EVALUATION OF BOOK VALUE PER SHARE AS A BASIS FOR VAULATION OF DIFFERENT SECTORS

A Market Approach

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Executive Summary

The study analyses the Price to Book ratio of a sample of indices to look for consistencies and/or trends in the ratio. A consistency or trend in the P/B ratio of an index would imply that the market corrects to an equilibrium level of P/B ratio over a period of time. The presence of such an equilibrium means that the market holds the P/B ratio dear and follows it. The absence of any consistency or trend would mean that another variable is at play and that the book value of a share is of little relevance in the market and is an ineffective valuation metric.

Acknowledgement

Declaration

I hereby declare that all the data has been sourced from reliable and ethical sources. The analysis and conclusions are my own and have not been plagiarised. If there is any resemblance to any other research work, it is purely coincidental.

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Abbreviations

Abbreviation	Meaning
PB	Price to Book Ratio
NSE	National Stock Exchange of India
Nifty	The general market index of NSE
Nifty Auto	The index comprising of stocks of automobile companies listed on NSE
Nifty Bank	The index comprising of stocks of banks listed on NSE
Nifty FMCG	The index comprising of stocks of Fast Moving Consumer Goods companies listed on NSE
Nifty IT	The index comprising of stocks of Information Technology companies listed on NSE
Nifty Media	The index comprising of stocks of media houses listed on NSE
Nifty Realty	The index comprising of stocks of Real Estate companies listed on NSE
Nifty Pharma	The index comprising of stocks of Pharmaceutical companies listed on NSE
Nifty Midcap 50	The index comprising of stocks of 50 medium sized companies listed on NSE
ADF Test	Augmented Dickey Fuller Test for Stationarity

Introduction

Present day equity valuation employs various metrics that are used to estimate the intrinsic worth of a company. Some metrics are computed using the data from financial statements while others use a combination of data from the financial statements and market determined variables. Book value per share is an example of the former metric. Theoretically the book value of a share is the amount that a shareholder would get after selling all the assets of the company and settling all liabilities at the amounts mentioned on the company's balance sheet. In other words it is obtained by dividing the sum of accumulated profits, raised capital and other net gains by the total number of shares the company has outstanding.

In practice, if the company is liquidated the shareholder doesn't receive the book value. It depends on the price at which the assets are sold and liabilities settled, which can be significantly different from what the company's balance sheet reveals. Another approach to valuation that involves estimating the company's future does not apply here either as the book value of a share reveals nothing about the company's future. Shares of a company do not trade in the market at their book value. They trade at either a premium or a discount to the book value. While the company itself cannot be valued in the market at the book value, the book value may play a role in the company's valuation. The premium or discount to the book value at which the share of that company trades may offer a significantly better picture. If there is a consistency in this premium/discount, it would mean that the book value of a share has a major role to play in the company's share price. This premium/discount can be represented by the Price to Book (PB) ratio of the company. This study focuses on discovering such consistencies (if any).

Background of the Study

The study focuses on the dynamics of the PB ratio of indices to make conclusions on whether the market is influenced by the book value of the underlying shares. In order to highlight the differences in PB dynamics in different sectors, the study uses the PB ratio of sectoral indices. It should be noted that this study focuses on the effectiveness of the book value per share metric from an individual investor's perspective. The book value of a share is also relevant during private merger and acquisitions. These private transactions are out of the scope of the study.

Objectives and Variables

The study seeks to discover consistencies in the PB ratios of companies of different sectors. Specifically, the study checks for stationarity, employs various forms of regression based machine learning models to describe the time series data (PB Ratio) and checks for autocorrelation.

The PB ratio of the following sectoral indices have been used

1. Nifty Auto
2. Nifty Bank
3. Nifty FMCG
4. Nifty IT
5. Nifty Pharma
6. Nifty Realty
7. Nifty Media

Apart from these sectoral indices, the PB ratios of the Nifty and the Nifty Midcap 50 have ben analysed. These indices have been chosen because of availability of data. The data for the PB has been taken from the official website of the National Stock Exchange of India (NSE). The data points have been taken from the year of inception of these indices or June 2000 (whichever is later). At minimum, each index has 2000 data points.

Quantitative Data Analysis

Stationarity Analysis

The ADF Test has been used to check for stationarity. The ADF Test returns the p-value that represents the probability of being wrong if one was to claim that a particular dataset is stationarity. The 1% level of significance has been used in this study.

Table 1: P-value of ADF Test

Index	P-Value
Nifty Auto	0.322369803
Nifty Bank	0.104768734
Nifty FMCG	0.012465455
Nifty Media	0.294602913
Nifty Midcap 50	0.29735435
Nifty	0.038087943
Nifty IT	4.36E-09
Nifty Pharma	0.709761073
Nifty Realty	0.038935158

