

SOFT COMPUTING AND STOCK MARKET

The applications of soft computing is spread together with the development of knowledge in the branch of mathematical analyses. The aim is to fix best the future development of prices of shares, currency ratios and commodities during the operation in the world market. The results from fundamental, psychological, technical analyses and other methods can be applied for these purposes. One of the possible methodology for time series analyses and prediction is shown in Appendix. The description is as follows:

A) A great deal of information can be received from press, radio, television and Internet, e.g.: news from firms, their plans, management, economic information such as (EPS, P/E, ROE), future earning potentials, dividends, income, debt, returns, income statement, balance sheet, earning and financial comments and so on. As well the values dealing with the history of data of prices might be obtained with various samplings, i.e. to obtain a time series. The time series can be processed by means of mathematics analyses with their advantages and disadvantages (objective process, fail of calculation).

B) Data mining means the classification, sampling, sorting, cleaning, supplement and transformation of data. Data mining can include verification and simple evaluation.

C) The information can be processed by fundamental analyses. E.g. the Delphi method enables us to evaluate the knowledge of analysts and based on the scale of influence leads into the decision making process with there advantages and disadvantages (subjective process).

D) As the input analysis could be used the methods of determining whether the time series is deterministic, fractal or random. Having proved that the time series is purely random, another search with the aim to determine the future development of price is irrelevant. We can be disappointed with the results of incorrect analyses. Hurst exponent indicates, whether the time series is normally distributed, has long "memory", whether the time series trend is an antipersistent (persistent) or reverting (reinforcing) time series. The fractal dimension can be used for these purposes, too. Other possibility is to use the Lyapunov exponent, which determines the range of predictability of time series. If the time series is not random and has a good predictability then it is suitable to continue in other analyses.

E) One can use the analyses by means of Elliott's waves, which applies the knowledge of psychological analysis. It is possible to determine the future tendency of future price from the types of waves.

F) It is possible to study the time series by means of regression analysis, dynamic models, fuzzy logic, artificial neural networks, genetic algorithms, chaos analysis, hybrid models, wavelet analysis or Kalman filter.

G) It is possible to analyse time series in a post mortal way. We can do a regression analyses and calculation of indexes which exist in huge number over past data. (E.g.: Bollinger Bands, Stochastic Oscillator, On Balance Volume, etc.). We can simulate buying and selling signals in the past in order to obtain a view of the behaviour of the price depending on time and to estimate the possible future development of the price.

H) It is possible to make a calculation of prediction of time series by means of the dynamic models represented by means of non seasonal and seasonal ARIMA (Autoregressive Integrated Moving Average) models and by various types of "smooth" models.

I) Another possible calculation is that of trend identification of prediction of time series by means of fuzzy logic. The trend prediction of time series is calculated on the basis of fuzzy rules. The process of fuzzification, fuzzy inference and defuzzification are used.

J) You can make a calculation of prediction of time series by means of the artificial neural networks. The sigmoid and hyperbolic tangent seems to be the best for prediction.

K) Another possible calculation is that of the trend identification of prediction of time series by means of genetic algorithms. The trend prediction is calculated on the basis of logical rules when the maximum profit is being searched by means of optimization. The various algorithms can be used for prediction of time series, for example parallel evolutionary ones.

L) The chaos analysis represents the calculation and evaluation of Hurst and Lyapunov exponents as mentioned in section D). The TAR (Threshold Autoregressive) model and ARFIMA (Autoregressive Fractional Integrated Moving Average) model can be mentioned in this section.

M) The hybrid systems can be created by the combination of fuzzy logic, artificial neural networks, genetic algorithms and the theory of chaos. There can be various combinations where the neuro – fuzzy- genetic – chaos one is the most complicated.

N) It is possible to analyse time series in a post mortal way by wavelet analyses. We can use for decomposition of time series the wavelet function according Daubechies. The future values can be estimated by means of Kalman filter.

O) The simulation is the process that describes the behaviour of the analysed system (stock market) by means of differential equations. The stock market as a financial system can be described as a system with a positive and negative feedback. The positive (negative) feedback amplifies the increase (decrease) of prices.

P) Other outputs can be based on the intuitive forecasting or “exotic” analyses can be mentioned. E.g. the influence of the sun and phases of the moon on prices of shares.

Q) The decision making process is very complicated. Because there can be even contradictory outputs from these analyses, it is suitable to apply the fuzzy logic for their evaluation.

R) It is necessary to evaluate and compare the results of prediction with the actual values in a post mortal way. The quality of prediction models can be evaluated, for example by means of MAPE (mean absolute percentage error). This way is possible to change the weight of individual analyses. The decision making process is a dynamic one where the continuous and on line evaluation become necessity.

S) The buying and selling signals can be realised in various ways e.g. by means of e-business via Internet or in other ways.

