Contents

List of figures xiii
List of tables xiv
Preface xv

1 Introduction 1

1.1 Preliminaries 1
1.2 Contracts, incentives and asymmetric information 6
1.3 Search theory 8
1.4 Institutional aspects of search economics 9
1.5 The explanatory power of economic search 10
1.6 Outline of this volume 11

2 Mathematical methods 19

2.1 Introduction 19
2.2 Markov chains and related processes 19
2.3 An introduction to stochastic dynamic programming 34
2.4 Some results in probability theory: a measure theoretic approach 41
2.5 The Poisson process 45

3 The history and evolution of sequential analysis 49

3.1 Introduction 49
3.2 Early literary and intuitive contributions to the economics of job search 50
3.3 Stigler's insights 52
3.4 Stigler's model 53
3.5 Early mathematical contributions to the economics of job search 55
3.6 The sequential job search model 57

3.7 Sequential analysis: a deeper mathematical perspective 58
3.8 Optimal stopping theory 59
3.9 Markov decision processes 63
3.10 The four stellar examples of MDPs 63

4 The basic sequential search model and its ramifications 65

4.1 Introduction 65
4.2 An important example 69
4.3 The fixed-sample size model 70
4.4 The basic sequential search model: infinite time horizon, no discounting 72
4.5 An alternative view of the reservation wage 74
4.6 Infinite time horizon: discounting 75
4.7 Infinite time horizon with discounting and a random number of job offers 76
4.8 Risky ordering and sequential search 77
4.9 The basic sequential model: search for the lowest price 81
4.10 Optimal stopping 89
4.11 Finite time horizon 90
4.12 On-the-job search 92
4.13 Search in the presence of experience qualities: the Lippman and McCall belated information model 94
4.14 The Lucas equilibrium model for the basic sequential search model 97
4.15 Reservation wage property preserved in a continuous search model 98
4.16 Optimal replacement policy 100
4.17 Martingales and the existence of a reservation wage 101
Appendix 4.I: A naive comparison of FSM and BSM 103
Appendix 4.II: A more sophisticated comparison of FSM and BSM 106
Appendix 4.III: The French version of BSM 110

5 Estimation methods for duration models 116

5.1 Introduction 116
5.2 Hazard functions 117
5.3 Counting processes and martingales 121
5.4 Parametric methods for continuous-time data with covariates 129
5.5 The Cox regression model 136
5.6 Discrete-time duration data 143

5.7 Multi-spell discrete-time models 149
5.8 Competing risk models 151
5.9 General discrete-time life history models 154
5.10 Specification tests for duration models 159

6 Unemployment, unemployment insurance and sequential job search 161

6.1 Introduction 162
6.2 Mismatch unemployment 163
6.3 Layoff unemployment with positive probability of recall: the temporary layoff 168
6.4 Unemployment insurance and job search decisions (Mortensen 1977) 171
6.5 More on the incentive effects of unemployment insurance 177
6.6 Efficient unemployment insurance (Acemoglu and Shimer 1999) 184
6.7 More on optimal umemployment insurance 191

7 Job search in a dynamic economy 198

7.1 Introduction 198
7.2 Search in a dynamic economy (Lippman and McCall) 199
7.3 Labor market interpretation 202
7.4 Variable intensity of search 203
7.5 The basic theorem 205
7.6 Wealth and search 206
7.7 Systematic search 207
7.8 Optimal quitting policies 208
7.9 Monotone Markov chains and their applications: Conlisk's research 208
7.10 Recent research by Muller and Stoyan 214

8 Expected utility maximizing job search 217

8.1 Introduction 217
8.2 Characterizing risk and risk aversion 218
8.3 Comparative statics results 225
8.4 Applications of Theorem 8.8 226
8.5 The basic job search model 227
8.6 Expected utility maximizing search with recall 229
8.7 Expected utility maximizing search without recall 241
8.8 Risk aversion and the wage gap 244
8.9 Consumption commitments and local risk aversion 244

9 Multi-armed bandits and their economic applications 246

9.1 Introduction 246
9.2 The multi-armed bandit problem 246
9.3 General MAB framework 256
9.4 A model of job search with heterogeneous opportunities 257
9.5 Miller's model of job matching and occupational choice 262
9.6 Superprocesses: adding decisions to bandits 265
9.7 Discounted restless bandits 272

10 A sample of early responses to Diamond's paradox and Rothschild's complaint 277

10.1 Introduction 277
10.2 Price dispersion 279
10.3 Matchmaking 280
10.4 Search technology 280
10.5 Principal–agent problems and durable matches 281
10.6 Equilibrium models of price dispersion 281
10.7 General structure of equilibrium models 300

11 Equilibrium search after the Diamond–Mortensen–Pissarides breakthrough 303

11.1 Introduction 303
11.2 Two-sided search and wage determination: the Mortensen–Pissarides approach 305
11.3 Matching technology 306
11.4 Search equilibrium 308
11.5 Equilibrium unemployment (Mortensen and Pissarides 1999) 309
11.6 Wage differentials, employer size, and unemployment 313
11.7 Equilibrium search with offers and counteroffers 317
11.8 Competitive search equilibrium 324
11.9 Labor market policies in an equilibrium search model (Lucas–Prescott in action) 325
11.10 The search contributions of Lars Ljungqvist and Tom Sargent 331
11.11 Two-sided search, marriage and matchmakers 345
11.12 Bilateral search and vertical heterogeneity 349
11.13 Two-sided search with fixed search costs 350
11.14 Rocheteau–Wright models of search and money 353
11.15 Recent discoveries 354

12 Structural estimation methods 356

12.1 Introduction 356
12.2 Early models (Kiefer and Neumann 1979a, 1979b) 356
12.3 Illustrations of structural estimation 357
12.4 The general model 365
12.5 Solution methods 367
12.6 Finite horizon ($T < \infty$) search model 367
12.7 Estimation methods 368
12.8 Structural estimation of equilibrium job search models 369
12.9 Structural estimation and model complexity 380
12.10 Dacre, Glazebrook, Nino-Mora (1999) 383

13 The ubiquity of search 387

13.1 Historical prelude 387
13.2 Introduction 389
13.3 The evolution of money 392
13.4 Liquidity and search 397
13.5 The housing market and liquidity (Krainer and Leroy) 407
13.6 The house-selling problem: the view from operations research 413
13.7 The natural rate of unemployment 414
13.8 A modern approach to the natural rate of unemployment 416
13.9 Adam Smith on dynamic stochastic models 418
13.10 Coordination and inflation 418
13.11 Economic growth and coordination 419
13.12 Auctions versus sequential search 420
13.13 Auctions and bidding by McAfee and McMillan 425
13.14 The analytics of search with posted prices 434
13.15 Sale of a deteriorating asset via sequential search 437
13.16 Middlemen, market-makers, and electronic search 437
13.17 Real options 446
13.18 Resource allocation in a random environment 462

14 Topics for further inquiry 471

14.1 Exchangeability 471
14.2 Polya urns 474
14.3 Urn methods 475
14.4 The secretary problem 483

14.5 The economics of information, behavioral biology, and neuro-economics 487
14.6 Equilibrium search models revisited 490

Notes 491
Bibliography 506
Index 540