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Efficiency Hypothesis of the Stock Markets: A Case of Indian Securities

Gagan Deep Sharma (Corresponding author)
Department of Management Studies
BBSB Engineering College
Fatehgarh Sahib, Punjab, India
Tel: 91-9915-233-734 E-mail: angrishgagan@gmail.com

Mandeep Mahendru
Department of Management Studies
Gian Jyoti Institute of Management & Technology
Mohali, Punjab, India
Tel: 91-9872-896-504 E-mail: mandeep129@rediffmail.com

Abstract

The paper attempts to investigate the validity of the Efficient Market Hypothesis on the Indian Securities Market. Initially, the paper discusses the definitions and types of the EMH, as also the literature available on the same. Taking a sample of eleven securities listed on the Bombay Stock Exchange (BSE), the oldest stock exchange of Asia, we apply the runs tests and the autocorrelation tests in order to judge the efficiency of the Stock Markets. The Autocorrelation test when directly applied to share prices gives conflicting results with Runs test and thus, making it difficult to reach a definite conclusion. Then, the autocorrelation test is applied to first differenced series, which gives satisfactory results. In a nutshell, it is observed that the effect of stock prices for the sample companies on future prices is very meager and an investor cannot reap profits by using the share price data as the current share prices already reflect the effect of past share prices.

Keywords: Efficient Market Hypothesis (EMH), Indian securities market, Bombay Stock Exchange (BSE), Autocorrelation test, Runs test

1. Introduction

In the course of studying the Fundamental analysis, the investment projects are ranked by comparing factors like economic influences, industry factors and pertinent company information such as product demand, earnings, dividends, etc. Taking these factors into consideration, investors reach upon an intrinsic value for the firm's securities. By comparing these values with current prices of the security, the investment decisions are taken. The Fundamental analysis, however, is criticized on the ground that all financial data and information of a given security is already reflected in the market price of that security. Therefore we cannot rely much on the Fundamental analysis.

The Technical analysis, on the other hand, implies that by observing and studying the historical information about the behavior of a given stock, one can predict the future price movements of the security. But the Technical analysis, too, is not free from criticism. It is not by itself the road to the riches. It is the tool that should be used along with the Fundamental analysis. Despite the assertions of Technicians, Technical Analysis is still an art. Its successful use shall require talent, intuition, commonsense, experience and most importantly – the luck. All this calls for a theory that can assist a potential investor in managing his portfolio. Efficient Market Theory is one such theory that aims to explain the behavior of stock markets.

The efficient market hypothesis (EMH) is a backbreaker for forecasters. In its crudest form it effectively says that the returns from speculative assets, are unforecastable. This is a venerable thesis, its earliest form appearing a century ago as the random walk theory *(Bachelier, 1964).*

This paper is divided under eight parts. The first part gives the Introduction to the paper. The second part elaborates the

definition of Efficient Market Hypothesis; the third section of the paper explains the types of EMH and the empirical tests for the same, fourth section presents the mathematical modeling of the EMH, fifth section reviews the literature on EMH, sixth section explains the methodology of the paper, seventh section presents the findings and the eight section concludes.

2. Definition of efficient market hypothesis

One of the famous definitions of EMH has been given by *Jensen (1978)*. He opines:

"A market is efficient with respect to information set Φt if it is impossible to make economic profits by trading on the basis of information set Φt."

Malkiel (1992) provides another closely related definition of EMH:

"A capital market is said to be efficient if it fully and correctly reflects all relevant information in determining security prices. Formally, the market is said to be efficient with respect to some information set, Φt, if security prices would be unaffected by revealing that information to all participants. Moreover, efficiency with respect to an information set, Φt, implies that it is impossible to make economic profits by trading on the basis of Φt."

The primary role of the capital [stock] market is allocation of ownership of the economy's capital stock. In general terms, the ideal is a market in which prices provide accurate signals for resource allocation: that is, a market in which firms can make productive-investment decisions, and investors can choose among the securities that represent ownership of firms' activities under the assumption that securities prices at any time 'fully reflect' all available information. *(Fama1970)*.

The link between an asset market that efficiently reflects available information (at least up to the point consistent with the cost of collecting the information) and its role in efficient resource allocation may seem natural enough. Further analysis has made it clear, however, that an informationally efficient asset market *need not* generate allocative or production efficiency in the economy more generally. The two concepts are distinct for reasons to do with the incompleteness of markets and the information-revealing role of prices when information is costly, and therefore valuable *(Stiglitz 1981)*.

