Contents

List of illustrations x
Preface xi
Acknowledgements xiii

1 Introductory survey of the interpretations: some historical background **1**

Introductory survey of the interpretations 1
Origins and development of probability theory (c. 1650 to c. 1800): mathematics 3
Origins and development of probability theory (c. 1650 to c. 1800): practical applications and philosophy 8

2 The classical theory **14**

Universal determinism and Laplace's demon 14
Equally possible cases 17
Janus-faced probability 18
Why was probability theory not developed in the Ancient World? 22

3 The logical theory **25**

Cambridge in the Edwardian era 25
Probability as a logical relation 29
Measurable and non-measurable probabilities: the Principle of Indifference 33
Paradoxes of the Principle of Indifference 37
Possible solutions to the paradoxes 42

4 The subjective theory **50**

Ramsey's criticisms of Keynes 52

Subjective foundations for mathematical probability: the Ramsey–De Finetti theorem 53
A comparison of the axiom system given here with the Kolmogorov axioms 65
Apparently objective probabilities in the subjective theory: exchangeability 69
The relation between independence and exchangeability 75
Criticism of De Finetti's exchangeability reduction 77
Some objections to Bayesianism 83
De Finetti's route to subjective probability 85

5 The frequency theory **88**

Probability theory as a science 88
The empirical laws of probability 92
The limiting frequency definition of probability 96
The problem of randomness 105
The relation between Von Mises' axioms and the Kolmogorov axioms 109

6 The propensity theory: (I) general survey **113**

Popper's introduction of the propensity theory 114
Can there be objective probabilities of single events? 119
Classification of propensity theories 125
The propensity theories of Miller, the later Popper and Fetzer 126
Propensity and causality: Humphreys' paradox 129

7 The propensity theory: (II) development of a particular version **137**

Criticisms of operationalism: a non-operationalist theory of conceptual innovation in the natural sciences 138
A falsifying rule for probability statements 145
Derivation of the empirical laws of probability 150
The Kolmogorov axioms and the propensity theory 160

8 Intersubjective probability and pluralist views of probability **169**

Intersubjective probability 169
The spectrum from subjective to objective 175
Pluralist views of probability 180

9 An example of pluralism: differences between the natural and social sciences **187**

General arguments for interpreting probabilities in economics as epistemological rather than objective 188
Soros on the difference between the natural and social sciences 195
Operationalism is appropriate for the social sciences, but not for the natural sciences 200

Notes 206
References 212
Index 218