The ADF Test at 99% confidence classifies the Nifty IT as stationary. To confirm the classification, the study analyses the cumulative mean and variance plots of Nifty IT and compares it with the cumulative mean and variance plots of a dataset that is known to be stationary. The comparative dataset is sampled from gaussian distribution with a defined mean and variance which are equal to the mean and variance of Nifty IT PB ratio. The following is the comparison:
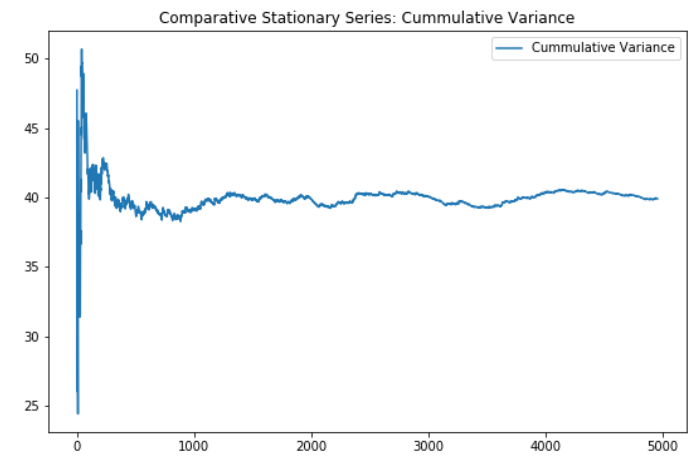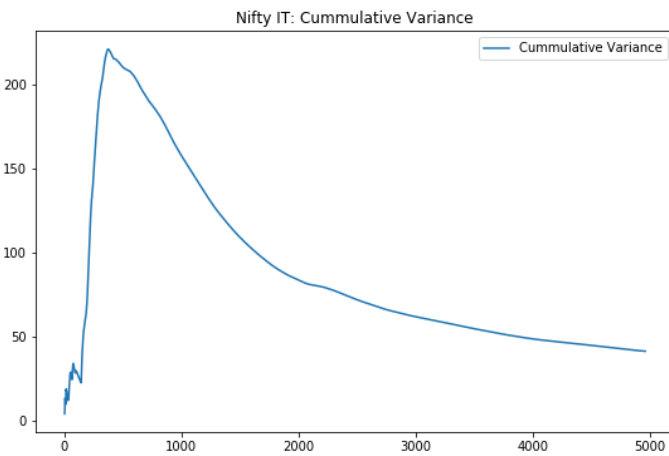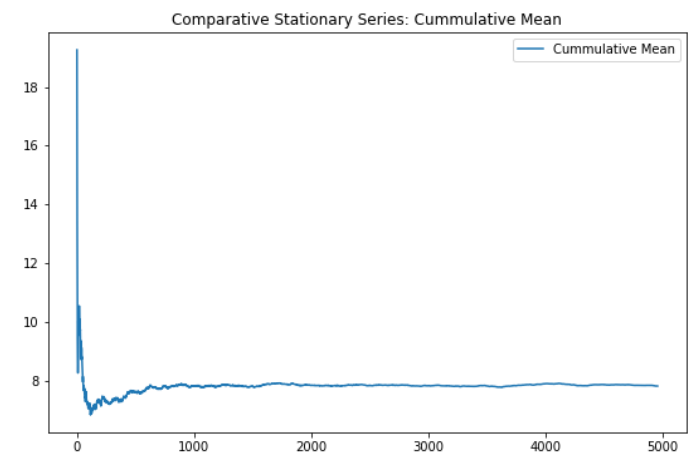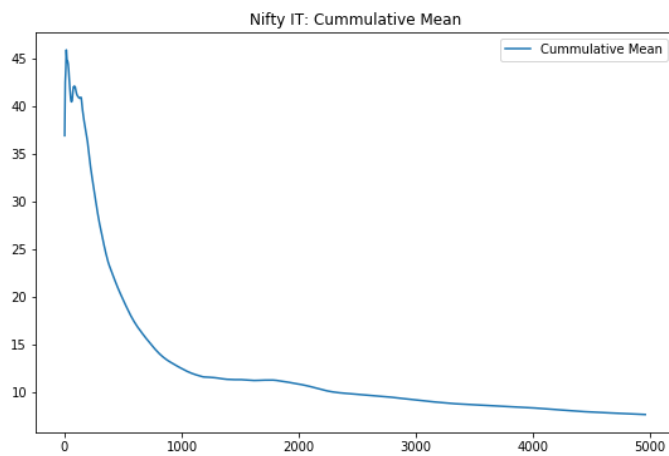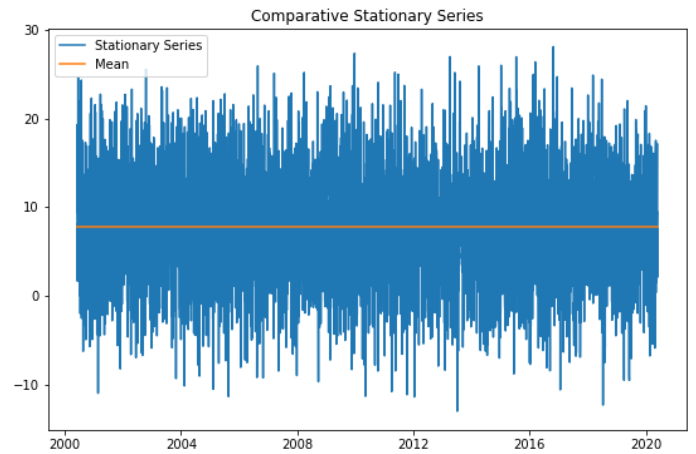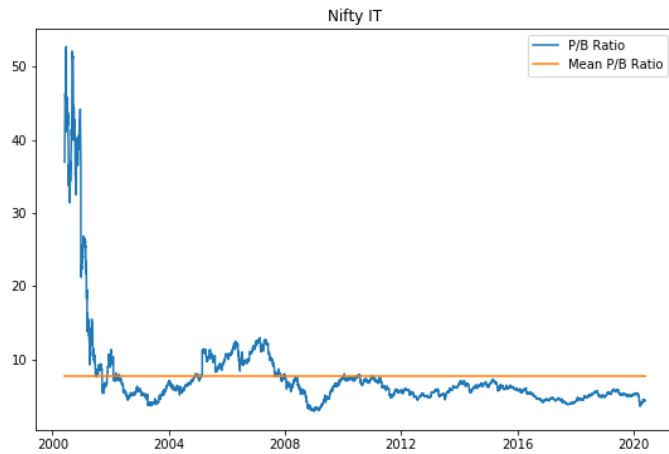
Figure 1: Nifty IT Stationarity Analysis

