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THE DECSION MAKING PROCESS OF MARKET INVESTMENT AND APPLICATION OF NEURAL NETWORK IN ASSIGNING APPROPRIATE WEIGHT AGE: A CONCEPTUAL EXCERCISE

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INTRODUCTION

The study of investment has been impaired by two fundamental constraints. The first constraint being the investors decision to pick and choose scripts from a list of trading stocks in a market and the second is the randomness through which the prices of these scripts move.

The problem that we face in the first instance arises of the fact that the decision process of the investors are affected by a series of information which float in the market, besides the fact that the investors carry a certain perception about a script. An investor uses both of these to come to an investment decision.

The second problem that is faced is the randomness through which the prices of these scripts are traded in the market. Though, the randomness is there, when a representative graph is created out of the trading prices in the market a definite pattern emerges. The fact remains that, such definitive pattern also get repeated. This forces us to conclude at one point or the other that, there is an order in the apparent randomness that we observe.

To understand what we are trying to discuss we have to look at some other analogy. Before that, let us at least agree that the process of investment decision and the stock market are two independent systems.

If we look at a living system, at the very inception, we find that the zygote is an infusion of two cells, which starts multiplying in a random manner. Now suppose, we take out from the set of information the fact that, we are sure about the living being that will ultimately come out at the end the process of cell division. Then the whole thing looks random and chaotic to us. But, the fact remains that, the cells grow in a certain way and from an apparent randomness, a complete living being is created, which is in order. We may further add here that as the living being keeps on re-orienting itself and grows older, the system within becomes more developed. How does this happen at all? The fact remains that, as the living being grows, there is wear and tear of the system. This should lead to continual destruction of the system. If these were allowed to grow, then whole system would collapse. This is known as entropy. Entropy describes the state of chaos that will occur if the destructions in the system are allowed to continue. The system creates a process where by the entropy is reduced and the system becomes more organized and non-chaotic. Thereby, the living being

emerges from chaos to an order. We may realize the fact that, the process that we are talking about is irreversible process through the period of time.

The analogy that we drew has greater meaning for us to understand in context of capital market analysis and the investment decision process since we have agreed at the beginning that both are systems and there fore can draw lessons from the living systems.

The prices that are generated for the scripts are time irreversible and apparently looks random. At the same time there is a general pattern which emerges which means despite the fact that there looks to be randomness, there is an order in it. We might even observe that the process has a part of it pre-designed and is in order and the other part of it is random in nature.

Now, when the investors take decision in this market, they use their learning in order to pick and choose the scripts in order to get the best performing portfolio for themselves. Doing so they use weightage, which are derived from their learning experiences. These weightages might take the decision far and wide from the real world situation.

In this light we might observe that the ideal investment would take place, when, a deterministic and reversible model can be built to predict and decide the price behavior of the stock market. Unfortunately, since the process itself is irreversible such a model building would be an exercise in futility.

Coming back to the usage of weightage in the investment decision process, we might observe that the weightage is a multipilcative factor to the investment parameter. As the process of investment moves, the weightages tend to increase in size and at the end, the proportion of the weightage is far too larger than the original investment parameter itself. This makes decision of investment difficult and inaccurate.

OBJECTIVE OF THE STUDY

The paper tries to understand the problems that are faced in making investment decision and try methods of neural network model in eliminating and overcoming some of those.

SOME EARLIER CONTEXTUAL WORK ON USAGE OF NEURAL NET WORK

There had been several cases where the neural network has been used to predict the stock prices and related areas of financial prediction. Dutta and Shekhar (1998) applied neural network to non-conservative domain of assigning rating to corporate bonds: Kimoto et al (1990), developed a system in which several modular neural networks learn the relationships between the past technical and economic indexes and timing for when to buy and sell. Yoon and Swales (1991), demonstrate that the neural network approach is capable of learning a function of maps input to output and encodes it in the magnitudes of the weights in the network's connection. Plasman, et al (1998) evaluate if a feed-forward artificial neural network specification can improve the prediction performance of the structural and random walk exchange rate models that fail to capture the highly nonlinear, monetary and non monitory relationships. Shaw and Gentry (1988) presents an expert system that mimics the thought process of lending officer. Pant and Rao

(2003) used a specific kind of ANN model to predict the BSE index and price. Most of study are based on predetermined model and addresses the success rate. Therefore there was a scope to work on a model that works on both the failure and the success of the predictive prices.

