Contents

PREFACE vii

CHAPTER I. Fundamentals of the Monte Carlo Method 1
1. Definition and Simple Examples of the Application of the Monte Carlo Method 1
2. Accuracy of the Monte Carlo Method and its Main Characteristics 7
3. Generation of Random Numbers 13
4. Solution of Systems of Linear Algebraic Equations . 19
5. Random Walk and the Solution of Boundary Value Problems 23
6. The Monte Carlo Method and the Simulation of Markov Processes in a Computer 31

CHAPTER II. Evaluation of Definite Integrals 39
1. Simple Applications of the Monte Carlo Method 39
2. Some Methods for Reducing the Variance 46
3. Evaluation of Multidimensional Integrals 61
4. Evaluation of Wiener Integrals 73
5. Application of Quasi-Random Points to the Monte Carlo Scheme 78

CHAPTER III. Applications of the Monte Carlo Method in Neutron Physics 84
1. The Monte Carlo Method in Elementary Particle Problems 84
2. Simple Interactions of Neutrons With Nuclei and Their Simulation 92
3. Passage of Neutrons Through a Plate 104
4. Some Methods of Calculation of the Criticality of Nuclear Reactors 118

CHAPTER IV. Application of the Monte Carlo Method to the Investigation of Mass Service or Congestion Processes, Including Queueing 127
1. General Information on Mass-Service Problems . . . 127
2. Mathematical Description of an Input Consisting of a Stream of Calls Requiring Service 129

3. Mass-Service Systems 134
4. The Generation of Random Streams of Calls 138
5. Structure of an Algorithm for Solving Mass-Service Problems by the Monte Carlo Method 148
6. Considerations On the Processing of the Results of Simulation 153

CHAPTER V. Application of the Monte Carlo Method to Information Theory 156
1. Statistical Properties of Signals and Noise 156
2. Formulation of the Basic Problems of Detection Theory 170
3. Procedure for the Solution of the Main Problems of Detection Theory 184
4. Other Problems 188

CHAPTER VI. Generating Uniformly Distributed Random Quantities by Means of Electronic Computers 196
1. Comparison of Various Methods of Generating Random Quantities 196
2. Obtaining Uniform Pseudo-Random Numbers on Computers 198
3. Criteria to Test the Quality of Uniform Pseudo-Random Numbers 208
4. Physical Generators of Uniform Random Numbers . 220
5. Tests of the Operation of Random-Number generators 238

CHAPTER VII. Transformation of Random Numbers 244
1. Properties of Quasi-Uniform Quantities 244
2. Simulation of Independent Random Events 247
3. Typical Features of the Simulation of Events by Means of Random Numbers With Few Digits 251
4. Methods of Obtaining Random Numbers With Assigned Distribution Law 252
5. Simulation of Random Vectors and Random Functions 264
6. The Simulation of Certain Multidimensional Quantities 266

APPENDICES 273

REFERENCES 281

INDEX 299