Hung T. Nguyen Berlin Wu

Fundamentals of Statistics with Fuzzy Data



Contents

Chapter 1. Introduction	I
1.1 What is Fuzzy Statistics?	1
1.2 Why Do We Need Fuzzy Statistics?	2
1.3 How to Carry Out Statistical Inference with Fuzzy Data?	3
Chapter 2. Set-valued Data	5
2.1 Random Closed Sets	5
2.2 Coarse Data	9
Chapter 3. Modeling of Fuzzy Data	13
3.1 Fuzzy Sets	14
3.2 Fuzzy Logics	19
3.3 Fuzzy Relations	27
3.4 α -level Sets of Fuzzy Sets	28
3.5 Fusion of fuzzy Data	31
Chapter 4. Random Fuzzy Sets	35
4.1 Back to Sampling Surveys	35
4.2 Fuzzy Numbers	38
4.3 Fuzzy Set-Valued Random Elements	39
Chapter 5. Aspect of Statistical Inference	45
5.1 Fuzzy Data in Sampling Surveys	45
5.2 Coarse Data	46
5.3 Large Sample Statistics with Coarse Data	50
5.4 Random Set Data on Finite Spaces	53
5.5 Random Set Data on Metric, Compact Space	67
Chapter 6. Convergence of Random Fuzzy Sets	71
6.1 Stochastic Convergence of Random Sets	71
6.2 The Choquet Integral	73
6.3 A Variational Calculus of Set Functions	79
6.4 Choquet Weak Convergnece	87
Chapter 7. Fuzzy Statistical Analysis and Estimation	109
7.1 The Nature of Fuzzy Samples	109
7.2 Fuzzy Sample Mean for Fuzzy Data	113
7.3 Fuzzy Sample Median for Fuzzy Data	115

X Contents

7.4 Fuzzy Sample Mode	117
7.5 Heuristic Properties Related to the Fuzzy Statistics	119
7.6 Miscellaneous Applications	121
7.7 Concluding Remarks	127
Chapter 8. Tests of Hypothesis: Means	129
8.1 Introduction	129
8.2 Soft Distance with Fuzzy Samples	132
8.3 Some Properties of Fuzzy Data	134
8.4 Hypothesis Testing with Fuzzy Sample	137
8.5 Fuzzy χ^2 -test of Homogeneity	140
Chapter 9 Fuzzy Time Series Analysis and Forecasting	145
9.1 Introduction	145
9.2 Fuzzy Time Series	148
9.3 Multivariate Fuzzy Time Series Modeling and Forecasting	153
9.4 Measuring Beliefs in the Forecasting Process	162
9.5 Empirical Studies	169
9.6 Concluding Remarks	181
References	183
Index	193