THE PERCEPTUAL MODEL OF INVESTMENT PROCESS

To have an understanding of the process of investment, we should give it an in-depth look. In order to get the best performing portfolios for themselves, investors pick and choose the scripts based on their perceptual learning. Furthermore, they try to pick only those scripts, which, according to their learning, will move towards the expected direction. Generally, Investors use instruments like Trend Analysis and Technical Analysis to forecast for individual scripts. Most of these instruments are dependent on historical data.

More often than not, the stock market, which is known for its volatility, defies all these predictions and rules. These abrupt changes remain unaccounted to all these perceptual learning of the investors. There is a probability that the market will face an abrupt change and vice versa.

When the market is going through the phase of abrupt changes, the market will behave chaotically and prices go haywire (upwards or downwards). This can be denoted as chaos band. When the market sails smooth, prices follow an orderly change and hit the order band. Here we should also state that in any system, the more the chaos the lesser will be the order. Similarly, the greater the chances of the reducing the chaos, the higher the chance of reaching an order.

As we know that there are chances of the market going through the abrupt phases as well as sailing smooth, let's denote the probability of the market to be in order or not facing chaos by p and the probability of the market run into abrupt change or chaos by q.

Therefore, the investment decision point will be the sum function of the probability of the market running into chaos and the market running into order.

$E(\delta) = f(p, q)$ .....(1)

p = the probability of the order

q = the probability of chaos

(We assume that 1-p = q in this situation)

In a typical investment decision process, the investor would take up a price to enter the market. Let's say the investor is investing at a price Pm, which is the current market price for a particular stock XYZ Corporation. Now, the investment process for a particular investor will be in order, if the ruling market price follows the expected path and at the next time frame Tithe price becomes P e, the expected price of the investor. In this case we will say that the market is in order and the price is hitting the order band. The investor will have hit the order band of the process if he/she reaches the expected positive return on the investment.

Hence, the change in return when the price hitting the order band, denoted by O will be,

$O = Pe - P_m / P_m$ .....(2)

Taking the stance, as discussed earlier, we can say that the investor will hit the chaos band of price, if they fail to reach Pe. Let this failure price be denoted as P_f. So this will make them hit the chaos band of the market expected price.

Therefore the change in the return when the price hitting the chaos band, denoted by C will be,

$C = P_f - P_m / P_m$. .....(3)

Therefore, the total change received by the investor will be affected by both the probabilities of market hitting the order and chaos band. And the investor while taking the decision of choosing a stock will have to use a discriminatory weight for both the factors, based on his own learning.

While doing so he will use all the factors, which would lead to his ability to reach, the band of order in the market. This weightage "co", is essentially, the differentials gain that the investor has on the total chances of his reaching the order out of the chances of the reaching the order and hitting the chaos band.

Since, the investment probability of an investor is the sum of the product of his/her weightage ascribed to the order band and as against the weightage ascribed to the chaos band, we can write equation (1) as follows:

$E(\delta) = \omega O + (1-\omega) C$

$E(\delta) = \omega [(P_e - P_m)/P_m]$

$+ (1-\omega)[(P_f-P_m)/P_m]$ .....(4)

In order to reach an expected price in the market and succeed, the expected risk arbitrage payoff will be zero.

Now, if we divide both the numerator and the denominator of equation (4), by Pm and solve for co, we obtain the following value of equation:

$$\omega = [1 - (P_f / P_m)] / [(P_e / P_m) - (P_f / P_m)]$$

$$= [P_m - P_f] / [P_e - P_f] \quad .....(5)$$

THE FUNCTIONING OF THE STOCK MARKET AND THE INVESTMENT PROCESS

As discussed earlier, the investor tends to seek a price in the stock market, which is best fit to his/her investment decision. In order to do this, the most common source of information the investor will seek is the price pattern of the market where he/she wants to enter. The process will make the investor seek information in a manner, where by he/she has several options to enter the market and exit it, just in case, one opportunity is lost. This will lead him/her to seek a band of price as discussed earlier. The suggested method would be obviously, to move along the trend of the market.

Now, suppose, the investor uses a certain amount of investment prudence and use the market information. In the process, the investor obtains a particular trend and extrapolates it to two or three points over a period of time in order to create three entry or exit prices in the market for him/her self.

Say, for our own convenience sake we propose that he want to exit the market by using a put at a high price and square of the deal. But, on the very day the investor was to exit, the market slumped below the expected price. This upsets the whole plan of the investor and makes his investment difficult. Why does this happen? Precisely because, the investors forecast of the market was way from the real price band and the weightages he/se has used were large enough to sway them away from the actual price that the market could have reached.

