

Contents

1	Mathematical Methods of Budget Modeling	1
1.1	Budget as an Object of Modeling and Management	2
1.1.1	Budget Structure and Contents	2
1.1.2	Main Principles of Budget Formation	3
1.2	Budget Models	6
1.2.1	Models of Knowledge Representation and Budget Functioning	6
1.2.2	Semantic Model of Budget Representation	10
1.2.2.1	Object Domain Model	10
1.2.2.2	A Budget Structure Graph	14
1.2.2.3	A Graph Representing Budget Values	14
1.2.2.4	An Example of the Semantic Model	17
1.2.3	Frame-Based Model of Budget Knowledge Representation	18
1.2.3.1	Budget Model	18
1.2.3.2	Budget Item Model	20
1.2.3.3	An Example of the Frame-Based Model	21
1.3	Mathematical Budget Models	23
1.3.1	Static Mathematical Budget Model	24
1.3.2	Mathematical Model of Interaction of Income and Expenditure Items	28
1.3.3	Model of Budget Sensitivity	32
	References	37
2	Methods and Mathematical Models of Budget Management	39
2.1	Current Trends in Budgeting	39
2.2	Current State of Budget Control Methods and Mathematical Models	41
2.3	General Concept of the Programmable Method of Budget Mechanism Control	43

2.3.1	General Statement of the Problem of Budget Mechanism Control	43
2.3.2	Cybernetic Approach to the Description of Budget Mechanism	44
2.3.3	System Approach to the Mathematical Model of Budget Mechanism	47
2.4	Mathematical Models of Budget Expenditure	50
2.4.1	Construction of Program Movements for Budget Expenditure	50
2.4.2	A Model of Program Control of the Expenditure Budget Part	52
2.4.3	Model of Management Adjustment	57
2.4.4	Description of Algorithms of Basic Processes	59
2.5	Mathematical Models of Budget Revenue Part	61
2.5.1	Basic Provisions Describing Interactions of Budget Items	61
2.5.2	Learning Elements of Budget System	62
2.5.3	Model of Correction of Budget Revenue Forecast	65
2.6	Model of Information System for Program Budget Control	66
	References	69
3	Energy-Entropic Methods in Assessment and Control of Economic Systems	73
3.1	Arguments in Favor of Application of the Thermodynamic Approach to Economic Systems	73
3.2	Energy-Entropy Model for Assessment of Economic System Management	80
3.3	Energy-Entropy Approach as the Basis of System Estimation of Production Management Quality	83
3.3.1	United Measuring System of Energy Resources	83
3.3.2	Methods Used to Estimate Power Consumption (Efficiency of Power Resources Usage) at the Enterprise Level	85
3.3.3	Entropic Evaluation of Production Efficiency	86
3.3.4	Usage of Energy-Saving Criterion to Assess Production Control Quality	92
3.3.4.1	A Thermodynamic Approach to Constructing Systems Controlling Production Processes	92
3.3.4.2	Comparison of Production Processes in Terms of Energy-Entropy	95
	References	97
4	Currency Trading Methods and Mathematical Models	99
4.1	Currency Market Research and Management	99
4.2	Mathematical Models of Equilibrium Exchange Rates	102
4.2.1	Model Development and Analysis	102

4.2.2	Equilibrium Exchange Rate: Statement of the Problem and Ways to Solve It	104
4.2.3	Optimal Adjustment of Currency Exchange Rates	106
4.2.4	Building a Balanced Directed Graph	108
4.2.5	Equilibrium Exchange Rates: Problem-Solving Procedures	111
4.2.5.1	Statement of the Assignment Problem	111
4.2.5.2	Assignment Problem as a Linear Programming Problem	112
4.2.5.3	Assignment Problem as a Transportation Problem	112
4.2.6	Experimental Study of the Model of Equilibrium	115
4.3	Mathematical Projection Models for Currency Transactions	119
4.3.1	Forecast Problem of Risk Minimization	119
4.3.2	A Collocation Model for Forecasting Operations on the Currency Market	121
4.3.2.1	Background of the Collocation Model	121
4.3.2.2	Development of Mathematical Model for Forecasting Exchange Rate	122
4.4	Information Decision Support Systems in Currency Operations	125
4.4.1	Development of Information Model for Decision Support System in Currency Exchange Operations	125
4.4.2	IS Software	127
	References	129
5	Methods and Mathematical Models of Innovation Project Appraisal	131
5.1	Current Status of Innovation Project Review and Appraisal	131
5.1.1	Innovation Project as a Subject of Analysis and Appraisal	131
5.1.2	Existing Methods and Tools of Evaluating Innovation Projects	132
5.2	Development of Methods and Models for Assessing Innovativeness and Competitiveness of Innovative Projects	138
5.2.1	The Essence of Innovation and Competitiveness	138
5.2.2	Innovativeness Criteria for Innovative Projects	139
5.2.3	Competitiveness Criteria for Innovative Projects	140
5.2.4	Method and Graphic Model for Assessing Innovativeness and Competitiveness of Innovative Projects	145
5.3	Development of Methods and Models for Assessing Feasibility and Cost-Effectiveness of Innovative Projects	157
5.3.1	Basic Steps in Designing an Innovative Project	157
5.3.2	Basic Life Cycles of Innovation Projects	160
5.3.3	The Method and Graphic Model for Assessing Feasibility and Economic Effects of Innovation Projects	166
5.3.4	Method and Graphic Model for Innovation Project Evaluation	175

