

Forecasting of BSE-SENSEX @EOD using Astronomical Parameters

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Abstract

The main aim of this research/experiment work is to explore the relationship/association between selected astronomical parameters and the End-Of-The-Day (EOD) stock index returns. This relationship could be utilized to forecast the expected outcome of EOD closing. The present research work evaluates the effect of selected astronomical parameters (Moon-Phase) on the past 39 years of Indian BSE-SENSEX index data and forecast the probable future day closing i.e. whether positive or neutral or negative closing. The system would eventually filter the stock index data for selected astronomical parameters for a given day and find out the Strike-Rate (number of bullish days & bearish days), Average-Daily>Returns (ADR), Standard Deviation, Range, Gap-Ups/Gap-Downs. These parameters along with the historical plot of ADR for each Moon-Phase versus date has been analyzed to forecast the probable EOD closing for a given date.

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1. Introduction

STOCK market prediction/forecasting is among the most interesting and challenging task in the field of finance and is being explored by analysts/scientists around the globe. This research project finds a place in Financial Astronomy/Astrology, an uncharted and less explored method of security/stocks/index analysis. Traders or investors of stock market mainly dependent on fundamental study/analysis and/or technical study/analysis as a method of stock analysis while taking investment decisions. However the above methods fail to nail down the proper timing of entry and exit from trade and thereby reducing the overall profits. Hence financial astronomy which oversees the prediction of prices of stocks/indices in ahead of time, which depends on the planetary positions, greatly improves the investment/trading decisions and thereby overall profits.

Following are some of the long established methods to do stocks/index analysis. These analyses are done to find out probable future movement of stocks.

Fundamental Study/Analysis: Method of measuring the instrument intrinsic/true cost by probing the company's financial performance, associated financial and economic factors. Basically fundamental study/analysis consists of combined analysis of economic, related overall sector and company itself. Here, the measured intrinsic cost is compared with market cost/value of the respective stocks. Based on the comparison, one can explore whether the stock is at correct value or less-priced or high-priced.

Technical Study/Analysis: This method is applied to forecasts the direction of stock prices using historical/past price data. The price patterns in historical/past data can be found out and these patterns would repeat in future also. Hence here the past price information is used to predict/forecast the probable future price information. Some of the widely used technical study/analysis indicators are different kinds of Moving-Averages, RSI, MACD, Choppiness Indicator, Aroon-Indicator and many others.

Financial Astronomy/Astrology: This is highly unexplored area and uses the planetary positions to forecasts the future price information. There are vast numbers of astronomical parameters that could be used to explore the behavior of the stock market. One such parameter is the Moon-Phase. One can associate both technical study and the financial astronomy techniques to improve the trading decisions.

Some of the astro-parameters used for analyzing stock price behavior are aspects (angle between the two planets), Declinations, Signs (placement of planets across 12 signs), Eclipses (Solar and Lunar), Apogee/Perigee, Sun/Moon and other planets crossing equator, Planetary Speeds, Retrogradation of Planets, Ingression/Regression/Egression of Planets, Bull and Bear strength of Astrological Signs, Combustion, Moon-Phases, Moon-Constellations.

The below figure shows the diagrammatic representation of the relationship between the astronomy,

traders/investors and the stock-market..

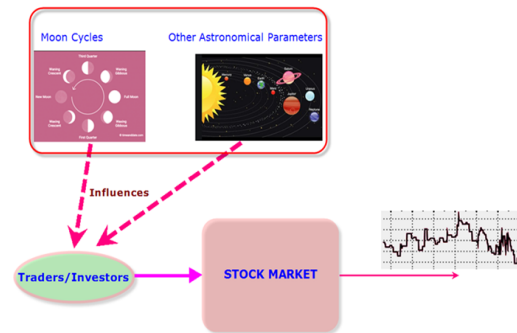


Fig 1: Relation between Astro-Parameters & Stock Market

Source: Own Design

Figure 1: Relation between Astro-Parameters & Stock-Market

This research project has attempted to check the historical price behavior of Indian SENSEX with all the 30 Moon-Phases. Each day is associated with the particular Moon-Phase. This is calculated using sidereal longitude positions of Moon & Sun for a given day and location.