In other words we can say is that, the investor has hit the chaos band due to higher weightages (existing out of the

wrong learning and improper usage of weightage). This happens because the probable price path that the investor has observed is only one part of the total part of probable price shifts that occur in the market.

To elaborate this we give the figure 1.

The figure 1 indicates that the investor could take up path A as per the ability to predict the market, which is guided by the weightages he/she is able to ascribe according to the learning.

If, the investor take path A and the market follow any of the path i.e., B, or C or D, then the investor's market perceptive price P10 will never be reached instead, P8, P6 or P3 might be reached at X1 point of time when the investor wants to quit the market.

Earlier in our discussion, we have proposed a price, which is PF. The price band P8, P6 and P3, indicate the band through which the investor can reach the chaos band. This as indicated above will take the investor away from the price he/she wants to reach the expected price Pe.

This is where the weightage comes into picture. Let us reconsider the equation (5).

$\omega = (P_m - P_r) / (P_e - P_r)$

Rearranging the equation we get,

$\omega (P_e - P_r) = (P_m - P_r)$

or, $P_r = (P_m - \omega P_e) / (1 - \omega)$ .....(6)

We observe that, as ω increases, $(1 - \omega)$ decreases and makes ωP_e larger. Now, whether this increase of co will lead to an increasing or decreasing value of Pr depends on the value of P_m & P_e.

This observation leads us to some very interesting observations, which is represented in the Table:1.

To elaborate this we give the figure 1 below.

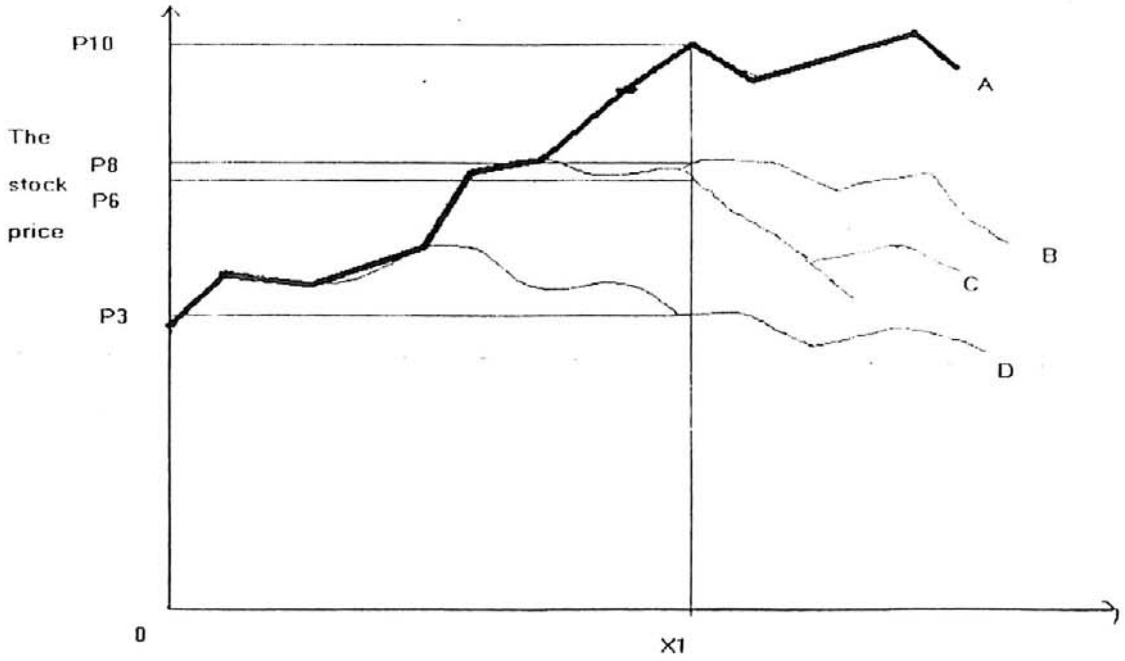

Fig 1 :
The various probable price paths that are expected over a period of time

Table 1.

Expected market trend change due to change in Pc vis-a-vis ω

Change in value of weightage	Market Trend	
	Bullish	**Bearish**
ω increases	P_f decreases	P_r increases
ω increases	P_f increases	P_r decreases

If we interpret the table 1 above, we reach the following conclusions

When the market is going through a Bullish trend, generally Pe is greater than P_m, and with increase of co, ωP_e increases by a value large enough to nullify the effect of decreasing (1- ω) and thus, P_r decreases.

