This study has replaced only one independent variable in each of the selected superior models while revising them. Future studies can consider replacing more variables and adding new variables to revise the models.

### Conclusion

The present valuation models are developed well over a span of years. Stock market valuation is considered as the most multifaceted and this is due to different underlying factors influencing the valuation of Sensex stocks. Traditional valuation models were not able to produce accurate value estimations for each Sensex stock in the Indian stock market. Hence, the present study initially tested three equity valuation models for Sensex stocks in India, selected three superior equity valuation models (PEPBCAPM Models – Price to Earnings Model, Price to Book Value Model and CAPM) are revised. As the Machine Learning Multiple Regression approach has significant impact on the forecasting performance of the equity valuation models, this study refined the three revised Models using machine learning approach. The refined models were tested and it was found that the valuation accuracy of all the models got improved. This study followed an innovative and integrated approach to the Sensex

stock price forecasting problem through equity valuation models using Machine Learning Approach improved its reliability in valuing Sensex stocks than ever before

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