

Contents

Introduction	1
Potential Theory in Classical Probability	3
Nicolas Privault	
1 Introduction	3
2 Analytic Potential Theory	4
3 Markov Processes	24
4 Stochastic Calculus	31
5 Probabilistic Interpretations	46
References	58
Introduction to Random Walks on Noncommutative Spaces	61
Philippe Biane	
1 Introduction	61
2 Noncommutative Spaces and Random Variables	62
3 Quantum Bernoulli Random Walks	68
4 Bialgebras and Group Algebras	73
5 Random Walk on the Dual of $SU(2)$	76
6 Random Walks on Duals of Compact Groups	80
7 The Case of $SU(n)$	82
8 Choquet-Deny Theorem for Duals of Compact Groups	87
9 The Martin Compactification of the Dual of $SU(2)$	90
10 Central Limit Theorems for the Bernoulli Random Walk ...	94
11 The Heisenberg Group and the Noncommutative Brownian Motion	100
12 Dilations for Noncompact Groups	106
13 Pitman's Theorem and the Quantum Group $SU_q(2)$	110
References	114

Interactions between Quantum Probability and Operator	
Space Theory	117
Quanhua Xu	
1	Introduction
2	Completely Positive Maps
3	Concrete Operator Spaces and Completely Bounded Maps
4	Ruan's Theorem: Abstract Operator Spaces
5	Complex Interpolation and Operator Hilbert Spaces
6	Vector-valued Noncommutative L_p -spaces
7	Noncommutative Khintchine Type Inequalities
8	Embedding of OH into Noncommutative L_1
	References
	158
Dirichlet Forms on Noncommutative Spaces	
	161
Fabio Cipriani	
1	Introduction
2	Dirichlet Forms on C^* -algebras and KMS-symmetric Semigroups
3	Dirichlet Forms in Quantum Statistical Mechanics
4	Dirichlet Forms and Differential Calculus on C^* -algebras ...
5	Noncommutative Potential Theory and Riemannian Geometry
6	Dirichlet Forms and Noncommutative Geometry
7	Appendix
8	List of Examples
	References
	272
Applications of Quantum Stochastic Processes in Quantum	
Optics	
	277
Luc Bouten	
1	Quantum Probability
2	Conditional Expectations
3	Quantum Stochastic Calculus
4	Quantum Filtering
	References
	306
Quantum Walks	
	309
Norio Konno	
Part I: Discrete-Time Quantum Walks	
1	Limit Theorems
2	Disordered Case
3	Reversible Cellular Automata
4	Quantum Cellular Automata
5	Cycle
6	Absorption Problems
	311
	350
	357
	368
	377
	387

Part II: Continuous-Time Quantum Walks	
7	One-Dimensional Lattice 401
8	Tree 410
9	Ultrametric Space 420
10	Cycle 432
	References 441
Index 453