Dyckman and Morse (1986) state "A security market is generally defined as efficient if (1) the price of the security traded in the market act as though they fully reflect all available information and (2) these prices react instantaneously, or nearly so, and in unbiased fashion to new information".

3. Types of efficient market hypothesis

The phrase "efficient market" used to describe the market price that fully reflects all available information was coined by *Fama (1970)*. Furthermore, he classifies the market efficiency into three levels on the basis of the information: Weak, Semi-strong and Strong forms.

3.1 Weak-form efficient market hypothesis

The weak form of the theory also known as the 'Random Walk' says that the current price of the stocks already fully reflect all the information that is contained in the historical sequence of the prices. In simpler words, we can say that the price of a stock already stands adjusted to all the historical information available about it. Therefore there is no benefit, so far as forecasting the future is concerned, in examining the historical sequence of prices. In an aggressive form, the theory concludes that if there is no value in studying the past prices and part price changes, there is no value in the technical analysis. Thus, the Random Walk Theory is a direct repudiation of the technical analysis.

This theory can further be explained with the help of an example. A close look at the stock prices sometimes reveals day-of-the-week effects (stock prices may tend to rise on Monday and fall on Friday), time-of-the-year effects (stock prices may tend to rise in January), and small firm effects (small-firm prices may typically rise by more than large-firm prices). But little evidence exists that average investor can use these effects to earn above normal profits once transaction costs such as brokerage are taken into account. In nutshell, the null hypothesis in this form of theory maintains that an investor is not going to gain anything from the knowledge that he possesses about the historical movements in the price of that stock.

Several studies address the issue of whether stock price behaviour is a random walk or not. *Robert (1959)* and *Osborne (1959)* found that stock price movement follows a random walk. "The random walk hypothesis simply states that at a given point in time, the size and direction of the next price change is random with respect to the knowledge available at that point in time." *(Dyckman and Morse, 1986)*.

There have been four major methods to test the dependence of return on time (Weak-form of market efficiency): serial correlation tests, filter rule test, cyclical tests, and volatility test.

3.1.1 Serial correlation tests

In order to test the independence between successive price changes, correlation tests are particularly appropriate. These tests tend to determine when price changes or proportional price changes in some future period are related. If these changes are correlated, points plotted on a graph will tend to lie along straight line. The test for this approach was performed in daily return by Schwartz and *Whitcomb (1977a, 1977b)* and *Rosenberg and Rudd (1982)*, who found that the first order serial correlation of daily return residual from the market model is small but significantly negative.

3.1.2 Filter tests

The Filter rule operates as follows- If the daily closing price of a Security moves up at least 'x' percentage, buy the security until the price moves down at least 'x' percentage from a subsequent high, at which time simultaneously sell and go short. The short position should be maintained until the price rises at least 'x' percentage above a subsequent low, at which time cover and buy. Now the question arises- what is the optimal size of 'x'? If 'x' is too small (e.g., 0.5%), then trading in the security will involve high transactional costs. On the other hand, if 'x' is too large, then many turning points will be missed. The evidence shows that the size of filter is irrelevant because whatever be its size, no filter rule can systematically generate excess returns over a 'Buy & Hold' strategy. This approach was investigated by Alexander (1961), and Fama (1965), who found no abnormal return was generated.

3.1.3 Cyclical tests

This test involves Time Series study. Under this method, cyclical behaviour is studied by using Statistical methods. *Granger and Morgensterm (1963)*, *Cross (1973)*, *French (1980)*, *Gibbons and Hess (1981)* and *Bonin and Moses (1974)* used these tests and investigated Day, Week and months of the year in stock behaviour, and in particular the effect of Monday, Friday and January.

3.1.4 Volatility tests

The main assumption for the volatility test is that "expected returns are constant and the variation in stock prices is driven entirely by shocks to expected dividends" *(Fama, 1991)*. *Grossman and Shiller (1981)* attempt to use volatility testing to examine whether the variation in expected return is rational. They found that the variation in expected return is irrational.