Now, when Pc decreases with an increasing co always indicate towards wider 'order band' and sleeker 'chaos band' i.e. the probability of hitting the order band will also increase alongwith and the probability of hitting the chaos band will decrease. This leads the investor to an ideal situation where shelhe can reach the expected price with ease and greater probability and thus we can say that this perceptual model works perfectly in the bullish market trend.

When the market is going through a Bullish trend, generally P e is lesser than Pm, and with increase of ω, ωP_e increases, but the value is not large enough to nullify the effect of decreasing (1-ω) and thus, P_r increases.

So, when Pr increases with an increasing co, then we can similarly say that it is indicating towards wider 'chaos band' and sleeker 'order band' i.e. the probability of hitting the chaos band will increase alongwith and the probability of hitting the order band will decrease. So, this situation lead the investor to a situation from which it's very difficult to reach the expected price and the probability is very low.

Hence, the perceptual model has a propensity to be trained when there is a bearish trend in the market.

Using neural network and training of a model to predict the price in the market.

In order to train a model, we need to understand what are the probable price objectives that an investor will face. Under any given set of bullish or bearish trend in the market, the investor has to target the market with an exit or entry price. At the same time the market will generate a price trend. Therefore, at a given point of time there shall be four sets of alternative faced by an investors which are stated as follows:

a. The Investor has a higher target price and the market has a higher price trend.
b. The Investor has a higher target price and the market has a lower trend
c. The investor has a lower target price and the market has a lower trend.
d. The investor has a lower target price and the market has a higher trend

We therefore face a four-quadrant problem as indicated in figure 2.

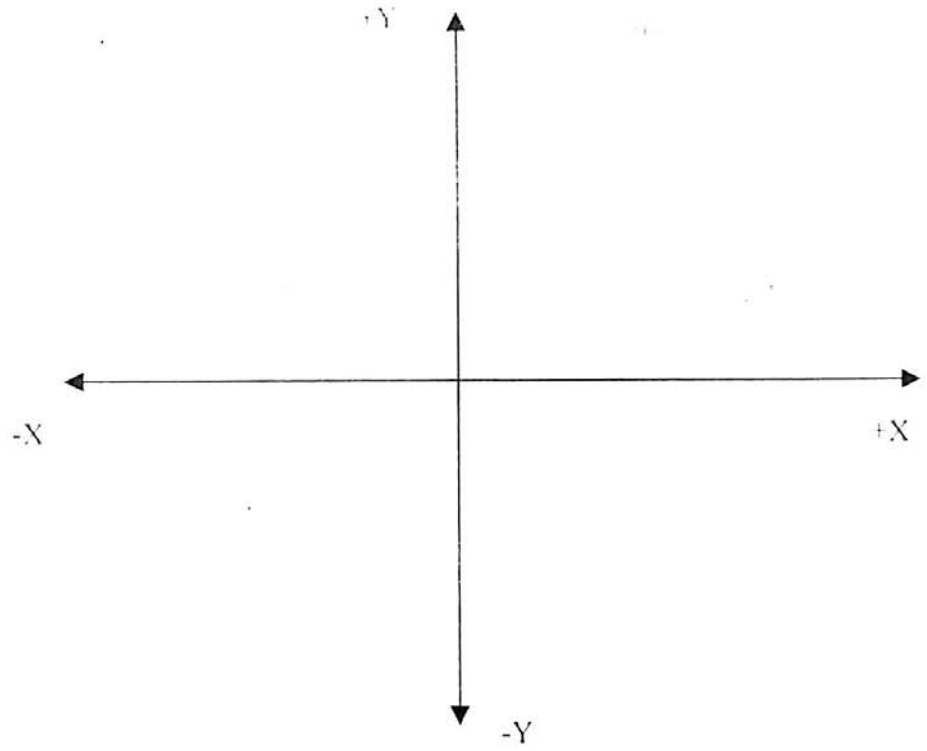

Fig 2: Opportunity of investor to enter the market vis-a-vis the market trend.
NOTE: The Y-axis indicates the market trend and the X- axis indicate the price opportunity of the investor. The negative part of the axis indicates the lower target price and lower market index and the positive axis indicate the higher target price and the higher market index.

Therefor at any point of time when the investor enters the market, they will use the weightages as depicted by the market information flow. In case we have a bearish market we shall have to deal with the two quadrants where the Y-axis is negative. The strategy of the investor will be to go to + X, + Y quadrant if he/ she wishes to sell the stock or go back to - Y, -x if he/she wants to buy the stock. This is in expectation that the investor has + X expectation and the market is - Y at the point of the entry of the investors.