The two images in the first row are a plot of the Nifty IT PB and the Comparative Time Series. The images in the second row are a plot of their cumulative means. A cumulative mean or a cumulative moving average is an average of all datapoints up till a particular datapoint in the series. When the reference datapoint is the last point in the series, the cumulative mean is equal to the mean of the series. Stationary series (whose mean does change) has a cumulative mean plot as shown in the second figure of the second row. Similarly the cumulative variance is the variance of all datapoints up till a particular datapoint in the series. The cumulative variance of a stationary series is as shown in the second figure of the third row. These plots try to capture aspects that the ADF Test tends to miss out on. The plot proves that the Nifty IT PB is not stationary in nature.

Machine Learning Models:

The regression used in the machine learning models was:

1. Linear Regression: This model is a simple time series regression whose coefficients are estimated on the training data and the model was tested on the test data.
2. Naïve Mean Model (predicting the mean): This model simply predicts the mean of the training data. This model has been implemented as a baseline model.
3. Last N Days Model: This model simply predicts the mean of the last N days of the training set. Arbitrary values of 50 day, 100 day, 150 day and 200 day are used for N.
4. Polynomial Regression: This model employs polynomial regression whose coefficients are estimated on the training data and performance is measure in the testing data. Polynomial Regressions with degrees up to 7 have been used.

The first 3 models are meant to be compared and the last one has been implemented to address problems of underfitting. The performance of the models is evaluated by their R-square scores. The degree to which a model is overfitted is established by the difference in the R-square on the training set and the testing set.

The results were as follows:

Table 2: R-Square on test data

Index	Naïve Mean Model	Linear Regression	Last 50 Day Average	Last 100 Day Average	Last 150 Day Average	Last 200 Day Average
Nifty Auto	-5.49087	-19.016	-1.79411	-4.69886	-7.79332	-9.89153
Nifty Bank	-2.89303	-0.115	-0.00111	-1.31E-05	-0.00333	-0.02217
Nifty FMCG	-3.05442	-6.11928	-6.00522	-2.36956	-1.57981	-1.30583
Nifty Media	-15.3361	-12.9446	-3.9829	-8.58241	-13.877	-17.4006
Nifty Midcap 50	-48.9287	-31.9069	-0.01017	-0.42674	-1.04365	-0.80496
Nifty	-0.00013	0.005765	-0.10616	-0.12711	-0.06145	-0.04159
Nifty IT	-7.09255	-54.6347	-1.27215	-1.94659	-3.37768	-4.19647
Nifty Pharma	-77.4316	-49.4074	-6.11226	-6.29516	-6.54039	-9.22367
Nifty Realty	-5.10576	-689.993	-3.69872	-4.35451	-4.56508	-4.41609

Table 3: Comprehensive Summary of Performance of Polynomial Regression

Index	Degree of Regression	R-Square on training data	R-Square on testing data	Model Variance
Nifty Auto	1	0.21264819	-19.01602449	19.22867268
Nifty Auto	2	0.361723182	-46.61078205	46.97250523
Nifty Auto	3	0.655983527	-1.406339735	2.062323261
Nifty Auto	4	0.658753235	0.080567596	0.578185639
Nifty Auto	5	0.713320492	-45.13693007	45.85025057
Nifty Auto	6	0.549454749	-0.557597786	1.107052535
Nifty Auto	7	0.525615566	-0.093922281	0.619537847
Nifty Bank	1	0.413587533	-0.114996102	0.528583635
Nifty Bank	2	0.505744455	-2.171626038	2.677370493
Nifty Bank	3	0.560016539	-0.608056308	1.168072847
Nifty Bank	4	0.589384284	-8.775610489	9.364994773
Nifty Bank	5	0.605739378	-0.281119534	0.886858912
Nifty Bank	6	0.591000753	-10.70334476	11.29434551
Nifty Bank	7	0.515665281	-50.41118119	50.92684647
Nifty FMCG	1	0.063178592	-6.119276998	6.18245559
Nifty FMCG	2	0.357529891	0.344926318	0.012603573
Nifty FMCG	3	0.390988667	-1.701204799	2.092193466
Nifty FMCG	4	0.391071625	-2.042036083	2.433107707
Nifty FMCG	5	0.396890276	0.481955779	-0.085065503
Nifty FMCG	6	0.423285454	-24.03508053	24.45836598
Nifty FMCG	7	0.232291542	-5.629711806	5.862003348
Nifty Media	1	0.01571307	-12.94457328	12.96028635
Nifty Media	2	0.297480311	-57.12270567	57.42018598
Nifty Media	3	0.340240693	-25.9773042	26.31754489
Nifty Media	4	0.435506322	-1.476483933	1.911990254
Nifty Media	5	0.450104256	-10.93408552	11.38418978
Nifty Media	6	0.39772477	-2.778831654	3.176556424
Nifty Media	7	0.332175375	-7.323626732	7.655802107
Nifty Midcap 50	1	0.014872156	-31.90686266	31.92173482
Nifty Midcap 50	2	0.462775359	-83.20933214	83.6721075
Nifty Midcap 50	3	0.548690027	-0.863695448	1.412385475
Nifty Midcap 50	4	0.548726048	-1.633672505	2.182398553
Nifty Midcap 50	5	0.591914955	-370.6250024	371.2169174
Nifty Midcap 50	6	0.603558464	0.210657633	0.392900831
Nifty Midcap 50	7	0.344126889	-1794.696793	1795.04092
Nifty	1	0.005710544	0.005764541	-5.40E-05
Nifty	2	0.068212073	-3.616284309	3.684496383
Nifty	3	0.112037194	-0.710837042	0.822874236
Nifty	4	0.279105915	-78.73479676	79.01390268
Nifty	5	0.251251762	-4.309845399	4.561097161
Nifty	6	0.341156413	-91.80195548	92.14311189

