1 Introduction: Why Strategy in R?

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Why study strategic interaction computationally, and why R is the right tool for the job.

1.1 The computational turn in game theory

Game theory began as a branch of mathematics. Von Neumann and Morgenstern (1944) laid the foundations; Nash (1950) proved that every finite game has an equilibrium. For decades, the field advanced primarily through theorems and proofs.

But the questions that matter most — *Which equilibrium will players actually reach? How do strategies evolve in populations? Can machines learn to play well?* — are fundamentally computational questions. They require simulation, numerical methods, and algorithm design. This book is about answering those questions with working code.

1.2 Why R?

R is the lingua franca of statistical computing and data science. It has mature ecosystems for visualization (`ggplot2`), data manipulation (`dplyr`), differential equations (`deSolve`), network analysis (`igraph`), and interactive graphics (`plotly`). For researchers who already think in R, there is no reason to context-switch to another language for game-theoretic computation.

Where R falls short — deep learning, counterfactual regret minimization — we use Python via `reticulate`, keeping the analysis pipeline in R while calling specialized Python libraries.

1.3 The structure of this book

The six parts of this book form a progression:

1. **Foundations** build the conceptual vocabulary: what games are, how to solve them, what equilibrium means.
2. **The R Toolkit** introduces the packages and utilities we use throughout.
3. **Simulation** moves from analytical solutions to computational experiments: Monte Carlo, agent-based models, evolutionary dynamics.
4. **AI and Machine Learning** explores how learning agents interact strategically: reinforcement learning, self-play, and frontier methods.
5. **Applications** grounds the theory in real domains: auctions, matching markets, bargaining, and empirical case studies.
6. **Ethics and the Future** asks what happens when strategic AI systems interact with humans and each other.

Each chapter is self-contained enough to read independently, but the parts are designed to be read in order for a coherent narrative.

1.4 How to use this book

Linear reading is best for graduate courses or self-study in game theory with a computational focus. Start at Part I, Chapter 1.

Reference reading works well for practitioners who need a specific tool. Jump to the relevant chapter, follow cross-references backward for prerequisites.

Project-based reading pairs well with the exercises. Each chapter ends with problems that can serve as starting points for course projects or research extensions.

Let’s begin.