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Marco Alberto Javarone

Statistical Physics and Computational Methods for Evolutionary Game Theory

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Disinterested love for all living creatures,
the most noble attribute of man.

Charles Darwin

Preface

The idea to write this book originated during the Conference on Complex Systems held in Amsterdam on September 2016, where the first satellite on evolutionary game theory was proposed and obtained the attention of several participants, thanks also to two great Keynote speakers: Yamir Moreno and Francisco C. Santos. The evolutionary game theory represents a vibrant and growing research field. So far, many interesting books have been written on this topic or have introduced at least in part its main elements. So, the reader might wonder why a further book on this topic should attract the attention. Well, actually, aside from providing a brief introduction to the main concepts, the aim of this book is to frame evolutionary game theory in the context of the science of complexity providing, at the same time, an overview on some computational strategies for dealing with the related models. As discussed in the following chapters, nowadays the science of complexity deals with different topics, which can be viewed as a very big basket including a number of challenging topics, spanning from biology to social science. Here, the evolutionary game theory constitutes a valuable framework for representing and studying different complex phenomena. In addition, as mentioned, the second goal is to highlight the connections with statistical physics issues, e.g., the phenomenon of phase transitions, and to show how to use its tools, combined with other computational methods, for studying the dynamics of evolutionary game theory models. Accordingly, we hope to stimulate the interest of readers with some relevant contributions to this field, as scientific papers and other books, found in the list of references. Unfortunately, due to the limited space, we have not been able to include all the valuable references. The structure of the book reflects the need to condensate relevant issues, exposing them in a clear and simple way. Therefore, we decided to begin with a simple introductory chapter, followed by a second one focusing on some statistical physics methods. Moreover, the second chapter illustrates some computational methods for generating and analyzing complex networks, being a "tool" of great interest also in this area. Then, Chaps. 3 and 4 illustrate practical cases, i.e., the structure of two famous games (Chap. 3), the prisoner's dilemma and the public goods game, and two applications (Chap. 4), one framed in the context

of social dynamics and the other in that of combinatorial optimization. Finally, a conclusive chapter summarizes some important concepts exposed in the previous chapters and provides a short overview on further developments. To conclude, we hope that students and researchers will find the book useful for starting their journey in this exciting field.

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