Nifty	7	0.282147853	-370.7516448	371.0337927
Nifty IT	1	0.212179402	-54.63468863	54.84686803
Nifty IT	2	0.313886928	-70.04722715	70.36111408
Nifty IT	3	0.451586334	-440.2120316	440.663618
Nifty IT	4	0.607984342	-970.6421248	971.2501091
Nifty IT	5	0.306760835	-731.6070116	731.9137724
Nifty IT	6	0.212393995	-314.4184759	314.6308699
Nifty IT	7	0.184283544	-468.7898007	468.9740842
Nifty Pharma	1	0.055667531	-49.40743633	49.46310386
Nifty Pharma	2	0.549564136	-34.28145663	34.83102077
Nifty Pharma	3	0.552600871	-55.43753716	55.99013803
Nifty Pharma	4	0.817600101	-298.5106059	299.328206
Nifty Pharma	5	0.821676126	-136.2932204	137.1148965
Nifty Pharma	6	0.856703569	-266.0107013	266.8674048
Nifty Pharma	7	0.826118837	-477.7154336	478.5415524
Nifty Realty	1	0.301374078	-689.9934803	690.2948544
Nifty Realty	2	0.600127137	-957.3216582	957.9217853
Nifty Realty	3	0.775111876	-1543.881253	1544.656365
Nifty Realty	4	0.843462493	-1139.012243	1139.855705
Nifty Realty	5	0.841084752	-961.4529624	962.2940471
Nifty Realty	6	0.498990374	-20849.5129	20850.01189
Nifty Realty	7	0.367443235	-33807.47137	33807.83881