5.3.5	Research into the Methods and Models on Innovation Project Evaluation	176
5.4	Development of an Information System of Innovation Project Examination	181
5.4.1	Decision Support Systems	181
5.4.2	DSS Functional Model Development	182
5.4.3	Development of Information Model of Innovation Project Evaluation	185
	References	192
6	Mathematical Methods for Making Investment Decisions	195
6.1	Basic Concepts of the Risk Theory of an Investment Project . . .	196
6.2	Investment Decisions: Project Choice and Risk Management . .	202
6.2.1	Methods Supporting Decision-Making	202
6.2.2	Methods Used to Assign the Utility Function Values . . .	203
6.2.3	Search for the Best Pareto Point	207
6.2.4	Convolutions of Estimation Criteria	211
6.2.5	Criteria Used to Choose Optimal Solution	213
6.2.6	Choosing a Group Solution on the Basis of Multicriterion Estimation	214
6.3	Assessment of Investment Project in the Multicriterion Context .	215
6.3.1	The Hierarchy-Analysis Method as a Synthesis of Quantitatively Measurable Expert Information	215
6.3.2	Assessment of Investment Project by Complex Criteria .	219
6.4	Probabilistic Approach to Quantitative Risk Assessment	224
6.4.1	Simulation Modeling of Investment Risks	226
6.5	Quantitative Risk Analysis Based on the Methods of Fuzzy Mathematics	228
6.6	Information Support for the Investment Project Analysis	240
6.6.1	Filtration of Investment Projects	242
6.7	Examples of Investment Decision-Making	246
6.7.1	Assessment of Investment Project Variants	246
6.7.1.1	Problem formalization	247
6.7.1.2	Creation of Information Database	250
6.7.1.3	A Computer Experiment	252
6.7.1.4	Quantitative Risk Assessment	256
6.7.2	Comparative Assessment of Business Plans in Terms of Risk	258
	References	262
7	Multi-Objective Stochastic Models for Making Decisions on Resource Allocation	265
7.1	Applicability of Multiple Criteria Optimization Methods	266
7.2	The Decision-Making Problem of Resource Allocation in Terms of Utility Theory	267
7.2.1	Classical Principles of Choosing Alternative Solutions . .	267

7.2.2	Aggregation of Preferences in the Course of Decision-Making	268
7.2.3	Optimality of Making Decisions on Resource Allocation	270
7.2.4	Principles of Choosing Decisions on Resource Allocation Combining Classical Choice Principles	271
7.3	Formulation and Convolution of Criteria in Monocriterial Decision-Making Models	274
7.4	Single-Stage Stochastic Models for Limited Resource Allocation with Probabilistic Constraints	279
7.5	Multi-Stage Stochastic Models of Limited Resource Allocation with Probabilistic Constraints	282
7.6	Use of the Combined Policy Model for Making Decisions on Resource Allocation	285
7.6.1	Allocation of Maintenance Resources by Teplocentral Public Enterprise	285
7.6.2	Combination of Policies of Resource Allocation in the Investment Management	289
	References	293
8	Mathematical Methods and Models for Monitoring of Government Programs	295
8.1	Government Program as a Targeted System with Program Management	296
8.1.1	Classification and Stages of Implementation of Government Programs	296
8.1.2	Aims and Tasks of Monitoring of Government Programs	297
8.2	Government Programs in Terms of Systems Theory and General Management Theory	299
8.3	Information and Model Representation of Government Programs and Methods of Monitoring Their Implementation	301
8.3.1	Formalization of Representation of the Government Program as a Hierarchical Tree	301
8.3.2	A Model Evaluating the State of the Top of the GP Tree	302
8.3.3	Task of Evaluation of Process Completion Time at the Top of the PHP Tree	304
8.3.4	A Production Model of Assessment of GP Status and Degree of Objective Achievement	305
8.3.5	The Task of Rapid Reallocation of Funds	309
8.3.6	The Task of Optimization of Network Management Model for Construction Works in Fuzzy Environment Based on the “Time-Cost” Criterion	311
8.4	Methods and Models for Evaluation of GP Implementation	314
8.4.1	Approaches to the Evaluation of Implementation of Government Programs	314

- 8.4.2 Fuzzy Cognitive Model of Risk Assessment of GP
 - Implementation 316
 - References 324
- 9 Methodology for Identification of Competitive Industrial Clusters . 327**
 - 9.1 Cluster Analysis of Kazakhstani Regions 328
 - 9.2 Methods of Identification of Competitive Industrial Clusters . . . 338
 - References 348
- Conclusion 351**
- About the Author 355**

Mathematical Methods and Models in Economic
Planning, Management and Budgeting

Mutanov, G.

2015, XIV, 356 p. 99 illus., 19 illus. in color., Hardcover

ISBN: 978-3-662-45141-0