

# Games and Information

## An Introduction to Game Theory

Third Edition

**ERIC RASMUSEN**

*Indiana University, Bloomington*



**B** **BLACKWELL**  
*Publishers*



# Contents

\* Starred sections are less important.

<i>List of Figures</i>	x
<i>List of Tables</i>	xiii

<b>Preface</b>	<b>xv</b>
Contents and Purpose	xv
Changes in the Second Edition, 1994	xv
* Changes in the Third Edition, 2001	xvi
Using the Book	xvii
The Level of Mathematics	xviii
Other Books	xix
Contact Information	xxiii
Acknowledgements	xxiii

<b>Introduction</b>	<b>1</b>
History	1
Game Theory's Method	2
Exemplifying Theory	2
This Book's Style	4
Notes	6



## **PART 1: GAME THEORY** **9**

<b>1 The Rules of the Game</b>	<b>11</b>
1.1 Definitions	11
1.2 Dominant Strategies: the Prisoner's Dilemma	19
1.3 * Iterated Dominance: the Battle of the Bismarck Sea	22



1.4	Nash Equilibrium: Boxed Pigs, the Battle of the Sexes, and Ranked Coordination	25
1.5	Focal Points	31
	Notes	33
	Problems	36
<b>2</b>	<b>Information</b>	<b>38</b>
2.1	The Strategic and Extensive Forms of a Game	38
2.2	Information Sets	43
2.3	Perfect, Certain, Symmetric, and Complete Information	47
2.4	The Harsanyi Transformation and Bayesian Games	51
2.5	Example: the Png Settlement Game	59
	Notes	62
	Problems	64
<b>3</b>	<b>Mixed and Continuous Strategies</b>	<b>66</b>
3.1	Mixed Strategies: the Welfare Game	66
3.2	Chicken, the War of Attrition, and Correlated Strategies	70
3.3	Mixed Strategies with General Parameters and $N$ Players: the Civic Duty Game	75
3.4	Randomizing versus Mixing: the Auditing Game	79
3.5	Continuous Strategies: the Cournot Game	81
	Notes	84
	Problems	88
<b>4</b>	<b>Dynamic Games with Symmetric Information</b>	<b>90</b>
4.1	Subgame Perfectness	90
4.2	An Example of Perfectness: Entry Deterrence I	93
4.3	Credible Threats, Sunk Costs, and the Open-set Problem in the Game of Nuisance Suits	95
*4.4	Recoordination to Pareto-dominant Equilibria in Subgames: Pareto Perfection	103
	Notes	105
	Problems	106
<b>5</b>	<b>Reputation and Repeated Games with Symmetric Information</b>	<b>109</b>
5.1	Finitely Repeated Games and the Chainstore Paradox	109
5.2	Infinitely Repeated Games, Minimax Punishments, and the Folk Theorem	111
5.3	Reputation: the One-sided Prisoner's Dilemma	117
5.4	Product Quality in an Infinitely Repeated Game	119
*5.5	Markov Equilibria and Overlapping Generations in the Game of Customer Switching Costs	122
*5.6	Evolutionary Equilibrium: the Hawk-Dove Game (formerly section 4.6)	125

	Notes	129
	Problems	133
<b>6</b>	<b>Dynamic Games with Incomplete Information</b>	<b>137</b>
6.1	Perfect Bayesian Equilibrium: Entry Deterrence II and III	137
6.2	Refining Perfect Bayesian Equilibrium: the PhD Admissions Game	142
6.3	The Importance of Common Knowledge: Entry Deterrence IV and V	146
6.4	Incomplete Information in the Repeated Prisoner's Dilemma: the Gang of Four Model	149
6.5	The Axelrod Tournament	151
*6.6	Credit and the Age of the Firm: the Diamond Model (formerly section 15.1)	153
	Notes	155
	Problems	156
<b>PART 2</b>	<b>ASYMMETRIC INFORMATION</b>	<b>159</b>
<b>7</b>	<b>Moral Hazard: Hidden Actions</b>	<b>161</b>
7.1	Categories of Asymmetric Information Models	161
7.2	A Principal-Agent Model: the Production Game $\times$	164
7.3	The Incentive Compatibility, Participation, and Competition Constraints	172
7.4	Optimal Contracts: the Broadway Game	173
	Notes	179
	Problems	182
<b>8</b>	<b>Further Topics in Moral Hazard</b>	<b>185</b>
8.1	Efficiency Wages (formerly section 8.4)	185
8.2	Tournaments (formerly section 8.5)	188
8.3	Institutions and Agency Problems (formerly section 8.6)	190
*8.4	Renegotiation: the Repossession Game	193
*8.5	State-space Diagrams: Insurance Games I and II (formerly section 7.5)	196
*8.6	Joint Production by Many Agents: the Holmstrom Teams Model (formerly section 8.7)	201
	Notes	204
	Problems	207
<b>9</b>	<b>Adverse Selection</b>	<b>211</b>
9.1	Introduction: Production Game VI	211
9.2	Adverse Selection under Certainty: Lemons I and II	215
9.3	Heterogeneous Tastes: Lemons III and IV	218
9.4	Adverse Selection under Uncertainty: Insurance Game III	222