Autocorrelation

The autocorrelation plots give the final indication if there is a trend involved. The plots are as follows:
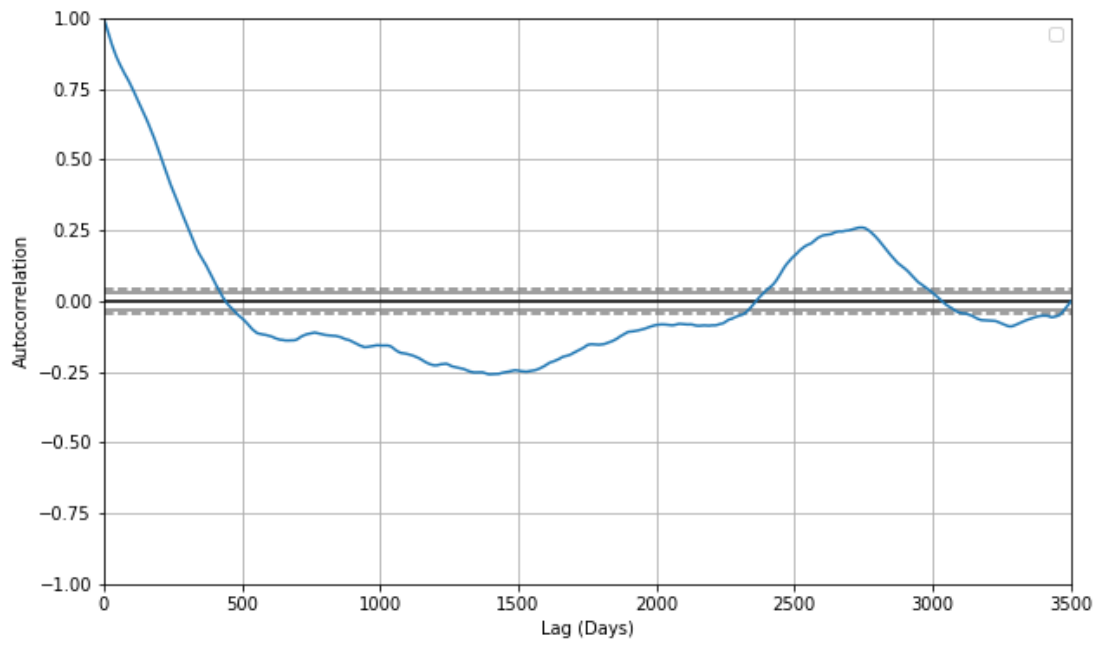