

Chapter 1

Case Studies, Problems and Their Statistical Investigation	1
1.1. Introductory Remarks	1
1.2. The Brownian Motion	6
1.3. The Torsion Pendulum and Electrical Circuits	13
1.4. The Chandler Wobble	27
1.4.1. The Rotation of the Earth	27
1.4.2. The Mathematical Description and Statistical Investigation	33
1.5. System Description	44
1.6. Measurement Analysis in Computer Systems	52
1.6.1. Measurement of Performance	52
1.6.2. Round off Errors in Solutions of Ordinary Differential Equations	60
1.7. Sunspot Activity	70
1.8. Kalman Filtering with Explicite Solutions (Signal Plus Noise Case)	79

Chapter 2

Elementary Gaussian Processes	95
2.1. Processes with Discrete Time	95
2.1.1. Main Theorems	95
2.1.2. Structure of Degenerate and Deterministic Processes	100
2.1.3. Spectral Representation of Processes, Autoregressive and Moving Average Type Processes	103
2.2. Processes with Continuous Time	118
2.2.1. Main Theorems	118
2.2.2. Stationary Gaussian Processes with Rational Spectral Density Functions	127
2.3. Density Functions and Sufficient Statistics	137
2.3.1. The Discrete Time Case	137
2.3.2. Some Auxiliary Theorems	144
2.3.3. The Radon- Nikodym Derivatives with Respect to the Wiener Measure	151
2.3.4. Unobservable Components	159

Chapter 3

The Maximum Likelihood Estimators and their Distributions
in the One Dimensional Case 169

3.1. The Basic Principles of Statistical Estimation Theory 169

3.2. The Unknown Mean 176

3.3. The Unknown λ 177

3.4. Two Unknown Parameters 185

3.5. The Discrete Time Case 193

3.5.1. Single Parameters 193

3.5.2. Distribution of the Derivatives of Likelihood
Function 198

3.5.3. Asymptotic Distribution of Maximum Likelihood
Estimates 207

3.5.4. Results Obtained for Discrete Analogues of the
Continuous-time Case 210

3.6. The Moments of Estimators and Asymptotic Theory 214

3.6.1. Sequential Estimation 218

Chapter 4

Multi-Dimensional Processes 221

4.1. The Complex Process 221

4.2. Construction of Confidence Intervals for the Parameter λ 225

4.3. Estimation of the Period 236

4.4. The Unknown Mean 239

4.4.1. The Complex Process 239

4.4.2. Linear Regression 240

4.4.3. Correct Estimates 242

4.4.4. Pitman's Estimates 245

4.4.5. Admissible Estimates 247

4.4.6. Minimax Weights in Trend Detection 250

4.5. Real Roots and Other Special Cases 253

4.6. Multi-Dimensional Case, Asymptotic Theory 258

Appendix A

Linear Differential Equations with Constant Coefficients 263

1. Preliminary Definitions and Notations, Matrices 263

2. Linear Systems with Constant Coefficients	268
<u>Appendix B</u>	
Probability Background	272
1. Gaussian Systems	272
2. Some Basic Concepts in Probability Theory	280
General Bibliography	
Books	288
References	294
Authors' index	308