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The Mathematical Theory of Minority Games. Statistical Mechanics of Interacting Systems

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The minority games have opened a new great topic in the non-cooperative game theory. Moreover, they represent a new tool for the study and analysis of the phenomenon of self-organization and stability of systems whose structure does not support the stability of the behavior of individuals and groups. For those who are not familiar with recent theory of games – the term “minority game” is used for non-cooperative games with odd number of agents, where each agent has only two alternatives of behavior, the choice of some of them is obligatory, and the players forming the less numerous group (minority group) become the winners. This basic model includes many specific modifications, mostly regarding the rules of the choice of individual strategies, sometimes also the winners’ pay-offs and some other components of the game. The minority games become especially interesting in the case of their many repetitions with special attention paid to the dynamics of the players’ behavior. The intuition, as well as the theoretical analysis, show that there cannot be any stable situations on the individual level but the game in the whole displays interesting regularities of statistical or, more generally global character.

The model of minority games has many inspirative applications in the theory of buy-and-sell markets, statistical physics, social grouping and many other fields. This motivates the increasing interest of the game-theoreticians in this type of games resulting in new publications devoted to the topic. The referred book belongs to them.

The text is divided into ten chapters, completed by six appendices. The chapters can be clustered into three groups. The first one is formed by three chapters of rather preparatory type. Except the generally game theoretical “*Introduction*” of the basic concepts, this group includes also “*Preparing the stage of statistical mechanics*” devoted to the preparation of concepts related to the physical applications of the theory, and “*Pseudo-equilibrium replica analysis*” which can be nearer to the models of social choice.

The second group includes six main chapters of the book. They are focused on the dynamics of the minority games (in the book also MG) in different modelled systems. These chapters deal with “*Dynamics of the batch MG with the memory*” regarding the basic mathematical formulation of the model, “*Dynamics of the on-linear MG with the fake memory*” in which the analysis of the dynamics with respect to the ergodicity of the system continues. After a very short chapter on “*The overall bid distribution*” the analysis of MG continues by chapters oriented to more specific models, namely “*MG versions with new types of phase transition*”, economically localized “*Dynamics of MGs with true market history*”, and suggestion of possible modifications titled “*Variations and generalizations*”.

The third group includes a single chapter, “*Notes*” summarizing heuristic comments to the presented model and its history. Most of the six appendices are devoted to some marginal or less common mathematical concepts presented in the previous chapters, except the first and the last appendices presenting the used mathematical conventions and a brief overview about mathematical simulations, respectively. The volume is completed by not very extended, however representative, list of “*References*” and by the “*Index*”.

The referred volume is organized in a lucid, well readable way and parted in relatively short sections allowing easy orientation in the text, as well as good re-orientation in the case of repeated study of some selected parts. The style of presentation is (except the last

chapter and two appendices) consequently mathematical. Nevertheless, the basic courses of mathematics are sufficient and, moreover, some less familiar concepts are explained in appendices.

The volume can be recommended to any reader with basic knowledge of university mathematics who wishes to see a representative overview of recent level of the research in the minority games theory and its most significant fields of applications.

Milan Mareš