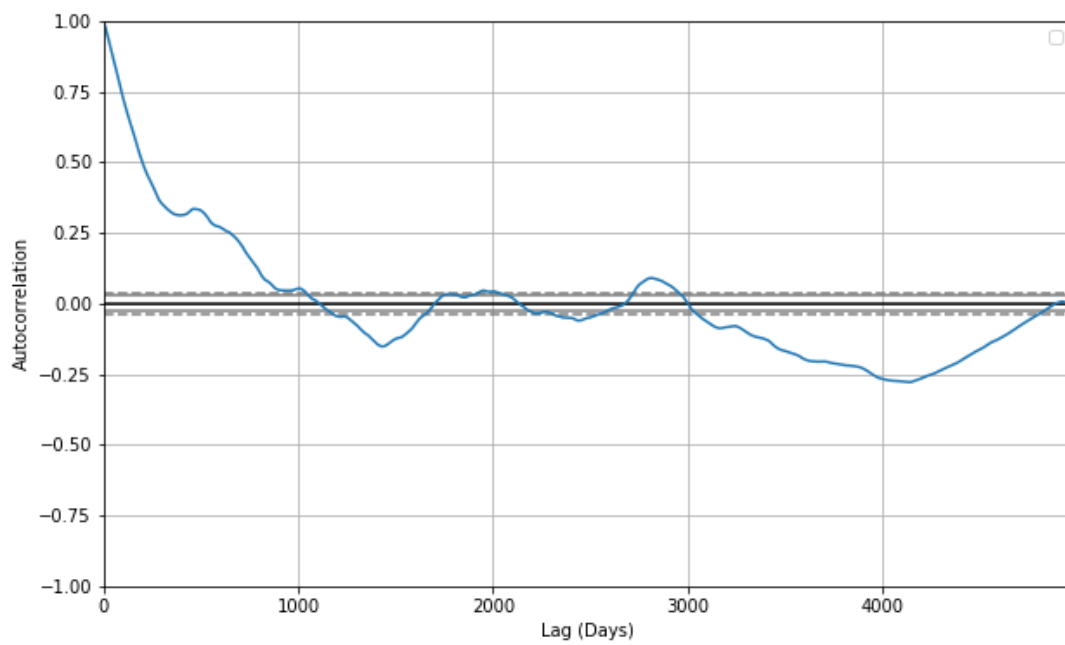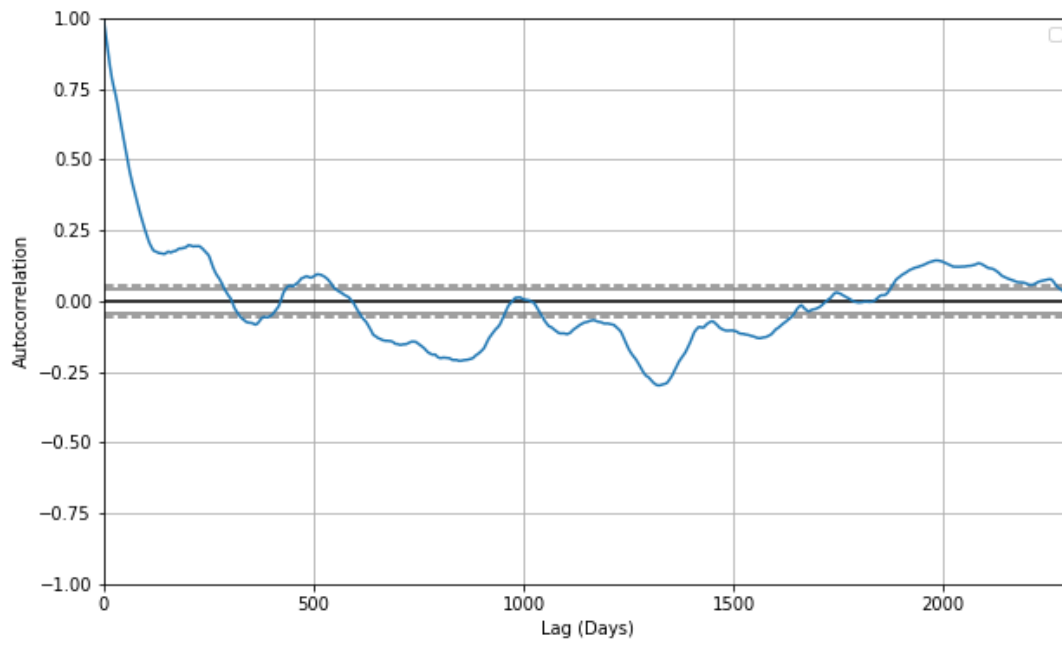
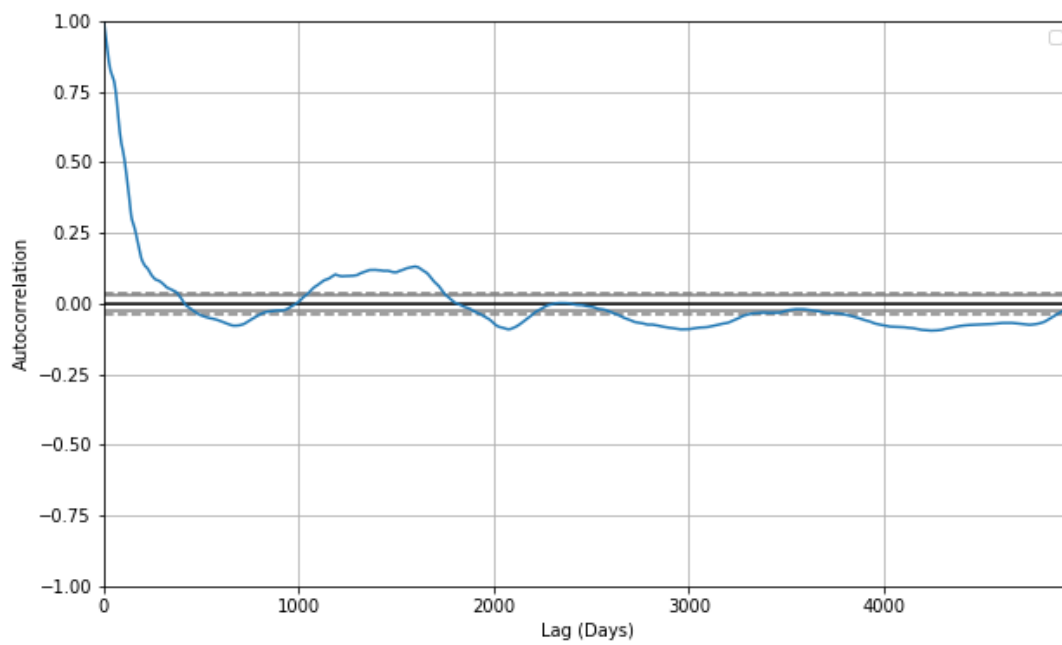Figure 2: Nifty Auto

