
HANDBOOK OF OPERATIONS RESEARCH IN NATURAL RESOURCES

Edited by

Andres Weintraub
University of Chile, Santiago, Chile

Carlos Romero
Technical University of Madrid, Spain

Trond Bjørndal
CEMARE, University of Portsmouth, UK

Rafael Epstein
University of Chile, Santiago, Chile

with the collaboration of

Jaime Miranda
Diego Portales University, Santiago, Chile

Contents

Contributing Authors	ix
Preface	xiii
Acknowledgments	xv
AGRICULTURE	1
Importance of Whole-Farm Risk Management in Agriculture RUUD HUIRNE, MIRANDA MEUWISSEN, AND MARCEL VAN ASSELDONK	3
Dealing with Multiple Objectives in Agriculture KIYOTADA HAYASHI	17
Modeling Multifunctional Agroforestry Systems with Environmental Values: Dehesa in Spain and Woodland Ranches in California PABLO CAMPOS, ALEJANDRO CAPARRÓS, EMILIO CERDÁ, LYNN HUNTSINGER, AND RICHARD B. STANDIFORD	33
Environmental Criteria in Pig Diet Formulation with Multi-Objective Fractional Programming TERESA PEÑA, CARMEN CASTRODEZA , AND PABLO LARA	53

Modeling the Interactions Between Agriculture and the Environment SLIM ZEKRI AND HOUCINE BOUGHANMI	69
MCDM Farm System Analysis for Public Management of Irrigated Agriculture JOSÉ A. GÓMEZ-LIMÓN, JULIO BERBEL, AND MANUEL ARRIAZA	93
Water Public Agencies Agreeing to A Covenant for Water Transfers: How to Arbitrate Price–Quantity Clauses ENRIQUE BALLESTERO	115
Positive Mathematical Programming for Agricultural and Environmental Policy Analysis: Review and Practice BRUNO HENRY DE FRAHAN, JEROEN BUYSSE, PHILIPPE POLOMÉ, BRUNO FERNAGUT, OLIVIER HARMIGNIE, LUDWIG LAUWERS, GUIDO VAN HUYLENBROECK, AND JEF VAN MEENSEL	129
FISHERIES	155
Fisheries Management RAGNAR ARNASON	157
Shared Fish Stocks and High Seas Issues TROND BJØRNDAL AND GORDON MUNRO	181
Game Theoretic Applications to Fisheries VEIJO KAITALA AND MARKO LINDROOS	201
Uncertainty in Bioeconomic Modelling LINDA NØSTBAKKEN AND JON M. CONRAD	217
Planning in Fisheries-Related Systems DANIEL E. LANE	237
Capacity and Technical Efficiency Estimation in Fisheries: Parametric and Non-Parametric Techniques SEAN PASCOE AND DIANA TINGLEY	273
Studies in the Demand Structure for Fish and Seafood Products FRANK ASCHE, TROND BJØRNDAL, AND DANIEL V. GORDON	295

FORESTRY	315
Models for Strategic Forest Management ELDON A. GUNN	317
Tactical-Level Forest Management Models RICHARD L. CHURCH	343
Harvest Operational Models in Forestry RAFAEL EPSTEIN, JENNY KARLSSON, MIKAEL RÖNNQVIST, AND ANDRES WEINTRAUB	365
Log Merchandizing Model Used in Mechanical Harvesting HAMISH MARSHALL	378
Forest Transportation RAFAEL EPSTEIN, MIKAEL RÖNNQVIST, AND ANDRES WEINTRAUB	391
Optimization of Forest Wildlife Objectives JOHN HOF AND ROBERT HAIGHT	405
Spatial Environmental Concerns ALAN T. MURRAY	419
Heuristics in Forest Planning JOHN SESSIONS, PETE BETTINGER, AND GLEN MURPHY	431
Forestry Economics: Historical Background and Current Issues RONALD RAUNIKAR AND JOSEPH BUONGIORNO	449
Multiple Criteria Decision-Making in Forest Planning: Recent Results and Current Challenges LUIS DIAZ-BALTEIRO AND CARLOS ROMERO	473
Forest Fire Management DAVID L. MARTELL	489
A Model for the Space–Time Spread of Pine Shoot Moth ROBERTO COMINETTI AND JAIME SAN MARTÍN	511
Adaptive Optimization of Forest Management in A Stochastic World PETER LOHMANDER	525

MINING	545
Application of Optimisation Techniques in Open Pit Mining LOUIS CACCETTA	547
Optimisation in Underground Mining CHRISTOPHER ALFORD, MARCUS BRAZIL, AND DAVID H. LEE	561
Long- and Short-Term Production Scheduling at Lkab's Kiruna Mine ALEXANDRA M. NEWMAN, MARK KUČHTA, AND MICHAEL MARTINEZ	579
An Integrated Approach to the Long-Term Planning Process in the Copper Mining Industry RODRIGO CARO, RAFAEL EPSTEIN, PABLO SANTIBAÑEZ, AND ANDRES WEINTRAUB	595
Index	611