Systemic Approach to Estimation of Financial Risks

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Modern approaches to risk estimation, forecasting and management are based upon intensive application of mathematical modeling, estimation theory, application of Bayesian statistics, simulation, decision making methods and techniques and other approaches [1]. One of the most suitable instrumentations for risk analysis and management create informational decision support systems (DSS) that are widely used for solving different problems from the realms of forecasting, control, medical and engineering diagnostics, planning and management. The systems of this type have the following advantages: wide possibilities for usage of various data processing techniques, identification and mathematical description of possible uncertainties directed towards improvement of quality for final results, hierarchical architecture of the systems is compatible with the human approach to decision making, the possibilities for application of several sets of necessary statistical criteria for testing intermediate and final results. All these possibilities create a part of systemic approach proposed for risk analysis and management.

The systemic approach to modeling and estimation of financial risks is based on system analysis ideas that refer to hierarchical data processing architectures, modern techniques for analyzing model structure and parameters, identification and taking into consideration possible uncertainties related to data and estimation algorithms. The approach also includes the possibilities for control of all relevant computational processes at all levels of hierarchical structure of the system by appropriate set of quality criteria so that to reach high quality of final results. It supposes analysis performing for internal and (stochastic) external influence factors to various sides of financial company activities including stochastic disturbances of different nature and types, application of statistical simulation techniques in the frames of DSS. The DSS proposed has features necessary for identification and taking into consideration possible uncertainties of structural, statistical and parametric type. The uncertainties are encountered in the process of preliminary data processing, model constructing, and computing forecast estimates. It is possible to substantially reduce their influence on the quality of the final result using such modern techniques as preliminary data pro-

cessing together with application of adaptive model structure and parameter estimation techniques.

The most often met statistical uncertainties, related to preliminary data processing, model development and estimation of forecasts are provoked by the following factors: measurement errors that is available practically in all cases of data collection independently on the data origin (including economy, finances and industrial control systems); stochastic external disturbances that usually negatively influence the process under study and shift the processes from desired mode (say, offshore capital transfer from some country, low quality of higher administration, unstable often changed laws, substantial corruption, local hybrid wars); missed observations and possible outliers; multicollinearity of independent variables, correlation of dependent variables with noise factors etc. The most often means used to fight the measurement noise and external stochastic disturbances are digital and optimal filters (say, Kalman, particle and elliptical filters). Today there is a number of Kalman filtering techniques designed for special cases. Appropriately designed adaptive Kalman filter provides a possibility for covariances estimation for stochastic disturbances and measurement noise as well as estimation of quality short-term forecasts. Optimal filter design requires model of the process (system) under study in the state space form.

Intellectual data analysis techniques are effectively hired for risk analysis, estimation and management that include static and dynamic Bayesian networks, nonlinear Bayesian regression, special statistical data processing techniques, multivariate distributions, and fuzzy logic. Very promising is combined application of various techniques in the frames of scenario based approach. All the techniques mentioned are suitable for implementing in the adaptive form which is useful for analyzing of nonlinear nonstatinary process widely spread in finances.

1. A.J. McNeil, R. Frey, P. Embrechts, *Quantitative risk management* (Princeton: Princeton University Press: 2005).