2. Literature Survey

Below are the published papers which highlight the empirical evidence of the Moon-Phase effect on various stock/securities markets around the globe. Majority of papers examined the effect of only two Lunar-Phases i.e. New-Moon (NM) and Full-Moon (FM). One paper explored four Moon-Phases.

Reference [1] have published the literature survey that highlight the effects of Lunar Calendar on financial markets. Here the various calendar effects like Summer-Effect, Holidays-Effect, Weekend/Daily-Effect and Monthly-Effect. In Monthly-Effect are examined, the author discusses about the Moon-Rotation patterns for the American Stock Index during 1963-81.

[2] have discussed about the impact of two lunar phases on stock/securities returns of the companies traded at Nairobi Stock Exchange. This work shows that the returns surge towards NM phase and FM phases in comparison to other days and also highlight the cumulative returns are more during the NM days, The paper considers two Moon-Phases among thirty phases also not attempted to forecast the EOD price.

[3] have discussed how Moon-Cycles alters human moods which in turn reflects in traders/investors behavior & finally it evaluates the association between Moon-Phase and stock/securities returns. The findings are that returns around FM dates were significantly lesser than returns around NM days. The paper considers two Moon-Phases among thirty phases also have not attempted to forecast the EOD price.

[4] have discussed the effect of four lunar phases (NM, FM, First-Quarter & Third-Quarter) on the Rate of Return of WIG Index on the Warsaw Stock Exchange.

This paper considers only four Moon-Phases out of thirty phases also has not attempted to forecast the EOD price.

[5] have explained the effect of astrophysical phases on different sectors of the Indian Stock Market.

[6] have discussed about the effect of movement of Moon across 12 sectors (Signs) of the Zodiac on BSE SENSEX. The effect on SENSEX is given in terms of hit rate percentage whether bull or bear. This research work does not uses Moon-Phases but used other astro parameter i.e. Moon-Transit across 12 signs/sectors of Zodiac and also this work has not attempted to forecast the EOD price.

[7] have presented the paper which gives some details about the introduction of the Financial Astrology.

[8] have presented the paper which nicely explains the various cycles associated with SUN and its impact on stock/securities markets. It also discusses about the impact of moon-cycles on the stock/security market returns.

[9] have presented the paper which reiterates the popular belief that Moon-Phases do influence the human financial performance.

[10] have investigated the relationship between Moon-Phases and stock market returns of various countries. The results indicate that the security returns are reduced near FM days compared to that of during NM days.

[11] have discussed about the lunar cycle impact on stock /security returns. Specifically, returns during approaching NM days are about double the returns during approaching FM dates. This pattern of returns is persistent and found it for all major U.S. stock indexes over the last 100 years and for nearly all major stock indexes of 24 other countries over the last 30 years.

[12] is a very old book which discusses about the forecasting /predicting prices of stocks and commodities using western/vedic astrology concepts.

3. Problem Statement

All the papers carried out the experimental analysis on the stock prices and proved statistically that there exists a strong correlation between astronomical parameters i.e. Lunar-phases and the movement of the stock prices. Paper [2] & Paper [3] uses only two Lunar-Phases, Paper [4] uses four Lunar-Phases.

The present research work attempted to exploit the above correlation to forecast the probable EOD closing by calculating parameters such as strike-rate (percentage of positive/negative days), percentage of gap-up/gap-down days, three types of daily-returns, and various visual graph plots of three types of daily returns versus date for each Moon-Phase. There are total 30 Moon-phases exists including Amavasya (NM) & Poornima (FM).

4. Methodology

- BSE-SENSEX Data Collection from 1980 to 2019

(Total 39 Years). Data is secondary in nature and extracted from BSE website.

- SENSEX data is preferred over NSE NIFTY data because of the availability of more past data history for the former.

- The time-frame of the collected date is daily. I.e. End-Of-Day (EOD) data.

- Calculation of astro variables i.e. Moon-Phase from years 1980 to 2019 using NASA Swiss Ephemeris API using Ephemeris Calculator Module.

- Price data contains the following information.

