

Contents

1	Basic Concepts	1
1.1	Fundamental of Probability	1
1.1.1	Probability Space	1
1.1.2	Random Variables	9
1.1.3	Family of Distributions	19
1.2	Stochastic Orders	23
1.2.1	Definitions of Stochastic Orders	23
1.2.2	Relations Between Stochastic Orders	26
1.2.3	Existence of Stochastic Orders	29
1.3	Model Description	31
1.3.1	Job Characteristics	31
1.3.2	Machine Environments	35
1.3.3	Scheduling Policies	37
1.3.4	Performance Measures	40
1.4	Notation	45
2	Regular Performance Measures	49
2.1	Total Completion Time Cost	49
2.1.1	Single Machine	49
2.1.2	Parallel Machines	52
2.2	Makespan	57
2.3	Regular Costs with Due Dates	60
2.3.1	Weighted Number of Tardy Jobs	60
2.3.2	Total Weighted Tardiness	64
2.4	General Regular Costs	66
2.4.1	Total Expected Cost	67
2.4.2	Maximum Expected Cost	72
2.5	Exponential Processing Times	74
2.5.1	Optimal Sequence for General Costs	76
2.5.2	Optimal Sequences with Due Dates	79
2.5.3	Examples of Applications	82

2.6	Compound-Type Distributions	85
2.6.1	Classes of Compound-Type Distributions	85
2.6.2	Optimal Sequences for Total Expected Costs	89
2.6.3	Optimal Sequences with Due Dates	91
3	Irregular Performance Measures	95
3.1	Earliness/Tardiness Penalties	96
3.1.1	Normal Processing Times	96
3.1.2	Exponential Processing Times	106
3.2	Expected Cost of Earliness and Tardy Jobs	117
3.2.1	Single Machine Scheduling	118
3.2.2	Parallel Machine Scheduling	120
3.3	Completion Time Variance	127
3.3.1	The Weighted Variance Problem	128
3.3.2	Structural Property of Optimal Sequence	130
3.3.3	Algorithm	133
	Appendix	135
4	Stochastic Machine Breakdowns	141
4.1	Formulation of Breakdown Processes	142
4.1.1	Machine Breakdown Processes	142
4.1.2	Processing Time and Achievement	143
4.2	No-Loss (Preemptive-Resume) Model	145
4.2.1	Completion Time	145
4.2.2	Minimizing Regular Cost Functions	146
4.2.3	Minimizing Irregular Costs	149
4.3	Total-Loss (Preemptive-Repeat) Model	157
4.3.1	Expected Occupying Time	158
4.3.2	Minimizing the Expected Weighted Flowtime	164
4.3.3	Maximizing the Expected Discounted Reward	169
4.4	Partial-Loss Breakdown Models	179
5	Optimal Stopping Problems	187
5.1	Preliminaries	187
5.1.1	σ -Algebras and Monotone Class Theorems	188
5.1.2	σ -Algebras vs Linear Spaces of Measurable Functions	190
5.1.3	Probability Spaces	191
5.1.4	Conditional Expectations	192
5.1.5	Uniform Integrability	192
5.1.6	Essential Supremum	196
5.2	Stochastic Processes	197
5.2.1	Information Filtrations	197
5.2.2	Stochastic Processes as Stochastic Functions of Time	199
5.3	Stopping Times	202

5.4	Martingales	206
5.4.1	Definitions	206
5.4.2	Doob's Stopping Theorem	207
5.4.3	Upcrossings	209
5.4.4	Maxima Inequalities	211
5.4.5	Martingale Convergence Theorems	213
5.4.6	Regularity of Paths	214
5.5	Optimal Stopping Problems	218
6	Multi-Armed Bandit Processes	225
6.1	Closed Multi-Armed Bandit Processes in Discrete Time	227
6.1.1	Model and Solution	227
6.1.2	Single-Armed Process	230
6.1.3	Proof of Theorem 6.1	234
6.2	Open Bandit Processes	234
6.2.1	Formulation and Solution	236
6.2.2	Proof of Theorem 6.2	239
6.3	Generalized Open Bandit Problems	244
6.3.1	Nash's Generalized Bandit Problem	244
6.3.2	Extension of Nash's Model	247
6.4	Closed Multi-Armed Bandit Processes in Continuous Time	248
6.4.1	Problem Formulation and Its Solution	248
6.4.2	An Account for Deteriorating Bandits	251
7	Dynamic Policies	253
7.1	Dynamic Policies and Information	253
7.2	Restricted Dynamic Policies for Total-Loss Breakdown Models	257
7.2.1	Total-Loss Breakdown Model	257
7.2.2	Optimal Policies with Independent Processing Times	261
7.2.3	Optimal Policies with Identical Processing Times	266
7.3	Restricted Dynamic Policies for No-Loss Breakdown Models	269
7.4	Partial-Loss Breakdown Models	272
7.4.1	The Semi-Markov Model for Job Processing	272
7.4.2	Integral Equations for Gittins Indices	274
7.4.3	Optimal Policies via Gittins Indices	276
7.4.4	Specific Partial-Loss Breakdown Models	278
7.5	Unrestricted Policies for a Parallel Machine Model	281
7.5.1	Optimality Equation	282
7.5.2	SEPT Policies	283
7.5.3	LEPT Policies	288
	Appendix	291
7.6	Bibliographical Comments	297

8	Stochastic Scheduling with Incomplete Information	299
8.1	Modelling and Probabilistic Characteristics	300
8.1.1	Formulation and Assumptions	300
8.1.2	Repetition Frequency and Occupying Time	301
8.1.3	Impact of Incomplete Information on Static Policies	303
8.2	Optimal Restricted Dynamic Policies	304
8.3	Posterior Gittins Indices with One-Step Reward Rates	308
8.3.1	Posterior Gittins Indices by One-Step Reward Rates	308
8.3.2	Incompletion Information for Processing Times	311
9	Optimal Policies in Time-Varying Scheduling	321
9.1	Stochastic Scheduling with Deteriorating Processing Times	322
9.1.1	Model Formulation	322
9.1.2	Processibility	325
9.1.3	The Characteristics of Occupying Time	331
9.1.4	Optimal Policies	335
9.2	Stochastic Model with Learning Effects	339
9.2.1	Optimal Policies with Learning Effects	340
9.2.2	Consideration of Unreliable Machines	344
10	More Stochastic Scheduling Models	347
10.1	Optimization Under Stochastic Order	347
10.1.1	Basic Problem	348
10.1.2	Stochastic Minimization of Maximum Lateness	349
10.1.3	Optimal Solutions with Exponential Processing Times and Due Dates	354
10.2	Team-Work Task Scheduling	360
10.2.1	Team-Work Tasks	360
10.2.2	The Deterministic Model	361
10.2.3	The Stochastic Model	367
10.3	Scheduling of Perishable Products	377
10.3.1	Perishable Products	377
10.3.2	The Base Model	380
10.3.3	Waiting Decision on a Finished Product	383
10.3.4	Decisions on Unfinished Products	385
10.3.5	Accounting for Random Market Demand	390
	References	395
	Index	407

Optimal Stochastic Scheduling

Cai, X.; Wu, X.; Zhou, X.

2014, X, 416 p. 3 illus., Hardcover

ISBN: 978-1-4899-7404-4