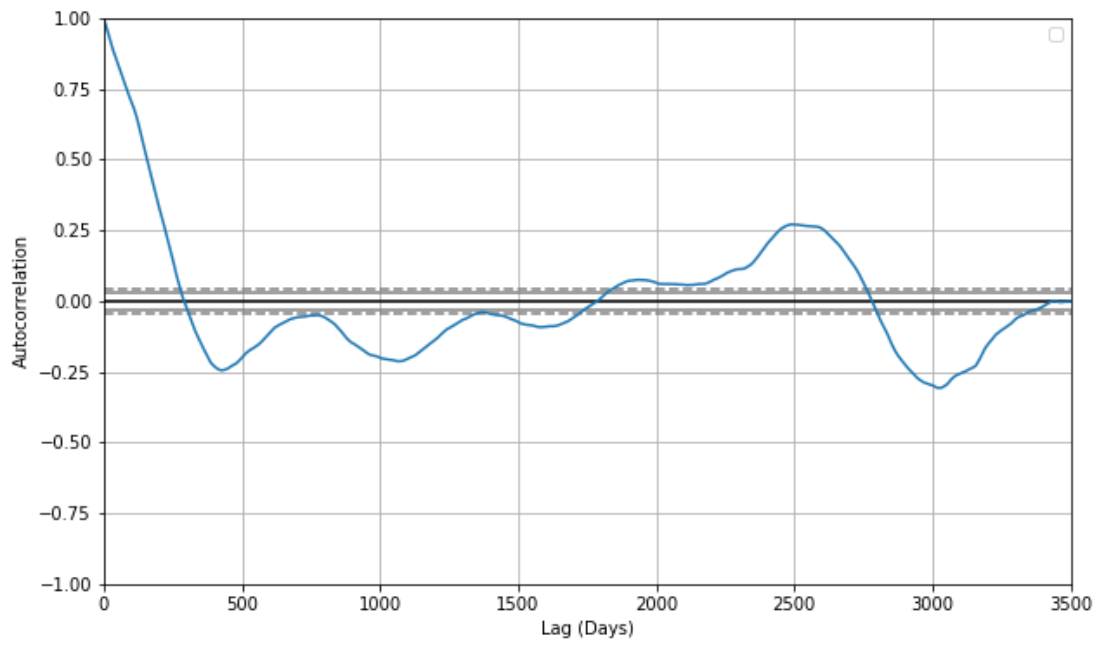Figure 3: Nifty Bank

Figure 4: Nifty FMCG

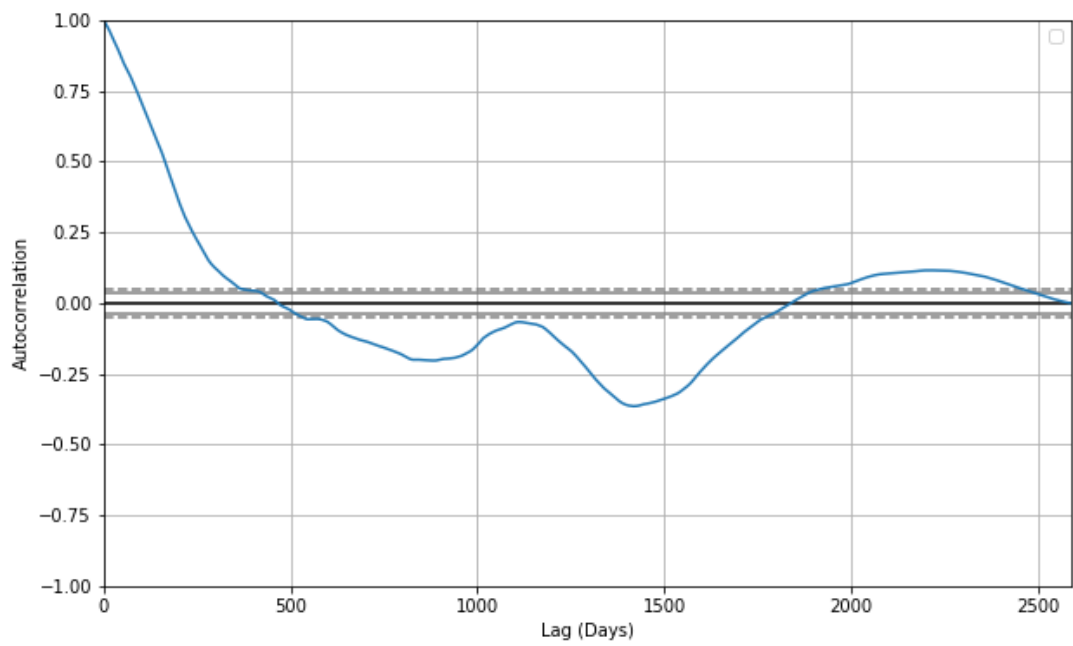*Figure 5: Nifty IT*

Figure 6: Nifty Media
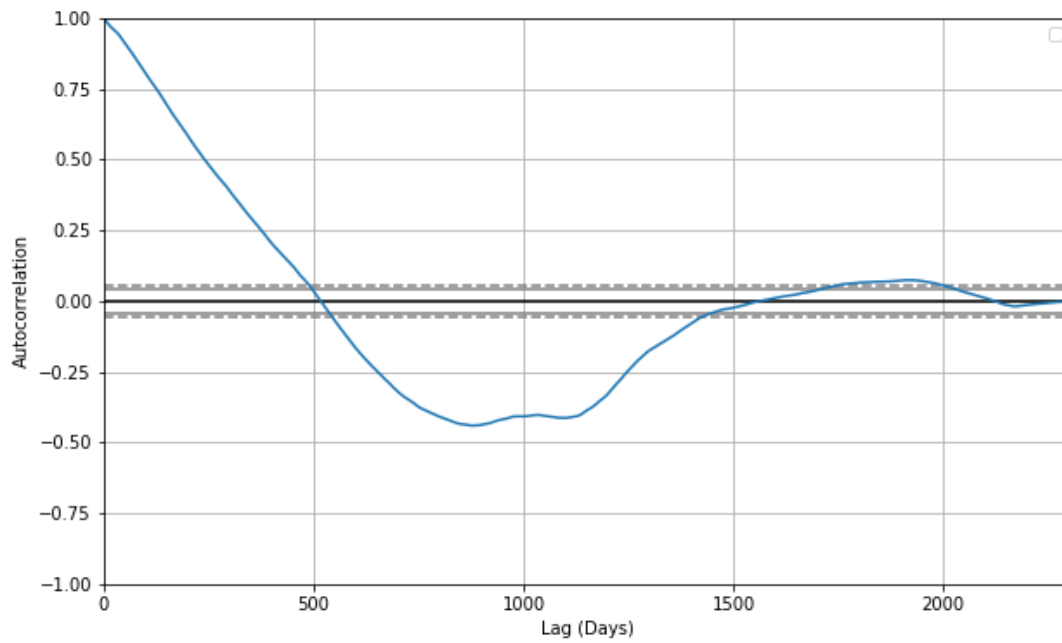

Figure 7: Nifty Midcap 50
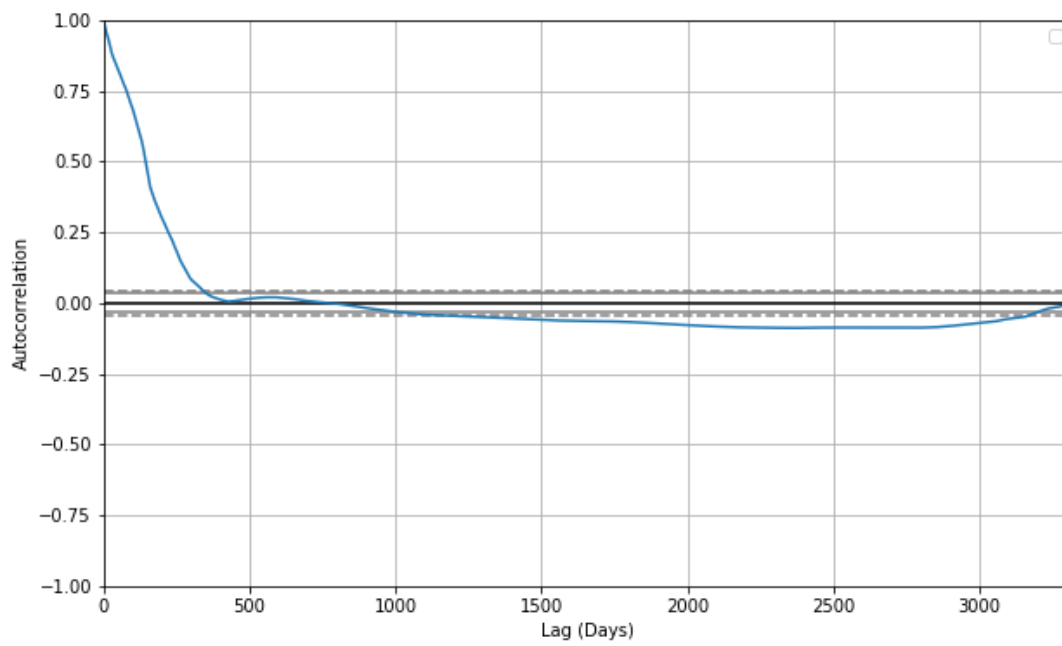
Figure 8: Nifty Pharma
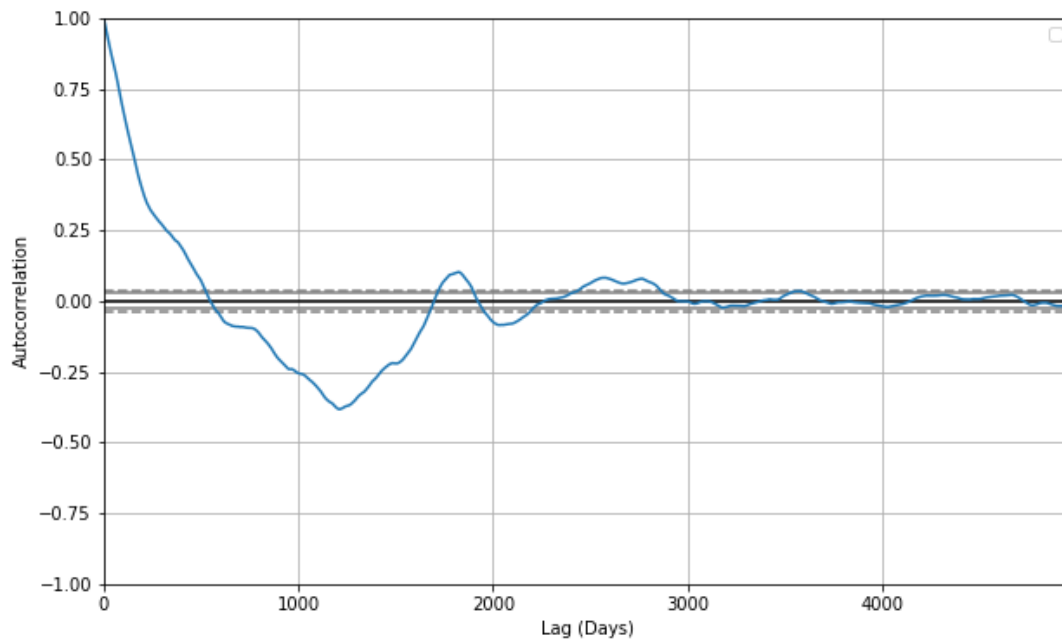

Figure 9: Nifty Realty

Figure 10: Nifty

Findings and Conclusions

The three approaches used for analysing the data:

1. Stationarity Analysis: The study checks the PB ratios for stationarity using the Augmented Dickey Fuller Test and visually through the cumulative mean and variance plots. A stationary time series is one whose mean and variance are not a function of time (do no change with time). If the PB ratio is found to be stationary, it would mean that the PB ratio has a constant mean and variance; implying that it is mean reverting. This means that the market has a tendency to correct the price of a stock over a period of time to bring it to an equilibrium PB ratio. The PB ratios of none of the indices was found to be stationary. This means that the notion of an equilibrium PB ratio and the markets reverting to it can be ruled out.

2. Machine Learning Models: Regression based machine learning models split the entire dataset into data meant for training the model and the data meant for testing the model. The machine learning model then fits an appropriate regression line on the training data and tests the performance of the regression line on the testing data. If any of the regression models produce good results, it would mean that PB ratios follow certain trends. This further implies that the market has a very stable method of valuing companies with respect to their book values.