Main-Parameters: *Date, Open, Low, High, Close, Prev-Close*. Only *Close* price is available between the years 1979 and 1990. Hence *Open, High, Low* price information are not available for these years.

Derived-Parameters: Returns, Strike-Rate (Positive/Negative Days), Gap-Up Days/Gap-Dn Days. Three types of returns are calculated using Open, Close, Prev-Open and Prev-Close data. More information on this is given in parameter calculations section.

Planetary-Data: Moon-Phase, Sun Longitude, Moon Longitude.

- Mapping of price data and astronomical parameters in an excel sheet in column wise.

- Exporting the complete excel data into SQLITE Database.

- Data can be filtered for a given Moon-Phase or any other combination of parameters from the database using SQL queries.

- The below figure gives the prospective system structure/architecture.

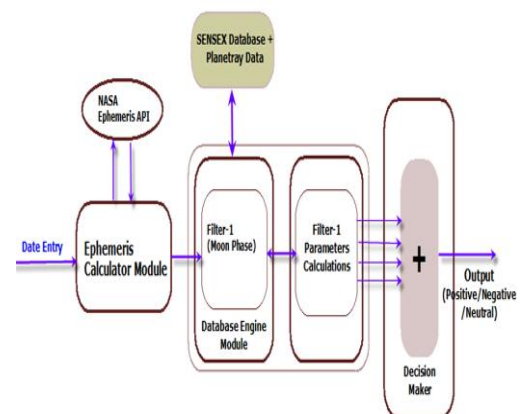


Figure 2: System Architecture

The end-to-end architecture consists of the following C++ modules.

A. Ephemeris Calculator Module

This is the first module interacting with the end-user. This module takes the date as the input and is used for finding the Moon-Phase parameter for a given date and location. The Bombay location is taken by default as indian stock exchanges are located in Bombay. This module interacts with the NASA's ephemeris C++ API to get the Moon and Sun longitude information which are used for

calculating Moon-Phase information. The calculation formula is given in *Section G*.

B. Database Engine Module:

Used for filtering of price data for given Moon-Phase information. This module interacts with the sqlite SENSEX database using C++ sqlite interface API and fires SQL queries to filter the price data information for a given Moon-Phase. Output parameters as described in the next section are calculated using the filtered data.

C. Decision Maker Module

This module will create the new filtered table as shown in *Table-I*. The module analyzes the output parameters using *Table-I* and decides the final probable outcome in terms of positive, negative or neutral. The detailed analysis method is given in *Section-0*.

5. Parameter Calculations

Following are the various parameters calculated for a given day.

D. Returns

Following three kinds of returns are practically possible.

- **R1_OPC** : Buy@Prev-Close-Price & Sell@Next-Open-Price
- **R2_OPO** : Buy@Prev-Open-Price & Sell@Next-Open-Price.
- **R3_CPC** : Buy@Prev-Close-Price & Sell@Next-Close-Price

The returns for the given day is calculated using the following formula.

$$R3_CPC = ((C - PC) / PC) * 100$$

Where,

- C = Close-Price for the given day.
- PC = Close-Price for the Previous day
- R3_CPC = Returns expressed in percentage.

E. Strike-Rate

Number of positive days and negative days. The day is positive if day's close price is higher than previous day close price. Similarly, the day is negative if day's close price is less than previous day's close price. The digit 1 is awarded to positive day and digit 0 is awarded to negative day.

F. Gap-Up & Gap-Down Days

Gap-Up day is the day when day's open price is higher than previous day's high price. Similarly, Gap-Down day is the day when day's open price is less than the previous day's low price. The digit 1 is awarded to Gap-Up day and digit 0 is awarded to the Gap-Down day.

G. Moon-Phase

This is one of the astronomical parameter calculated using Sun and Moon sidereal longitude positions for a

given day and location. In this work, Bombay is used as the location information for finding the Moon-Phase information.

Moon-Phase is calculated using the following formula.

$$MP = \text{Longitude (Moon)} - \text{Longitude (Sun)}$$

$$\text{if } (MP < 0) \quad MP = MP + 360.0$$

$$MP = (MP/12.0) + 1.0$$

Where, MP = Moon-Phase for the given day.

