

## Some Aspects of Financial Instruments' Price Modelling

Prof. Borko Krstic, Ognjen Radovic, Srdjan Marinkovic, and Ksenija Dencic

The necessity of mathematically describing some of the most complex and most unusual phenomena has started the searching for a "model" ai. for some mathematical rules that are capable of production some parts of the reality using computers. The classical attitude of complex system observation has been based on the universum reduction in the set of independent, separate entities, that are introverted and unable for real communication. Nonlinear dynamics is, on the other hand, concentrated to dynamics of the system on the whole. Nonlinear dynamic systems (NDS) are systems in a state of motion and systems whose behavior can not be expressed by linear algorithm. However, real world is a world consisted of endless heterogenities and complexities, one multidimension world that doesn't recognize straight lines and completely symmetrical forms; in this world, even empty space is squwed.

The scientists have pointed out to the fractal dimension of capital markets and brought back interest for nonlinear models. The idea of fractal nature of time series of many economic phenomena has been present for a long time, but it has been neglected because of the complex mathematics which one is in the connection with it. The application of complex nonlinear models and the interest for the fractal distribution has increased with the development of high technology. Fractal distribution is primarily the consequence of different sentiments of the investors as well as the result of time factor influence on decision making process.

Thanks to the fact that the scientist begin to understand better and better nonlinear systems, their complexity and selforganization, a new paradigm is emerging. We begin to understand complexity as natural state, not as deviation. Many physical systems are, in fact, complex nonlinear open systems. Simple, isolated systems (that are in the centre of attention of traditional science), present the extreme idealization.

APT (Ross & Ross, 1980.) has been wide used in portfolio management as alternative model for capital-asset pricing CAPM (Sharpe). A difficulty with APT arise when it should estimate expected stock's return. The fact that there is a set of factors with such characteristics that expected returns can be explained as linear combination of every asset's exposition to these factors, is the key idea of APT. Last years, artificial neural networks, instead of classical statistical techniques, has been used for prediction in APT model. The result that have been obtained using neural networks show better performance comparing to the linear regression for the predictions out-of-sample.

The aim of the authors has been to show some difficulties in the use of classical pricing models and to cite some modern tendencies in a nonlinear dynamics systems analyse (where as well belong financial instruments pricing). In the developed program (OLIMP 1.0), beside classic statistical approach to the stock price volatility estimation, the authors have used chaos theory, fractal analyse of signals and neural networks.