   The machine learning models showed bad results. The R-square values of all the models are poor across all indices. This means that no linear model is apt enough to predict the values of the PB ratio. In case of the Polynomial Regression model, Nifty Pharma and Nifty Realty got a strong R-square on the training data for degrees 4-7 and 3-5 respectively. However the extremely high model variances suggest that the respective models are overfitted.

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This means that the PB ratio doesn't have a trend that is based solely on the efflux of time and that some other variable is in play. The absence of time as a dominant independent variable implies that the book value of a share itself is irrelevant to the market and some other variable influences the premium/discount to the book value at which the share trades.

3. Autocorrelation plots: The autocorrelation analysis also explores recurring trends in the PB. This technique has been used to verify the findings of the first two. The plots make it evident that the correlation drifts towards 0 very quickly. This low correlation between lagged values implies that there is no underlying trend.

All the 3 approaches make it evident that there is no underlying trend or consistency in the PB ratio. This directly means that the book value of a share is a poor measure of valuation across all indices in the sample.

References

The only data used in this study is the PB ratio of the indices which have been studied. This data has been sourced from the website of NSE India.

More specifically, the link to downloading the data:
https://www1.nseindia.com/products/content/equities/indices/historical_pepb.htm

The compiled data has been presented in a .csv format in the folder name 'Data'. All the relevant charts for the models discussed earlier have been enclosed in a folder name 'Charts'. Additional .csv files have been stored in the submission for reference.