The basic problem, as indicated in the discussions earlier, will lead us to conclude that, the wrong wightages in this situation will sway the investors decision point away from the desired strategy make them stay at + X,- Y axis only, and may be at a greater price.

Figure 3 indicates the net result of the situation.

As we observe that the end filter only increases the weightage, we there for need to decrease the weigtage to a grater extent so that the filters here, can reduce the weightages and take the decision to the right quadrant.

In order to decrease this we use the neural net, where we use the back propagation algorithm. The logic of the usage of the net is that, just like a live system, the net work will train itself to the best price possible to suit the investment decision. In order to do so, it will generate a net, which will continuously generate

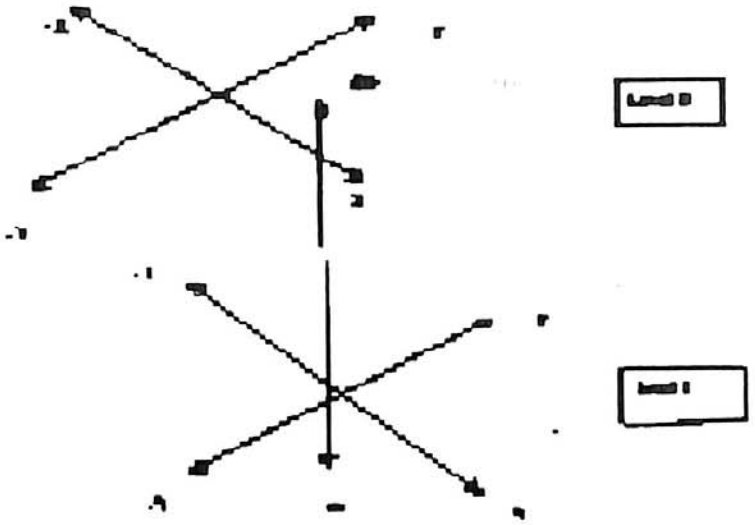

Fig 3: The Increase of weight age value as the various level of decision filter.
Note: The filter level basically indicates the decision of the investor to reach the choice goal.

price and substitute until, the right choice is reached.

Use of Neural Net work to generate right weightage.

In order to reduce the weightage we propose the classifier model of neural of network. The classifier model reduces the weightages in a more generalist way hence is better suitable model for the purpose of explanation of the study.

The neural net here is a sum function of the weitage and the expected price (band) that the investor proposes.

$$NET = \sum_{i} \omega \, P \quad \ldots\ldots\ldots\ldots\ldots (7)$$

Where,

ω_i= *The weightage of the model*

P_i=*The probable price (band),* P_e *or* P_f

In order to reduce the ω to Δω, we use the correction for the ω.

$$\Delta\omega = -\eta \frac{|P| \cdot P}{|P|^2} \quad \ldots\ldots\ldots\ldots\ldots (8)$$

As we go on correction factor the net works towards the right quadrant where the order price is located.

Now, suppose our value of Pi is in the negative quadrant. The probability of occurrence of the value is 1. Then in the negative quadrant the value will be -1. The'" correction of the Net value will be close to the predicted P in the model.

The model dm be trained to reach the approximate band of order, through the correction that we see here.

$$\Delta\omega = \frac{-1 \cdot 1}{+1} = -1 \quad \ldots\ldots\ldots (9)$$

The first level correction as we observe is still in the negative quadrant and therefore will not make the investor reach the correct price band.

Substituting, the value derived in equation, in equation (8), we get,

$$\text{Yo} = \begin{matrix} -1 \\ \vdots \\ +1 \end{matrix} \quad \begin{matrix} 1 \\ \vdots \\ +1 \end{matrix} \quad \ldots\ldots (10)$$

As we keep on correcting the weigtage gets corrected to the right quadrant where, the value is driven to an all positive quadrant. This is being propagated in a backward manner (hence, the name of back propagation algorithm), and the filtering happens in this above example in two stages.

In the model, we use one hidden layer. This hidden layer to train the model will increase provided the information that needs to be filtered is more. The inclusions of number of weightages (nodal) will also be critical to the model.

CONCLUSION

The model that is discuses above is based on a predictive failure and success rate of reaching a market band of prices. It is not possible by any human or artificial intelligence to predict the stock prices. Yet, it is possible to reach a appropriate order band of price and predict the market almost certainly. The model was trained by using classifier model of neura network. It was found that there are quite a good number of chances to predict the order brand provided the failure and success price of hit in relation to that of the market price can be learned and used to simulate the result. In order to simulate the model, the model can be trained to three layer of back ward propagation where by there will be hidden layer. The model discussed is generic in approach and can be trained using live data.

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