VON NEUMANN-GALE DYNAMICAL SYSTEMS WITH APPLICATIONS IN ECONOMICS AND FINANCE

Igor V. Evstigneev, University of Manchester

Joint work with E. Babaei, W. Bahsoun, S.D. Flåm, S.A. Pirogov, K.R. Schenk-Hoppé, and M.V. Zhitlukhin

Von Neumann-Gale dynamical systems are defined in terms of multivalued operators possessing properties of convexity and homogeneity. These operators assign to each element of a given cone a convex subset of the cone describing possible one-step transitions from one state of the system to another. The classical, deterministic theory of such dynamics was originally aimed at the modelling of economic growth (von Neumann 1937 and Gale 1956). Key results on von Neumann-Gale dynamical systems may be regarded as multivalued nonlinear versions of the Perron-Frobenius theorem on eigenvectors and eigenvalues of positive matrices.

Attempts to build a stochastic generalization of this theory were undertaken in the 1970s by Dynkin, Radner and their research groups. However, the initial attack on the problem left many questions unanswered. Substantial progress was made only in the late 1990s, and final solutions to the main open problems were obtained only in the last 10-15 years.

At about the same time it was observed that stochastic analogues of von Neumann-Gale dynamical systems provide a natural and convenient framework for financial modelling (asset pricing and hedging under transaction costs). This observation not only gave a new momentum to studies in the field and posed new interesting questions, but also made it possible to find a key to the solution of old problems. The new, financial interpretation of the mathematical notions and objects at hand amazingly suggested the way of proofs that could not be found earlier.

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