

Contents

Preface

ix

Abbreviations

xi

Introduction

1

Types of Problems Considered, 2

Description or Interpretation?, 7

1. Preliminaries

11

1.1. Random Functions, 11

1.2. On the Objectivity of Probabilistic Statements, 22

1.3. Transitive Theory, 24

2. Structural Analysis

29

2.1. General Principles, 29

2.2. Variogram Cloud and Sample Variogram, 34

2.3. Mathematical Properties of the Variogram, 57

2.4. Regularization and Nugget Effect, 74

2.5. Variogram Models, 80

2.6. Fitting a Variogram Model, 104

2.7. Variography in Presence of a Drift, 115

2.8. Simple Applications of the Variogram, 128

2.9. Complements: Theory of Variogram Estimation and Fluctuation, 137

3. Kriging

150

3.1. Introduction, 150

3.2. Notations and Assumptions, 152

3.3.	Kriging with a Known Mean, 154	
3.4.	Kriging with an Unknown Mean, 164	
3.5.	Estimation of a Spatial Average, 193	
3.6.	Selection of a Kriging Neighborhood, 201	
3.7.	Measurement Errors and Outliers, 210	
3.8.	Case Study: The Channel Tunnel, 215	
3.9.	Kriging under Inequality Constraints, 224	
4.	Intrinsic Model of Order k	231
4.1.	IRF-0 and IRF- k , 231	
4.2.	A Second Look at the Model of Universal Kriging, 233	
4.3.	Allowable Linear Combinations of Order k , 236	
4.4.	Intrinsic Random Functions of Order k , 243	
4.5.	Generalized Covariance Functions, 252	
4.6.	Estimation in the IRF Model, 265	
4.7.	Generalized Variogram, 276	
4.8.	Automatic Structure Identification in the General Case, 281	
5.	Multivariate Methods	292
5.1.	Introduction, 292	
5.2.	Notations and Assumptions, 293	
5.3.	Simple Cokriging, 296	
5.4.	Universal Cokriging, 298	
5.5.	Case of Gradient Information, 313	
5.6.	Multivariate Random Functions, 321	
5.7.	Shortcuts, 351	
5.8.	Space-Time Models, 362	
6.	Nonlinear Methods	375
6.1.	Introduction, 375	
6.2.	Simple Methods for Estimating a Point Distribution, 376	
6.3.	Local Estimation of a Point Distribution by Disjunctive Kriging, 388	
6.4.	Simple Methods for Estimating a Block Distribution, 419	
6.5.	Local Estimation of a Block Distribution by Disjunctive Kriging, 437	

7. Conditional Simulations

449

- 7.1. Introduction and Definitions, 449
- 7.2. Direct Conditional Simulation of a Continuous Variable, 462
- 7.3. Conditioning by Kriging, 465
- 7.4. Turning Bands, 472
- 7.5. Nonconditional Simulation of a Continuous Variable, 478
- 7.6. Nonconditional Simulation of an IRF- k , 506
- 7.7. Simulation of a Categorical Variable, 520
- 7.8. Object-Based Simulations: Boolean Models, 545
- 7.9. Constrained Simulations, 561
- 7.10. Practical Considerations, 571
- 7.11. Case Studies, 577

8. Scale Effects and Inverse Problems

593

- 8.1. Introduction, 593
- 8.2. Upscaling Permeability, 594
- 8.3. Stochastic Differential Equations, 602
- 8.4. Inverse Problem in Hydrogeology, 611

Appendix

636

References

650

Index

687