Genetic Algorithms to Optimise the Time to Make Stock Market Investment

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ABSTRACT

The application of Artificial Intelligence described in this article is intended to resolve the issue of speculation on the stock market. Genetic Algorithms is the technique that is used, with the article focusing on the different ways that chromosomes can be designed and on how the pertinent evaluation mechanism is established. The problem will be based on the speculation systems that are typical of Technical Analysis.

Categories and Subject Descriptors

I.2.8 [**Artificial Intelligence**]: Problem Solving, Control Methods, and Search – *Heuristic methods.*

J.4 [**Social and behaviour sciences**]*:* Economics.

General Terms: Algorithms, Economics.

Keywords: Stock exchange speculation, Genetic Algorithms, Technical Analysis, Chartism.

1. INTRODUCTION

There are two trends or types of analysis used by stock market traders. Exponents of Fundamental Analysis start from the hypothesis that the market mirrors a company's value based on its growth potential. They therefore anchor their forecasts on analysis of company accounts and trading figure projections. In this way, they can deduce whether a company is overvalued or undervalued. Technical Analysis is the second of the two trends. Its advocates do not concern themselves with 'fundamental' values such as sales, regulations or the working environment, but instead base their ideas on the hypothesis that any factor that truly influences the market will immediately show up in a company's share price and its negotiated volume. This technique therefore only studies indexes (digital filters for share prices and negotiated volume) and the charts that describe their movements. Chart analysis is a part of Technical Analysis called Chartism.

The Stock Market has attracted considerable academic attention, given the enormous sums of capital that are moved around it, and the wide range of techniques applied to forecasting stock prices range from those that border on the philosophic, such as the Golden Proportions of Elliot Waves, to more elaborate techniques such as Fuzzy Logic and Chaos Theory. All of them pursue the same end: to find some structure in a seemingly random signal. One of the classic techniques is the Tendency Line or minimum squares in Fundamental Analysis. Another that is frequently used for the Stock Market used indicators, which are generally based on weighted arithmetic averages, though these are little more than digital filters applied to quotation prices and shares volume.

Artificial Intelligence, particularly neural networks [1,4], has opened new horizons in the field of stock market-focused forecasting.

The first step in system design is to decide the approach to the problem. The following needs to be known: If you are out of the market, should you get into it? If you are in the market, should you get out?

A forecast of flat movements would entail biding one's time, as constantly joining and leaving the market entails considerable expense in the shape of intermediaries' commissions.

The inputs that will be considered, and which form the basis of decision-taking, will be the following technical indexes:

- The Relative Strength Index (RSI): This index ranges between 0 and 100 and measures the strength of a market tendency. Depending on the company, technical analysts recommend giving selling orders when it tops 70 and buying orders when it drops below 30.
- Moving Average Convergence Divergence (MACD); this index tries to predict market tendency changes before they happen. It provides two signals, which emit purchase and sales orders when they cross.
- The Stochastic Index attempts to forecast tendency changes, as MACD does, and provides two signals, %K y %D, which emit purchase and sales orders when they cross. Both signals are ranged between 0 and 100.

The aim of this article is not to define the formula of these indexes; suffice to say that there is a raft of finance-linked computer software that applies them.

2. The Genetic Algorithms Application

The chromosome will contain a series of bits with the main technical indicators, which will be used to situate the present market.

Table 1. Chromosome design.

3 bits	3 bits	3 bits	3 bits	3 bits
RSI	MACD	MACD - Sign	%K	%K - %D

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The evaluation function will have a chromosome as input and will give us a higher value the more the chromosome fits our criteria. For example, data that are not found will be penalised and will placed last when the population is organised. In contrast, if we find a chromosome that has occurred repeatedly, it should be scored positively and the number of times the chromosome has occurred should be evaluated and averaged [3]. It should be remembered that, given the discrete nature of the indicators that were quantified and the ongoing variation of the signals, neither of them will fit a single point and instead may possible fit a series of consecutive points (c.f. Figure 1).

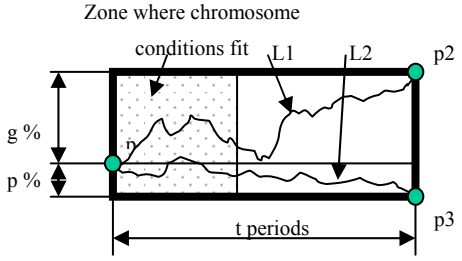

Figure 1: Zone where the chromosome maintains its value.

Point P1 is the first point where the market conditions are met. From this point an imaginary rectangle would be drawn defined by a percentage gain %g and a percentage loss %p. These two values define the upper and lower extremes of the rectangle and represent the maximum and minimum gains and losses. Their value will depend on the profitability sought and the risk that the investor is prepared to accept.

The evaluation function will evaluate situations providing profit positively, and situations leading to losses negatively. Another key factor is the time required to acquire profits or losses. Shorter periods of time should increase a positive output, as the stock price will have increased considerably with minimum risk involved. The corollary is also true; short periods associated to losses should be negatively evaluated. The evaluation function should also integrate a variant to improve investment opportunities [2]. If the number of times that market conditions prevail is not kept in mind, convergence may occur towards a one-off chance utopian solution that is unlikely to ever happen. One possibility would be:

$$\text{Evaluation(chromosome)} = \begin{cases} \text{If \% g} \rightarrow +1 \cdot (K_1 / t + K_2 \cdot N) \\ \text{If \% p} \rightarrow -1 \cdot (K_1 / t + K_2 \cdot N) \end{cases}$$

The value of the weighting coefficients K_1 y K_2 will depend on the risk function of the individual investor.

3. RESULTS

The genetic algorithm was run using data on the quotation prices of a Spanish telephony company for the 2004-2005 period, with separate daily values. The GA had the following characteristics: population size of 50 individuals, range-based selection, mask crossover, 80% crossover possibility, 1% mutation probability, elitism on one of the components and 10000 generations maximum. The continuous fitness function described above was applied, with constants K_1 and K_2 set at 1. The values of p% and g% were set at a value of 1.5%.

Table 3 provides the results for the best found chromosome and the coincidences that were found to improve the chromosome. In the Profit and Loss column, +1 indicates that the algorithm led to a profit for the particular coincidence, whereas –1 indicates that there was a loss. The day when this point began is also shown, as is the time it took to move from loss to the desired profits. The values for this chromosome are provided in Table 2.

Table 2: Values of the best chromosomes

RSI	MACD	MACD-sign	K%	D%
37.5 50	-0.0365 0.0372	-0.0365 0.0372	0 12.5	12.25 25

Table 3: Coincidences for the best chromosome.

	Profit/ Loss	Start	t
a)	+1	50	3
	+1	231	6
	+1	384	9

4. CONCLUSIONS

This article formulates an approach to the issue of stock market speculation from the perspective of when to buy in. Decisions are taken according to the values of certain technical indexes, with a Genetic Algorithm finding the optimum investment. Formulating the Evaluation Function and deciding chromosome hierarchy as a function of investment results obtained from historical data on stock prices is an interesting proposition.

The results obtained show that it is indeed possible to find and analyze positive market situations that have recurred on a number of occasions. We have shown how it is possible to add value or speed to results, or to increase the number of results (limiting risk). Future research could attempt to optimise this weighting in order to find a pattern that reiterates.

5. REFERENCES

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