List of 30 Moon-Phases are given in the *Table-I* under column *Phase-Name*.

Table 1: (Calculated Parameters for all the Moon-Phases)

Phase	Phase Name	%Green	%Red	%GapUp	%GapDn	R1_OPC	R2_OPO	R3_CPC	RESULT
1	S.Pratishta	56	44	18	13	26.73	38.47	35.84	Positive
2	S.Dwitiya	54	46	21	15	70.01	61.78	54.04	Positive
3	S.Tritya	51	49	28	18	32.87	11.42	28.22	Positive
4	S.Chaturthi	49	51	18	21	-5.23	-44.08	-37.55	Negative
5	S.Panchami	52	48	21	16	58.74	54.37	78.4	Positive
6	S.Shashti	55	45	25	16	41.44	62.81	62.15	Positive
7	S.Saptami	54	46	24	20	28.6	53.28	-8.61	Neutral
8	S.Ashtami	48	52	17	18	28.8	13.61	-4.87	Neutral
9	S.Navami	55	45	19	17	54.87	11.22	38.35	Positive
10	S.Dashami	53	47	20	18	14.63	-8.88	18.57	Neutral
11	S.Ekadashi	58	42	25	15	23.4	26.28	-24.68	Neutral
12	S.Dwadashi	58	42	17	19	1.84	-17.31	-22.28	Negative
13	S.Trayodashi	53	47	28	16	55.95	29.27	37.11	Positive
14	S.Chaturdashi	48	52	19	18	38.98	10.31	8.51	Neutral
15	Purnima	56	44	19	15	43.73	19.95	17.78	Positive
16	K.Pratishta	48	52	20	20	31.54	4.55	-15.13	Neutral
17	K.Dwitiya	58	42	22	20	15.49	-57.7	-19.65	Negative
18	K.Tritya	55	45	21	14	45.71	42.31	46.32	Positive
19	K.Chaturthi	53	47	21	16	63.83	44.46	41.96	Positive
20	K.Panchami	51	49	23	17	43.34	1.1	8.44	Neutral
21	K.Shashti	56	44	24	16	70.11	48.44	98.9	Positive
22	K.Saptami	56	44	24	16	51.4	47.53	51.83	Positive
23	K.Ashtami	58	42	19	21	-4.41	-15.3	-25.87	Negative
24	K.Navami	53	47	23	16	38.92	38.18	51.18	Positive
25	K.Dashami	51	49	20	23	15.03	44.82	-13.36	Neutral
26	K.Ekadashi	52	48	24	18	24.76	-4.15	-35.7	Negative
27	K.Dwadashi	58	42	24	15	70.76	48.84	78.53	Positive
28	K.Trayodashi	55	45	25	16	52.1	54.87	52.71	Positive
29	K.Chaturdashi	53	47	22	15	57.87	48.43	29.42	Positive
30	Anvasya	59	41	25	17	65.69	44.75	73.79	Positive

6. Software requirements

- Microsoft Excel
- R-Platform for Normality testing of returns
- Visual Normal Distribution Plot
- Kolmogorov-Smirnov (KS) Test
- Shapiro-Wilk test
- Programming Languages: C/C++
- Microsoft Visual Studio 2008
- Operating System: Win-XP/ Win-7, 4GB RAM
- Database: SQLITE
- Third Party Software: AmiBroker Market Charting Software

7. Results and Analysis

There are total 9385 rows of unfiltered SENSEX price data between the years 04/APR/1979 and 17/JAN/2020. The price data is filtered for each Moon-Phase. All the parameters i.e. returns, strike-rate, gap-up, gap-down days are calculated for each Moon-Phase. These parameters are consolidated and listed in the above *Table-I*. All the numbers in columns 3 to 9 are expressed in terms of percentage.

The green color (rows 1,2,3,5,6,9,13,15,18,19,21,22,24, 27,28,29,30) indicates probable positive day. The necessary condition for this is that all the three types of returns in columns 7, 8, 9 are positive, and supporting conditions are $\%(Green)$ column is greater than $\%(Red)$ column and $\%(GapUp)$ column is greater than $\%(GapDn)$ column.