3.2 Semi-strong form efficient market hypothesis

This form of the theory maintains that the current stock prices instantaneously and fully reflects all the public information about the security such as corporate reports, corporate announcements, information related to corporate dividend policies, forthcoming stock splits and so on. Thus the efforts by analysts and investors to acquire and analyze public information will not yield consistently superior returns. As soon as the information becomes public, it will be absorbed and reflected in the stock prices. If any such information does not lead to a change in security prices, then if the semi-strong form EMH is true, we can infer that the news contain no relevant information. Thus it would be too late for the investor to wait for the announcement to be reported in the financial press the next day.

The testing of Semi-strong form of EMH includes the testing of market reaction to accounting information, stock split, and block trading.

3.2.1 Market reaction to accounting information

Wilson (1987) reported a positive association between total accruals and cash flow from operation with stock return. His research concluded that total accruals and cash flow from operation taken together have incremental information content beyond earnings. Judy Rayburn (1986) examined the ability of operation cash flow and accrual data in order to explain the relative change in equity value (return). She observed that cash flow measures, aggregate accrual and current accrual are consistent with the information set used in value equity security (Abnormal Return). Harmon (1984) investigated the relative importance of earning versus fund flow, by examining the association between market reaction with earnings variables and fund variables. He concluded that earnings are more associated with market reaction than fund flows.

3.2.2 Stock Splits

Fama, Fisher, Jensen and Roll (1969) performed the first test for semi-strong market efficiency. They used risk-adjusted return to test for market efficiency with respect to the announcement of stock split and found a considerable high abnormal return prior to the announcement of stock split. On the other hand, after the stock split there is no extraordinary return, and the situation returns to exactly what EMH predicted. Fama,.et al. (1969) and Charest (1978a) found that market is efficient with respect to stock split information.

3.2.3 Block trades

When a large number of stocks are suddenly placed on the market for sale, it is called Block trading. Scholes (1972), Kraus and Stoll (1972), Grier and Albin (1973), Carey (1977) and Hess and Frost (1982), investigate the effect of the

sudden sale of a large number of stocks in the market. They found that there is a significant drop in price, but after a short period stock price rebounds to its prior level.

In a nutshell, the results from the empirical research are inconsistent with the semi-strong form market efficiency.

3.3 Strong form efficient market hypothesis

This form states that not only is the public information useless to the investor or analyst, but all the information is useless. In other words, the current stock prices instantaneously and fully reflect all known information about the securities including the privately available inside information. The markets are so efficient that not even someone with the most valuable piece of inside information can trade profitably on the basis of it. As an example, even the information about the forthcoming announcement by a Company regarding a split in its stock, cannot be used by an investor to his advantage.

Testing the return that is earned by an insider tests the EMH in strong form, Penman (1982) examines the insider trading around earning forecasting announcement. He found that insiders buy shares before the announcement and sell their shares after the announcement, by which they can achieve high abnormal return. Therefore, insiders do indeed have private information that is not impounded in the stock price.

4. Mathematical presentation of efficient market hypothesis

Fama (1970) gives the mathematical presentation of EMH in the following equations:

$$E(P_{j,t+1} / \Phi t) = [1 + E(r_{j,t+1} / \Phi t)] P_{jt} \quad (1)$$

Where,

E = Expected value operator.

Pjt = Price of Security j at time t.

Pj,t+1 = Price of Security j at time t+1 (including reinvestment of any intermediate cash income from securities.

rj,t+1 = One period percentage return=(Pj,t+1-Pjt)/Pjt.

Φt = Symbol of whatever set of information assumed to be "fully reflected" on share price at time t.

$$Z_{j,t+1}=r_{j,t+1}- E(r_{j,t+1} / \Phi t) \quad (2)$$

$$E(Z_{j,t+1} / \Phi t)= 0 \quad (3)$$

Where Zj,t+1 is the unexpected (or excess) return of security j at time t+1, the difference between the observed return, rj,t+1, and the expected return based on the information set Φt.

5. Literature on Efficient Market Hypothesis

Many studies have been conducted internationally which have focused on the efficient market hypothesis (EMH). However, the number of studies published on developing market is small in comparison to the volume of studies published on developed markets. The literature published to date is in favour of weak form efficiency, though pockets of inefficiency cannot be suppressed.

