

# Contents

<b>1</b>	<b>Introduction</b>	1
1.1	Background	1
1.1.1	Minority Game	2
1.1.2	Kolkata Restaurant Problem	2
1.2	Motivation of the Book	3
1.3	Plan of the Book	5
<b>2</b>	<b>Kolkata Paise Restaurant Problem</b>	7
2.1	Introduction	7
2.2	Stochastic Learning Strategies	9
2.2.1	Random Choice Strategies	9
2.2.2	Rank Dependent Strategies	10
2.2.3	Strict Crowd-Avoiding Case	12
2.2.4	Stochastic Crowd Avoiding Case	12
2.3	Convergence to a Fair Social Norm with Deterministic Strategies	13
2.3.1	A ‘Fair’ Strategy	14
2.3.2	Asymptotically Fair Strategy	14
2.4	Summary and Discussion	14
<b>3</b>	<b>Phase Transition in the Kolkata Paise Restaurant Problem</b>	17
3.1	Introduction	17
3.2	The Models	18
3.3	Results from Numerical Simulations	21
3.3.1	Model A	21
3.3.2	Model B	22
3.4	Analytical Treatment of the Models in Mean Field Case	23
3.4.1	Approximate Analysis of the Critical Point and Faster-Is-Slower Effect	26
3.4.2	Analysis of the Finite Size Effects on the Time to Reach the Absorbing State	28
3.5	Summary and Discussions	29

<b>4</b>	<b>Zipf's Law from Kolkata Paise Restaurant Problem</b>	31
4.1	Introduction	31
4.2	Model	33
4.3	Results	34
4.3.1	Distribution of Sizes	34
4.3.2	Utilization	37
4.3.3	Evolution with Fitness	39
4.4	Empirical Evidences	40
4.5	Summary and Discussions	41
<b>5</b>	<b>Minority Game and Kolkata Paise Restaurant Problem</b>	43
5.1	Introduction	43
5.2	Strategy of the Agents	44
5.2.1	Uniform Approximation in Guessing the Excess Crowd	45
5.2.2	Nonuniform Guessing of the Excess Crowd	48
5.2.3	Following an Annealing Schedule	50
5.3	Effect of Random Traders	52
5.4	Summary and Discussions	54
<b>6</b>	<b>From Classical Games, the Kolkata Paise Restaurant Game, to Quantum Games</b>	55
6.1	A Short Introduction to Classical Games	55
6.1.1	Definitions and Preliminaries	56
6.1.2	Repeated Games	62
6.1.3	Games and Evolution Theory	66
6.2	KPR	69
6.2.1	Some Simple KPR Results	70
6.2.2	Phase Transition	72
6.2.3	Minority Games	74
6.2.4	KPR Non-stochastic	79
6.3	Quantum Games	79
6.3.1	Quantum Strategies	84
6.3.2	Nash Equilibrium in Quantum Games	84
6.3.3	Quantum Coin Tossing and Bit Commitment	89
6.3.4	Strong and Weak Coin Tossing	91
6.3.5	Quantum Games and Semidefinite Programming	93
6.4	Quantum KPR	100
6.5	Summary	102
<b>7</b>	<b>Some Recent Developments: A Brief Discussion</b>	105
7.1	KPR Under Dynamic Setting	105
7.2	Reinforcement Learning	106
7.3	KPR and Wealth Distribution in Society	110
7.4	Summary and Discussions	111

<b>Appendix A: Statistical Physics: A Brief Introduction . . . . .</b>	<b>113</b>
<b>Appendix B: Quantum Mechanics: A Brief Introduction. . . . .</b>	<b>135</b>
<b>Appendix C: Game Theory (Classical): A Brief Introduction . . . . .</b>	<b>147</b>
<b>Appendix D: Minority Game: An Overview and Recent Results. . . . .</b>	<b>163</b>
<b>Appendix E: Extending KPR Problem to Dynamic Matching in Mobility Markets . . . . .</b>	<b>175</b>
<b>Appendix F: A Brief Discussion on Econophysics . . . . .</b>	<b>179</b>
<b>References . . . . .</b>	<b>195</b>
<b>Index . . . . .</b>	<b>207</b>

Econophysics of the Kolkata Restaurant Problem and  
Related Games

Classical and Quantum Strategies for Multi-agent,  
Multi-choice Repetitive Games

Chakrabarti, B.K.; Chatterjee, A.; Ghosh, A.; Mukherjee,  
S.; Tamir, B.

2017, XI, 208 p. 43 illus., 33 illus. in color., Hardcover

ISBN: 978-3-319-61351-2