The red color (rows 4,12,17,23,26) indicates probable negative day. The condition for this is that all the three

types of returns in columns 7, 8, 9 are negative. The yellow color (rows 7,8,10,11,14,16,20,25) indicates probable neutral day.

Normality test has been performed using R-Platform for the columns 7, 8, 9 which represent the three types of returns. The results of the test are as shown below.

Table 2: (Normality Test Results)

Returns	KS Test p-Value	Shapiro-Wilk Test p-Value
R1_OPC	0.988	0.734
R2_OPO	0.492	0.076
R3_CPC	0.872	0.356

The p-value in all the cases is greater than 0.05. Therefore it is concluded that the distribution of the SENSEX returns across all the Moon-Phases in order are not significantly different from normal distribution.

The *RESULT* column in the above table *Table-1* indicates which Moon-Phases are Positive or Negative or Neutral. We shall discuss the detailed behavior of SENSEX for each Moon-Phase by observing the following plots.

- **Strike-Rate Plot:** Scatter plot of number of positive closing days (%Green) on y-axis versus Moon-Phase on x-axis.
- **Gap-Up Plot:** Scatter plot of Gap-Up days (%GapUp) on y-axis versus Moon-Phase on x-axis.
- **Phase>Returns Plot:** Scatter plot of R2_OPO returns on y-axis versus Moon-Phase on x-axis.
- **Investment Returns Plot:** Stacked graph of all three types of returns for each Phase versus Date on x-axis. The *Strike-Rate Plot* is as shown below in Fig-3. It is clear that the number of positive days decreases towards phase-15 i.e. Full-Moon-Phase (Poornima) and increases towards phase-30 i.e. New-Moon-Phase (Amavasya).

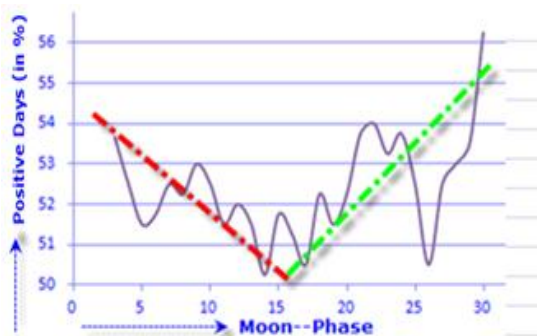


Figure 3: Strike-Rate Plot

The *Gap-Up Plot* is as shown below in Fig-4. It is clear that the number of Gap-Up days decreases towards

phase-15 i.e. Full-Moon-Phase (Poornima) and increases towards phase-30 i.e. New-Moon-Phase (Amavasya).

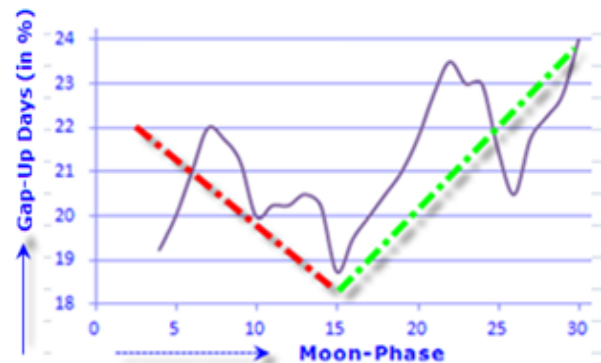


Figure 4: Gap-Up Plot

The Phase>Returns Plot is as shown below in Fig-5. The graph clearly shows that the average returns decreases towards phase-15 i.e. Full-Moon-Phase (Poornima) and increases towards phase-30 i.e. New-Moon-Phase (Amavasya).