*9.5	Market Microstructure (formerly section 15.3)	225
*9.6	A Variety of Applications	230
	Notes	233
	Problems	237
<b>10</b>	<b>Mechanism Design in Adverse Selection and in Moral Hazard with Hidden Information</b>	<b>240</b>
10.1	The Revelation Principle and Moral Hazard with Hidden Knowledge (formerly section 8.1)	240
10.2	An Example of Moral Hazard with Hidden Knowledge: the Salesman Game (formerly section 8.2)	244
*10.3	Price Discrimination (new)	247
*10.4	Rate-of-return Regulation and Government Procurement (formerly section 15.4)	255
*10.5	The Groves Mechanism (formerly section 9.6)	261
	Notes	263
	Problems	265
<b>11</b>	<b>Signalling</b>	<b>267</b>
11.1	The Informed Player Moves First: Signalling	267
11.2	Variants on the Signalling Model of Education	271
11.3	General Comments on Signalling in Education	275
11.4	The Informed Player Moves Second: Screening	277
*11.5	Two Signals: the Game of Underpricing New Stock Issues	282
*11.6	Signal Jamming and Limit Pricing (formerly section 14.2)	285
	Notes	289
	Problems	290
<b>PART 3</b>	<b>APPLICATIONS</b>	<b>293</b>
<b>12</b>	<b>Bargaining</b>	<b>295</b>
12.1	The Basic Bargaining Problem: Splitting a Pie	295
12.2	The Nash Bargaining Solution	296
12.3	Alternating Offers over Finite Time	299
12.4	Alternating Offers over Infinite Time	300
12.5	Incomplete Information	303
*12.6	Setting up a Way to Bargain: the Myerson–Satterthwaite Mechanism (new)	308
	Notes	319
	Problems	321
<b>13</b>	<b>Auctions</b>	<b>323</b>
13.1	Auction Classification and Private-value Strategies	323
13.2	Comparing Auction Rules	328
13.3	Risk and Uncertainty over Values (new)	330

13.4	Common-value Auctions and the Winner's Curse	331
13.5	Information in Common-value Auctions	334
	Notes	335
	Problems	338
<b>14</b>	<b>Pricing</b>	<b>340</b>
14.1	Quantities as Strategies: Cournot Equilibrium Revisited	340
14.2	Prices as Strategies	343
14.3	Location Models	349
*14.4	Comparative Statics and Supermodular Games	357
*14.5	Durable Monopoly	362
	Notes	367
	Problems	370
<b>*15</b>	<b>Entry</b>	<b>372</b>
*15.1	Innovation and Patent Races	372
*15.2	Takeovers and Greenmail	378
*15.3	Predatory Pricing: the Kreps–Wilson Model	383
*15.4	Entry for Buyout	386
	Notes	390
	Problems	391
	<b>Mathematical Appendix</b>	<b>393</b>
*A.1	Notation	393
*A.2	The Greek Alphabet	395
*A.3	Glossary	395
*A.4	Formulas and Functions	399
*A.5	Probability Distributions	400
*A.6	Supermodularity	401
*A.7	Fixed Point Theorems (new)	403
*A.8	Genericity (new)	404
*A.9	Discounting (formerly section 4.5)	406
*A.10	Risk	408
	<b>References and Name Index</b>	<b>411</b>
	<b>Subject Index</b>	<b>439</b>