

**Review of the master's thesis**  
**«Hierarchical Model of Corruption: Game-Theoretic Approach»**  
**by the student of master programm «Game Theory and Operations Research»**  
**Ivan Orlov**

Ivan Orlov's master thesis is devoted to the investigation of corruption in the framework of mathematical modeling. Research methods include tools of the classical game-theoretic approach, simulation and computer modeling, scenario and parametric analysis. The subject of the research and the ideas outlined in the work do not raise doubts about the relevance of the research.

The corruption model is designed as a three-level hierarchical game in which players are risk-neutral and utility maximizing. The problem is divided into two stages: embezzlement of money provided by a high-level player (leader) to solve a certain task, and inspection of the officials subordinated to the leader. It is assumed, that the inspection is effective (reveals existing embezzlement). In reality it creates the possibility of bribes. The constructed model is investigated in detail using a specific example with three levels and six officials using computer simulation. The equilibrium is found, but it looks pessimistic: the level of corruption is very high. Therefore, the settings for minimizing corruption were found. The cooperative setting of the problem was also considered. Coalition formation and allocation rules are formed, Myerson's value for the original and modified versions of the game were calculated. The simulations were repeated to obtain statistically reliable results.

An extensive review of the literature, the original formulation of the problem, the simulation performed, and the code, created for this purpose, are worth noting among the advantages of the work. The limitations of the work include the fact that the study of the model and the identification of general patterns were carried out using a particular example. It can be also noticed that the cumbersome mathematical calculations make it difficult to perceive the essence of the processes they describe. But this problem is difficult to avoid in the field of mathematics under study. These comments do not affect the overall positive impression of the work.

The volume of the master's thesis is 95 pages, including a list of references (18 sources) and appendices containing the simulation code and detailed mathematical calculations related to the analysis of the allocation rules. Earlier results were presented at the following conferences: Control Processes and Stability (CPS'20), MCTaIA-2020, the Fourteenth International Conference on Game Theory and Management (GTM'2020) and Control Processes and Stability (CPS'21) and were published or are being published at the moment in their proceedings. The Blackboard system's automatic report on the check for plagiarism revealed 100% of the original fragments in the text, which

indicates the absence of direct citation of the previously published works by the master's student and other authors.

Based on the above, I evaluate Ivan Orlov's thesis on “excellent” mark.

Scientific adviser:

Senior Lecturer of the Department of Mathematical Game Theory and Statistical Decisions

Saint Petersburg State University,

Ph.D.



S.Sh.Kumacheva