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Stock Exchange Forecasting with the Help of Neural Networks

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1 Introduction

For the human brain there are a lot of problems that seem to present no difficulty at all, still they are problems of high complexity when handed to a computer. Neural Networks (NN) represent one of man's approaches of simulating the process of human thinking, with the goal of constructing computers that can resolve such problems as easy as humans can. In a certain degree, NN simulate the in reality existing connections between the living neurons in a human brain, and the synapses between them.

But NN can go further than just trying to simulate the human mind: they can solve problems that present difficulty for man as well. One of the possible application fields is economical process forecasting. This study considers the Stock Exchange(SE) Simulation possibility.

The study is still in it's early stages. Several approaches have been considered, out of which: temporal sequence processing, filter coefficients computation, the game approach,genetic algorithms, intelligent interpretation of line diagrams, explanation facility of NN, OCR approach, parallel processing.

The gain that this study offers is, next to opening a number of search paths for further research(ers?), also a theoretical and methodical problem analisation. This article proposes also an original solution, with it's implementation scheme.

2 Stock Exchange Mechanism

The Stock Exchange is, in short terms, an auction market, where stocks are bought and sold at prices determined by the bids and offers of investors. These are represented on the trading floor by floor by floor professionals, who use their skill, judgment and experience in order to obtain the best possible prices for their customers. The whole process is supported and made easier by the extensive usage of advanced technology [1].

3 Time series

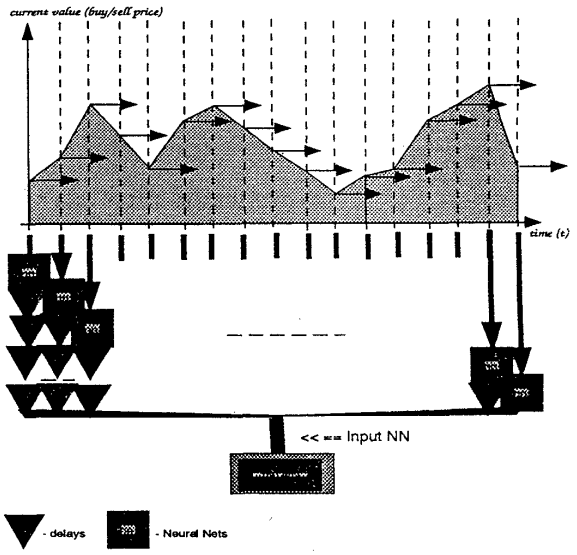
A time serie is [2]: "a set of values obtained by the observations made as an event develops usually taken an equal interval of time", that "can be represented graphically", and has characteristics of *trend* (general movement direction of the serie), *cyclus*, *season* and *irregular movements*.

All this features have been taken into consideration in the proposed solution, and as these factors have different reasons, different solving tools were constructed.

4 System Input Pre-Processing

The system input data are stock exchange market values (from the paper or other sources), processed finally to become a set of pairs of the form (*time_moment,value*), to serve as an input for the general NN.

The pre-processing mechanism is depicted in the following picture, that I consider self-explanatory:



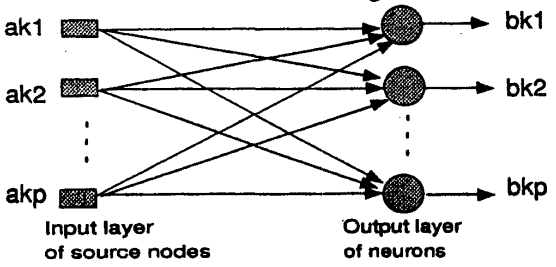
5 Neural Network: Heteroassociative Memory Matrix (HMM)

The function that has to be provided by the NN is the association of a set of *n* input values from the beginning of the considered time period with the set of the remaining *m* values till the end of this time.

The length of the time period and the rapport *n/m* is of considerable importance, but will be considered in further studies. The convergence chance of the NN depends on these choices (consider for instance n=1, when there is no prediction possible). Here the period is a month, and the rapport is considered given.

Therefore, the input-output relation is: *b=Ma*, with *a* the input vector of *n* values and *b* the output vector of *m* values. *M* is the HMM for which a suitable learning procedure has to be found.

The NN with the trained weights will be:



6 Mathematical considerations

The weights of the HMM matrix have to be computed. Several approaches were considered. The choices that have to be made are:

1) Selection of the NN for weights computation (number of layers, cells, etc.)

2) Selection of the computation rule (ex. : Delta-rule, Hebbian, etc.)

3)Selection of the actiovation function, last but not least, important for convergence aspects (threshold, sigmoid, etc.).

As initial energy function, allthough probably sufficient, the Delta-rule with the squared error penalty would do, but for a better convergence the *Linf* norm, also with squared-root, was chosen. The final function is:

dw[i,j]/dt=-nu[0]x[i]{r[i](w)+b[i]}.

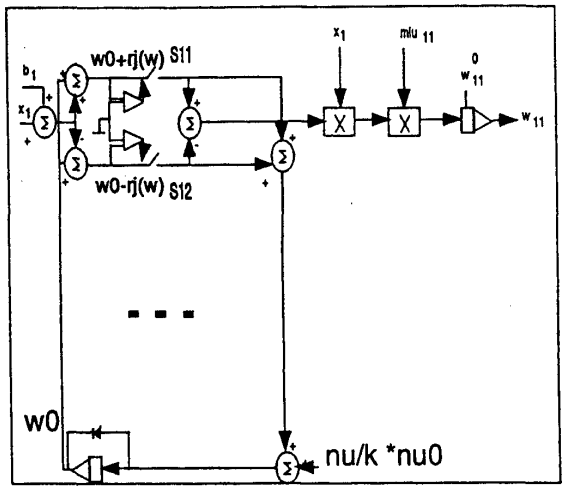
As for the layers, they can be deducted out of the further 7th chapter.

The activation function will be selected as the sigmoid function.

All values, input and output, are normalised values, in order to map over the continuous [0,1] interval.

7 Implementation Consideration

The equations computed above lead to the following scheme, that can be easily implemented as a NN:



The resulting network architecture implies 3 layers, two of sumators, and one of multiplicators, as can be seen in the picture.

This function should take care of the cyclus and seasonal movements, and in some respect, of the trend. The irregular movements will be covered by a indicator NN/rule base, which will add/subtract from the output value according to some proportionality considerations. The final output is therefore: *b'=Ma + sum(funct[every single indicator])*. See [3] for indicator computation.

8 Conclusion

For a problem of interest as the NN SE one there has been given an original and hopefully closer to the reality computational mechanism, strongly relying on NN parallel processing power.

Bibliography

[1]NYSENet, http://www.nyse.com/public/about/market

[2]Izzo,Pepicelli:NN WIRN VIETRI92,World Scientific

[3]Ankenbrand,Tomassini, ANN&Genetic Alg.,Springer