The decision making process has been made by means of fuzzy logic in a following manner. The outputs of fundamental analyses demonstrate the level of news, balance sheet and economic data such as EPS, P/E and ROE: the best, better, good, neutral, bad, worse, the worst. The outputs of psychological analyses are the prospective trend created by the behaviour of crowds on the stock market: neutral, high, medium, low increase or decrease. The outputs of the technical analyses are processed in the form of vague description from regression analyses, dynamic models, fuzzy logic, artificial neural networks, genetic algorithms and chaos analyses. The intra-daily, daily, weekly and monthly predictions and judgement of prices, indexes and their trend developments represent values: neutral, high, medium, low increase or decrease. The outputs of simulation and other methods can indicate the prospective trend of time series: neutral, high, medium, low increase or decrease.

All the inputs of fuzzy logic (output results from all analyses) are processed by fuzzy rules. The fuzzy rules are in the form: If **A** then **B**. The evaluation of prediction errors from various analyses has been used for setting the weights included in fuzzy rules. The analyses with more (less) accurate predictions have higher (lower) weight in the decision making process.

The output of fuzzy rules is produced in the form of scale in range from -100% to +100% (from immediate buy to immediate sell) or via five ranges: strong buy, buy, hold, sell, strong sell.

The figure represents the scheme of fuzzy logic decision making process, where the symbols of individual analyses C,E,G,H,I,J,K,L,M,A,O,P are used for inputs and Q for output.

The correct analyses and evaluation gives us the correct answer how to work with the prices of shares, currency rates or commodities. The elements of soft computing enable us to improve the decision making process during the operation on the world stock markets. The financial and economic processes prediction is so complicated that we are forced to use the best methods of analyses. The science turns into art here.

