

James N. Webb

# Game Theory

**Decisions, Interaction and Evolution**

Springer

# *Contents*

## **Part I. Decisions**

<b>1. Simple Decision Models</b>	<b>3</b>
1.1 Optimisation	3
1.2 Making Decisions	5
1.3 Modelling Rational Behaviour	11
1.4 Modelling Natural Selection	17
1.5 Optimal Behaviour	21
<b>2. Simple Decision Processes</b>	<b>23</b>
2.1 Decision Trees	23
2.2 Strategic Behaviour	24
2.3 Randomising Strategies	27
2.4 Optimal Strategies	31
<b>3. Markov Decision Processes</b>	<b>37</b>
3.1 State-dependent Decision Processes	37
3.2 Markov Decision Processes	39
3.3 Stochastic Markov Decision Processes	42
3.4 Optimal Strategies for Finite Processes	46
3.5 Infinite-horizon Markov Decision Processes	48
3.6 Optimal Strategies for Infinite Processes	50
3.7 Policy Improvement	54

## **Part II. Interaction**

<b>4. Static Games</b>	<b>61</b>
4.1 Interactive Decision Problems	61
4.2 Describing Static Games	63
4.3 Solving Games Using Dominance	66
4.4 Nash Equilibria	68
4.5 Existence of Nash Equilibria	76
4.6 The Problem of Multiple Equilibria	78
4.7 Classification of Games	80
4.8 Games with n-players	86
<b>5. Finite Dynamic Games</b>	<b>89</b>
5.1 Game Trees	89
5.2 Nash Equilibria	91
5.3 Information Sets	93
5.4 Behavioural Strategies	95
5.5 Subgame Perfection	99
5.6 Nash Equilibrium Refinements	101
<b>6. Games with Continuous Strategy Sets</b>	<b>107</b>
6.1 Infinite Strategy Sets	107
6.2 The Cournot Duopoly Model	107
6.3 The Stackelberg Duopoly Model	111
6.4 War of Attrition	114
<b>7. Infinite Dynamic Games</b>	<b>119</b>
7.1 Repeated Games	119
7.2 The Iterated Prisoners' Dilemma	121
7.3 Subgame Perfection	125
7.4 Folk Theorems	129
7.5 Stochastic Games	132
<b>Part III. Evolution</b>	
<b>8. Population Games</b>	<b>139</b>
8.1 Evolutionary Game Theory	139
8.2 Evolutionary Stable Strategies	140
8.3 Games Against the Field	144
8.4 Pairwise Contest Games	148
8.5 ESSs and Nash Equilibria	153
8.6 Asymmetric Pairwise Contests	157
8.7 Existence of ESSs	160

<b>9. Replicator Dynamics</b>	<b>165</b>
9.1 Evolutionary Dynamics	165
9.2 Two-strategy Pairwise Contests	168
9.3 Linearisation and Asymptotic Stability	171
9.4 Games with More Than Two Strategies	174
9.5 Equilibria and Stability	179

**Part IV. Appendixes**

<b>A. Constrained Optimisation</b>	<b>189</b>
<b>B. Dynamical Systems</b>	<b>193</b>
<b>Solutions</b>	<b>205</b>
<b>Further Reading</b>	<b>235</b>
<b>Bibliography</b>	<b>237</b>
<b>Index</b>	<b>239</b>