The general conclusion from numerous studies in developed countries is that the weak form of market efficiency holds and that no exploitable patterns in past trading records exist. More recently, however, a number of studies have raised questions about the degree of prevailing market efficiency and have pointed to some market inefficiencies based on observations such as autocorrelation, the small-firm effect, the January-effect and the weekend-effect (Aga and Kocaman, 2008).

Evidence from stock markets in developing countries is mixed. Dickinson and Muragu (1994) found evidence consistent with the EMH in their study of the Nairobi Stock Exchange. Barnes (1986), on the other hand, in his study of the Kuala Lumpur Stock Exchange provided only limited support of the weak form of the EMH. Zychowicz et al. (1995) concluded that on the Istanbul Stock Exchange, daily and weekly returns diverge from a random walk, while monthly returns are consistent with weak form market efficiency.

Fama and French (1992) explained that Portfolios constructed from ‘value’ stocks appear to produce superior investment returns over long horizons. Value stocks are those with high earnings, cash flows, or tangible assets relative to the current share price. After controlling for firm size and the variance of portfolio returns, stocks with low price-earnings ratios outperform the market.

Lakonishok, Shleifer and Vishny (1994) reach similar findings, and also present evidence that the variability of returns from value portfolios is no greater than for glamour portfolios. Thus, the higher returns earned by value portfolios do not appear to be due to a higher level of risk.

Poshakwale (1996) presented evidence concentrating on the weak form efficiency and on the day of week effect in the Bombay Stock Exchange under the consideration that variance is time dependent. Moving from its traditional functioning to that required by the opening of the capital markets, the BSE has presented different patterns of stock returns and supports the validity of day of the week effect. The frequency distribution of the prices in BSE does not follow a normal or uniform distribution, which is also confirmed by the non-parametric KS Test. The results of runs test and serial correlation coefficients tests indicate nonrandom nature of the series and, therefore, violation of weak form efficiency in the BSE. The other null hypothesis that there is no difference between the returns achieved on different days of the week is also rejected, as there is clear evidence that the average returns are different on each day of the week. The weekend effect is evident as the returns achieved on Fridays are significantly higher compared to rest of the days of the week. However, the results presented in the study are not adjusted for transaction costs. Nor have the results been adjusted for non-synchronous trading which may influence the serial correlation coefficients.

Beechey, Gruen and Vickery (2000) concluded that the efficient market hypothesis is almost certainly the right place to start when thinking about asset price formation. Both academic research and asset market experience, however, suggest that it does not explain some important and worrying features of asset market behaviour.

Timmermann and Granger (2004) observed that there are likely to be short-lived gains to the first users of new financial prediction methods. Once these methods become more widely used, their information may get incorporated into prices and they will cease to be successful. This race for innovation coupled with the market's adoption of new methods is likely to give rise to many new generations of financial forecasting methods.

Hadi (2006) identified EMH and provided some detail on the types of EMH, as well as identifying the empirical research that tested weak, semi-strong and strong forms of market efficiency. Accounting market based research more often assumes that market is efficient in semi-strong form, and the reason for this is that financial reports are considered public information once they are released to the market. He provided empirical evidence from the Jordanian market that showed that the security market reacted with mixed signal on releasing profitability, liquidly, and solvency information.

6. Methodology

The paper takes a sample of eleven securities listed on the Bombay Stock Exchange (BSE). The Bombay Stock Exchange is known as the oldest exchange in Asia. It traces its history to the 1850s, when stockbrokers would gather under banyan trees in front of Mumbai's Town Hall. The location of these meetings changed many times, as the number of brokers constantly increased. The group eventually moved to Dalal Street in 1874 and in 1875 became an official organization known as 'The Native Share & Stock Brokers Association'. In 1956, the BSE became the first stock exchange to be recognized by the Indian Government under the Securities Contracts Regulation Act.

BSE as a brand is synonymous with capital markets in India. The BSE SENSEX is the benchmark equity index that reflects the robustness of the economy and finance. At par with international standards, BSE has been a pioneer in several areas. SENSEX is an index of thirty securities.