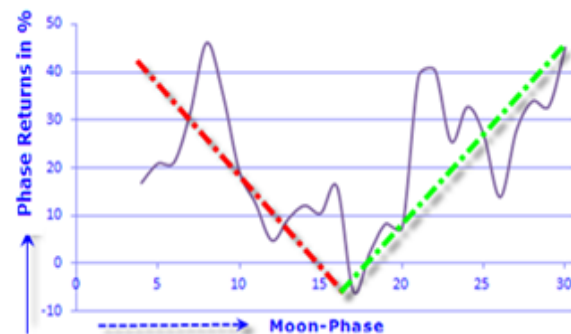


Figure 5: Phase>Returns Plot

There are total 30 Investment Returns Plot which is a stacked graph of all three types of returns for each Moon-Phase versus date/time. Few plots are shown below in Fig-6 to Fig-9. These plots indicate how the initial investment of INR100 will grow or shrink over time for last 39 years for each Moon-Phase. Observe the blue (thick) plot % (O-PC) in all the graphs which has a least standard deviation and offers very smooth movement without much volatility.

Fig-6 shows the returns plot of Moon-Phase-1. It is clear that all the three returns slope pointing in upward direction.

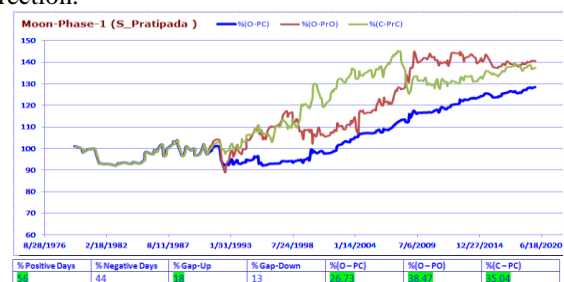


Figure 6: Shukla-Pratipada (Phase-1) Plot

Fig-7 below shows the investment returns plot of Moon-Phase-2. It is clear that all the three returns slope pointing in upward direction. This implies Moon-Phase-2 gave positive returns in last 39 returns though more volatility (Standard Deviation) is observed for the %(OPO) and %(CPC) returns plot compared to %(OPC) returns plot.



Figure 7: Shukla-Dwitiya (Phase-2) Plot

Fig-8 below shows the investment returns plot of Moon-Phase-4. It is clear that the %(OPC) returns slope (blue thick plot) pointing in upward direction. The other two returns plots i.e. %(OPO) and %(CPC) slope in downward direction. This implies Moon-Phase-4 gave negative returns in last 39 years.



Figure 8: Shukla-Chaturthi (Phase-4) Plot

Fig-9 below shows the investment returns plot of Moon-Phase-30 (Amavasya or New-Moon). It is clear to see that all the three returns slope pointing in upward direction with more momentum. This implies Moon-Phase-30 gave positive returns in last 39 years.

It is interesting to observe for Moon-Phase-30, all the three returns figures as shown in green color looks very high (more than double) compared to that of Moon-Phase-15 (Poornima or Full-Moon).



Figure 9: Amavasya (Phase-30) Plot

Similar observations has been made for the remaining investment returns plots for Moon-Phases 5 to 29 which are not shown here.

In order to forecast probable EOD closing of SENSEX for a given day, the day's Moon-Phase can be found out and cross check with the *Table-I*. The *RESULT* column value of *Table-I* indicates whether the day with a particular Moon-Phase is Positive or Negative or Neutral. The investment returns plot for this particular phase also need to be observed for further visual confirmation.

8. Conclusions and future work

Financial Astronomy is a vast subject and has many known and unknown parameters. Many previous published papers demonstrated the usage of one such parameter i.e. Moon-Phase & used only two phases. The present research work extended this further to all the Moon-Phases with various kinds of graphical scatter plots. These graphical plots do not exist in any of the published papers. Though this is not a holy-grail method of price forecasting, this method can be used along with other methods of market analysis like technical-analysis to improve the trading decisions. The method can be extended further for the individual stocks, forex, commodities, other country stock exchanges.

One can use multiple astronomical parameter like clubbing Moon-Phase with the Moon-Constellation (Nakshatra), or other planets constellations, or with planetary aspects or with planetary transits,

It is believed that the financial astrology/astronomy can be used to predict the intraday movement of stocks and indices where there are virtually none of the published papers available.

Besides financial domain, astro-parameters can also be used for predicting earthquakes, weather forecasting, Human Resource (HR) systems to identify the efficient employees as well as in recruitment to categorize or classify the potential applicants. Astro-parameters can also be used in medical domain.

One can mix astronomical parameters and machine

learning algorithms which itself is a separate research area.

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