



### University textbook

## PRIMJENA TEORIJE IGARA U PROMETU I LOGISTICI (APPLICATION OF GAME THEORY IN TRAFFIC AND LOGISTICS)

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As part of the library *Manualia universitas studiorum Zagrabiensis*, the textbook *Application of Game Theory in Traffic and Logistics (Primjena teorije igara u prometu i logistici)*, written by Jasmina Pašagić Škrinjar, PhD, and Borna Abramović, PhD, has been recently published. The book is primarily intended for students of the Faculty of Transportation and Traffic Sciences at the University of Zagreb as obligatory literature for the Game Theory (*Teorija igara*) course. Additionally, it may be useful to students of other faculties and universities of applied sciences where the application of game theory is studied. This textbook also provides useful insights for practitioners who make numerous business or technological decisions in real-life working environments, which can be modeled as decisions of opposing sides for any type of phenomenology. It is

important to point out that the content and the approach for this book was determined by the fact that it was intended for non-mathematicians. In that sense, the mathematical aspect is presented in the form of an engineer tool for specific examples which can be encountered in traffic and logistics.

The textbook contains 175 pages which are split into 11 chapters. The textbook is supplied with 32 figures, 66 tables and contains an appropriate index of concepts and list of references.

This university textbook is comprised of the following chapters, arranged in a logical methodological order:

In the first chapter, titled *Game Theory - A Decision-Making Tool for Traffic*, besides the introductory part on the necessity of studying game theory in traffic technology and logistics, the phases of solving decision-making problems are presented. Possible ways to make decisions in conditions of uncertainty are specifically explained.

In the second chapter, titled *The Basic Concepts of Game Theory*, the basic concepts and the related terminology of game theory are explained, including those of game, player, strategy, outcome, etc. The chapter covers the appropriate categories according to outcomes and explains how uncertainty and information availability affect the game and the outcome.

*Game Modeling* is the third chapter, where zero-sum and bimatrix games are defined. The extensive form of game representation is presented, as well as the appropriate transformation of the game from normal to the extensive form and vice versa.

The fourth chapter, titled *Solving Games Through Dominance*, provides an overview of methods for strategy selection according to the criterion of elimination of dominated strategies for zero-sum and non-zero-sum games, as well as the limitations of elimination of a dominant strategy.

In the fifth chapter, titled *Optimal Strategies - the von Neumann Criterion*, the minimax method of selecting a strategy is presented, as well as a method of establishing the existence of a saddle point and the selection of a pure strategy. In addition, for games without a saddle point, a method for establishing game probability for certain strategies is presented. Furthermore, modeling of matrix games by applying linear programming is covered.

The *Nash Equilibrium* is the title of the sixth chapter, where the concept of determining the Nash equilibrium in simulated games and the extensive form of games is described. Games with multiple Nash equilibria are presented, conditions of cooperation and coalition are defined, as well as the presentation of effects of such cooperations.

In the seventh chapter, titled *The Negotiation Game*, the theoretical basics of the negotiation game are presented. Additionally, illustrative examples from the areas of traffic and logistics are presented.

Chapter eight, titled *Discussing Game Theory and Possible Applications*, is especially notable, as it provides a critical review of the possible applications of game theory in real-life environment, along with the important remark of the authors that game theory should, after all, be understood just as modeling of real-life decision-making problems and consideration and quantification of all possible actions. The authors state that this model (i.e., in this case a game) should be comprehensive enough that it can be taken as a satisfactory approximation of a real-life business/technological situation being analyzed, but at the same time it should be simple and practical enough for a concrete analysis. Possible uses in traffic and logistics are presented with several examples throughout the chapter.

In the ninth chapter, titled *Some Concrete Uses for Game Theory*, game theory is applied to some practical problems, such as purchase of loading and unloading cranes, determining quality level of transport services, entry into a logistics market, price competition, and selection of a new bus route in urban transportation.

*Graphical Solutions for Matrix Games* is the title of the tenth chapter, where the graphical method for solving matrix games is presented through several examples.

In the final, eleventh chapter, titled *Models and Decision-Making*, features of certain models are described. A selection of methods and techniques is presented. Special attention was paid to the significant problem of data gathering for decision-making purposes. It is of great importance to point this out to future experts in the fields of traffic and transportation technology and logistics because they will often be the ones in charge of this extremely important and sensitive task in project teams. Real life has shown that many practical cases have encountered problems precisely in this decision-making aspect.

The reference list is comprised of 35 references from the field of game theory. This textbook was written so as to fully adhere to the professional terminology from the fields of game theory and the technology of traffic, transport and logistics. Most chapters are structured with a brief historical overview, clear definitions, and an illustrative example, followed by a detailed elaboration of a corresponding problem.

This university textbook fills a substantial void in studying and teaching applied game theory in traffic and logistics.

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