The paper concentrates on the shares of eleven companies. These include – ACC, Bajaj Auto, Bharti Airtel, Cipla, Dr. Reddy's Labs, Grasim, HDFC Bank, Hindalco, Maruti Suzuki, Satyam Computers, and Wipro. All of these are listed on the Bombay Stock Exchange. Out of these companies, ACC, Bharti Airtel, Grasim, HDFC Bank, Hindalco, Maruti Suzuki, Satyam Computers, and Wipro are included in the thirty companies forming part of SENSEX. Cipla and Dr. Reddy's Labs are not included in the index stocks of BSE, but they are the index stocks of NSE's Nifty. Bajaj Auto, though listed on both NSE and BSE, is not the index stock at either of the two exchanges. The time duration of the study is June 30, 2007 to October 27, 2007.

7. Findings

The research used Runs Test and Autocorrelation Test in order to test the Efficient Market Hypothesis of the Indian securities. The findings of the two tests are shown hereunder:

7.1 Runs Test

Here, the null hypothesis to be tested is that the share prices do not make pattern i.e.

Ho = The prices do not make pattern

The null hypothesis considered here is common for all the sample companies.

The null hypothesis Ho is accepted if the value of Z is less than 1.96 and it is rejected if the value of Z exceeds 1.96.

Where, $Z = (r-\mu r)/\sigma r$

Where 'r' is no. of runs.

It can be seen from Table-1 that the value of Z is 0.687 for the share prices of ACC from July 2007 to October 2007. This value of Z is less than 1.96. So, the null hypothesis Ho is accepted i.e. the share prices do not make pattern. Share prices of ACC move randomly.

The calculated value of Z is 0.277 for the share prices of Bajaj Auto from July 2007 to October 2007. This value of Z is less than 1.96 and hence the null hypothesis considered in this case is also accepted. Share prices of Bajaj Auto move randomly i.e. share prices of this company do not make any pattern.

In case of Bharti Airtel, the calculated value of Z is -0.517 which is negative. Clearly it is less than 1.96. So, it shows that share prices of Bharti Airtel do not make pattern and these prices move randomly. It also shows that share market of Bharti Airtel is weak form efficient.

It is clear from Table-1 that the value of Z is -0.707 which is much less than 1.96. As the value of Z less than 1.96 accepts the null hypothesis Ho, therefore, null hypothesis that the share prices do not make pattern is accepted. It means that share prices of Cipla move randomly.

It is clear from Table-1 that the value of Z coefficient for Dr. Reddy's lab is 0. This value of Z is not in comparison with 1.96. So, share prices of dr. Reddy's Lab also do not make any pattern and these share prices move randomly.

Similarly, in case of Grasim, the calculated value of Z coefficient is-0.533. The value of Z coefficient less than 1.96 accepts the null hypothesis Ho, that share prices do not make pattern. Here, the value of Z is less than 1.96, so the hull hypothesis is accepted i.e. share prices do not make any pattern and move randomly.

In case of HDFC bank, the calculated value of z is -7.74. This value of Z is not within +1.96 and -1.96. So, the null hypothesis that share prices do not make pattern is rejected. Share prices of HDFC bank make pattern and do not move randomly.

The calculated value of Z is 0 for Hindalco. This value of Z is again less than 1.96. Here, null hypothesis is accepted which shows that share prices of Hindalco move randomly and these do not make any pattern.

The value of Z is 0.686 for Maruti Suzuki. Again value of Z coefficient is less than 1.96. It shows that null hypothesis that share prices do not make any pattern is accepted i.e. share prices of Maruti Suzuki move randomly.

Similarly, in case of Satyam and Wipro, the value of Z coefficient is 0.287 and 0.686 respectively. The value of Z is less than in both the Cases. It implies that null hypothesis is accepted for both the companies. The share prices of both Satyam and Wipro do not make any pattern and move randomly.

At the end, the analysis of Runs test shows that in every case the null hypothesis is accepted except one i.e. HDFC bank. It means share prices of the sample companies do not make any pattern and hence move randomly except HDFC bank.

7.2 Autocorrelation Test

Autocorrelation test is applied to weekly share prices of different sample companies and also to the first differences of share prices of different sample companies. In autocorrelation test, lag t is correlated with lag t+1, lag t+2, lag t+3 and so on. In the same way, lag t+1 is correlated with lag t+2, lag t+3, lag t+4 and so on. The auto correlation test applied directly to the weekly share prices of different sample companies did not give satisfactory results. So, the autocorrelation test has been applied on first differenced series of share prices of different sample companies.

Table 2 shows that lag1 is autocorrelated with lag2, lag3…….lag16. Lag2 is autocorrelated with lag3, lag4……lag16. In the same way, lag3 is autocorrelated with lag4, lag5 and so on. Similarly, all the different lags are autocorrelated with other lags.