Fuzzification

Fuzzy inference

Defuzzification

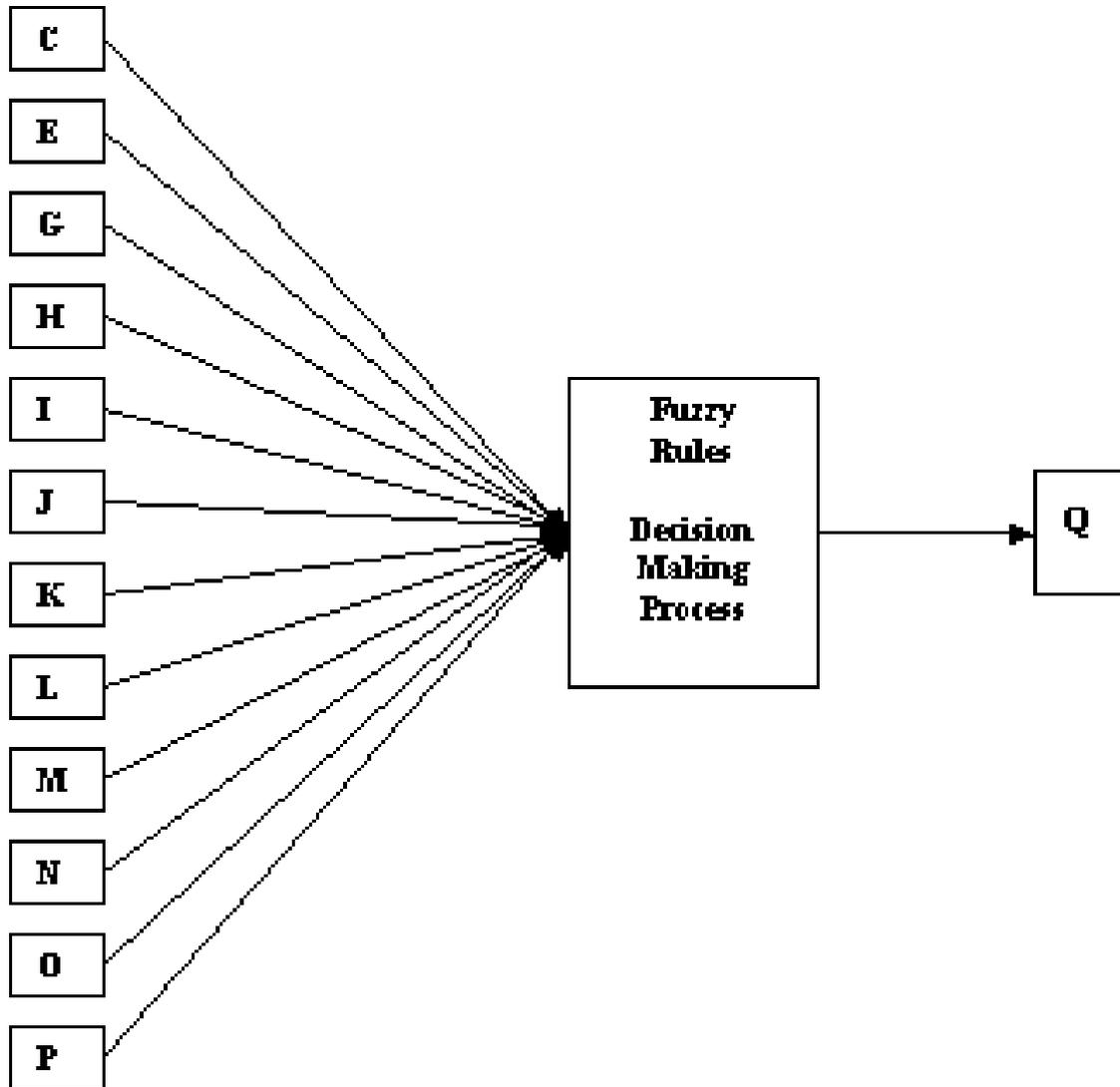
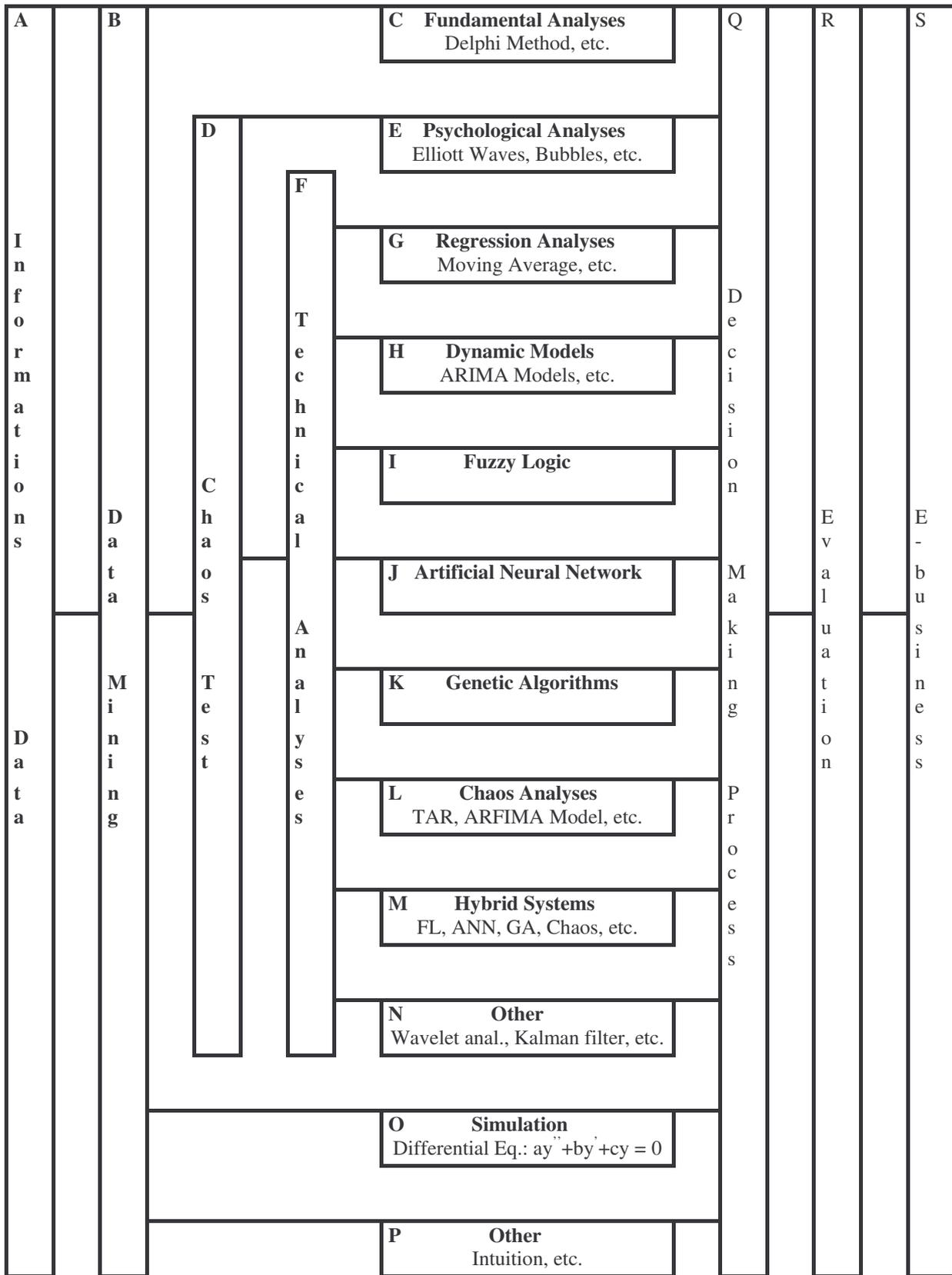


Figure: The scheme of fuzzy logic decision making process



Appendix: Soft computing and methodology for time series analyses and prediction