Here, the autocorrelation of lag1 is checked with lag2, lag3……..lag16. Now, form table-2, it is clear that sometimes the value is near to 1 i.e. 0.915 and sometimes it is near to 0 i.e. 0.393 and sometimes it is in middle i.e. 0.556. As the value varies up to extremes i.e. form 0.915 to 0.393, it means the share prices do not move in any pattern, instead these move randomly.

Now, if lag2 is autocorrelated with lag3, lag4……lag16 then it is clear from table-2, that sometimes the value is near to 1 i.e. 0.82 and sometimes it is 0.47 and sometimes near to 0 i.e. 0.178. So, all these varied values show that share prices move randomly and do not make any pattern.

Similarly in all the cases, when lag t is autocorrelated with other lags values change randomly showing that share prices do not make any pattern and move randomly.

It can be observed that the autocorrelation coefficient in most cases is near to 0.5, which indicates that the prices in lag t do not correlated with prices in lag t+1, lag t+2 and so on. Thus, it can be inferred that the effect of stock prices for the sample companies on future prices is insignificant, and investors cannot reap profits by using the share price data as the current share prices already reflect the effect of past share prices.

8. Conclusion

The research examined the weak-form efficiency of eleven (11) securities listed on the Bombay Stock exchange (BSE) using weekly data from July 2007 to October 2007. The Runs Test and Autocorrelation Tests were used as means of determining whether the BSE was efficient in weak-sense. The Autocorrelation test when directly applied to share prices gives conflicting results with Runs test and thus, making it difficult to reach a definite conclusion. Then, the autocorrelation test is applied to first differenced series, which give satisfactory results. Therefore, though the results lead us into believing that the BSE is weak form efficient, yet we choose to remain cautious in letting our belief transcend into a generalization.

The findings of this study indicate that the BSE needs to strengthen its regulatory capacity to boost investors' confidence. This would involve them being more stringent in enforcing financial regulations, performing regular market. Thus, at the end it can be inferred that the effect of stock prices for the sample companies on future prices is very meager and an investor cannot reap profits by using the share price data as the current share prices already reflect the effect of past share prices.

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Table 1. Values of Z coefficient for sample companies

Name of the company	Values of Z coefficient
ACC	0.687
Bajaj Auto	0.277
Bharti Airtel	-0.5173
Cipla	-0.707
Dr. Reddy’s Lab	0
Grasim	-0.533
HDFC	-7.74
Hindalco	0
Maruti Suzuki	0.684
Satyam	0.287
Wipro	0.686

Table 2. Values of autocorrelation coefficients for sample companies

	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8	Col 9	Col 10	Col 11	Col 12	Col 13	Col 14	Col 15
Col 1	1														
Col 2	0.72	1													
Col 3	0.68	0.38	1												
Col 4	0.60	0.60	0.69	1											
Col 5	0.57	0.47	0.58	0.92	1										
Col 6	0.92	0.82	0.69	0.71	0.68	1									
Col 7	0.39	0.19	0.57	0.19	0.26	0.41	1								
Col 8	0.89	0.78	0.69	0.86	0.79	0.91	0.21	1							
Col 9	0.66	0.64	0.80	0.96	0.87	0.78	0.28	0.86	1						
Col 10	0.69	0.84	0.36	0.49	031	0.75	0.17	0.68	0.52	1					
Col 11	0.83	0.85	0.58	0..82	0.82	0.92	0.40	0.91	0.82	0.70	1				
Col 12	0.72	0.18	0.38	0.26	0.38	0.58	0.28	054	0.28	0.36	0.49	1			
Col 13	0.64	0.77	0.16	0.28	0.36	0.67	0.48	0.55	0.29	0.61	0.75	0.35	1		
Col 14	0.77	0.72	0.80	0.88	0.83	0.85	0.49	0.89	0.89	0.57	0.89	0.34	0.58	1	
Col 15	0.69	0.33	0.94	0.53	0.49	0.68	0.74	0.61	0.65	0.30	0.55	0.46	0.28	0.75	1
Col 16	0.78	0.37	0.71	0.75	0.81	0.75	0..29	0.82	0.77	0.37	0.74	0.78	0.27	0.71	0.66