CONTENTS

List of Figures, Definitions and Key Propositions x

List of Symbols xv

Foreword xvii

1. Introduction: Where Do We Stand? 1

1.1 Tasks and Aims of Philosophy of Science 1

1.2 On the Historical Development of Philosophy of Science 3

1.3 Philosophical Positions in Contemporary Philosophy of Science 5

1.3.1 Logical Empiricism 5; 1.3.2 Critical Rationalism 7; 1.3.3 The Historical Account and Relativism 8; 1.3.4 Metaphysical and Scientific Realism 10; 1.3.5 Snapshots of Further Positions 12

1.4 Introductory Literature and Exercises 15

2. The Question of Unity: In Search of Common Foundations of the Sciences 16

2.1 Normative or Descriptive? The Method of Rational Reconstruction 16

2.2 Common Epistemological Assumptions 22

2.3 Common Methodological Features 25

2.4 Scientific Disciplines and Their Classification 27

2.4.1 The Special Status of Mathematical Sciences 30; 2.4.2 Testing the Common Foundations of Science 31; 2.4.3 Two Further Classifications of Sciences 34

2.5 The Question of Value-Neutrality 37

2.5.1 Max Weber's Value-Freedom Postulate and Its Critics 37; 2.5.2 Value-Neutrality and Means-End Inferences 39; 2.5.3 Explication of the Value-Neutrality Requirement 41

Bibliografische Informationen
http://d-nb.info/1049650417

digitalisiert durch DEUTSCHE NATIONAL BIBLIOTHEK

2.6 The Demarcation Problem and the Methodological Unity of Sciences 44
2.6.1 Demarcation 44; 2.6.2 Methodological Unity Instead of Physical Reductionism 46
2.7 Scientific Inference and Argumentation 49
2.7.1 Deduction and Induction 49; 2.7.2 Popper and the Significance of Inductive Inference in the Sciences 52; 2.7.3 Abduction and Inference to the Best Explanation 55; 2.7.4 Monotonic and Non-Monotonic Inferences 58

Complementary and Advanced Topics
2.8 How Much Metaphysics is Presupposed byScience? 59
2.8.1 Truth, Idealism and Realism 59; 2.8.2 Constructive Realism versus Radical Constructivism 61
2.9 On the Theory (In)dependence of Observation 63
2.9.1 Theory-Dependency of Observation—Pros and Cons 65;
2.9.2 A Definition of Theory-Neutral Observation Concepts 72
2.10 Value-Neutrality in the Context of Contemporary Debates 75
2.10.1 The Role of Values in Science 75; 2.10.2 Value-Neutrality in the Context of Meta-Ethics 77; 2.10.3 On the Difference between Sense Experiences and Value "Experiences" 78
2.11 The Justification of Induction: An Unsolvable Problem? 80
2.12 Introductory Literature and Exercises 85

3 The Conceptual Toolkit: Language, Logic and Probability 88
3.1 Kinds and Classification of Concepts 88
3.1.1 The Logical Type of Concepts 88; 3.1.2 Formalization: Syntax and Semantics, Statements and Models 92; 3.1.3 The Content Type of Concepts 96; 3.1.4 The Gradation (Scale) Type of Concepts 99
3.2 Classification of Sentences According to Their Content Type 105
3.2.1 Descriptive versus Prescriptive Sentences 106; 3.2.2 Observation and Basic Sentences, Empirical and Theoretical Sentences 107
3.3 Logical Truth and Deductive Logic 110
3.4 Conventions of Meaning and Definitional Truths 113
3.5 Classification of Sentences According to Their Generality 117
3.6 General Sentences, Lawlikeness, Determinism and Indeterminism 122
3.7 Content of Sentences and Kinds of Content 126
3.8 Verification, Falsification, Confirmation and Disconfirmation 128
3.9 Probability 129
3.9.1 Objective (Statistical) versus Epistemic (Subjective) Probability 129;
3.9.2 Mathematical Laws of Probability 133

Complementary and Advanced Topics
3.10 Disposition Concepts 135
3.11 Challenges to the Logical-Definitional-Synthetic Distinction 140

3.12 Relevance and Irrelevance in Logical Inferences 143
3.13 More on Probability 147
3.13.1 Construction of Probability Models and Sigma-Additivity 147; 3.13.2 Binomial Distribution and Law of Large Numbers 150; 3.13.3 Problems of Objective-Statistical Probability Concepts 152; 3.13.4 Problems of Subjective-Epistemic Probability Concepts 158; 3.13.5 Connections between Objective and Epistemic Probabilities: a Dualist Account 161
3.14 Introductory Literature and Exercises 168

4 A Question of Fit: Law Hypotheses and Their Empirical Testing 172
4.1 The Condition of Relevance 173
4.1.1 Relevance of Strict Laws 173; 4.1.2 Relevance of Statistical Laws 176
4.2 Testing of Strict Law Hypotheses for Truth and Relevance 181
4.2.1 The Method of Agreement and Difference 181; 4.2.2 Methodological Induction: How to Discover Strict Law Hypotheses 185
4.3 Testing Statistical Laws 188
4.3.1 Testing for Likely Truth and Acceptance Intervals 188; 4.3.2 Discovery of Statistical Hypotheses and Confidence Intervals 191; 4.3.3 Testing for Relevance and Significant Differences 193; 4.3.4 Statistical Representativity 196; 4.3.5 Test Statistics and Inference Statistics 198; 4.3.6 Sources of Error in Statistical Methods 200; 4.3.7 Applying Statistical Hypotheses to Individual Cases 203
4.4 Correlation and Causality 204
4.4.1 Hidden Variables 204; 4.4.2 Causal Direction 211

Complementary and Advanced Topics
4.5 Ceteris Paribus and Normic Laws 214
4.5.1 Comparative versus Exclusive CP Laws 214; 4.5.2 Normic Laws and Their Evolution-Theoretic Foundation 219
4.6 Probability Distributions for Continuous Variables 221
4.7 Bayesian Statistics 226
4.7.1 The Likelihood-Intuition: Objections and Replies 226; 4.7.2 The Bayesian Justification of the Likelihood-Intuition 229; 4.7.3 Objective Bayesianism and the Principle of Indifference 232; 4.7.4 Subjective Bayesianism and Convergence of Opinions 235
4.8 Introductory Literature and Exercises 238

5 Going Beyond Experience: Theories and Their Empirical Evaluation 242
5.1 Theoretical Concepts and Multiple Laws of Correspondence 242
5.2 The Example of Newtonian Physics 255
5.3 Theory Statics: The Structure of Scientific Theories 263
5.3.1 Components of Scientific Theories 263; 5.3.2 Theory Nets and Intertheoretical Relations 266

5.4 Methodological Features of (Good) Scientific Theories 268
5.4.1 System Character: Holism of Meaning, Content, and Theory Testing (Duhem's Thesis) 268; 5.4.2 Empirical Creativity, Global Unification, and Novel Predictions: Answers to Hempel's Dilemma 270
5.5 The Example of Piaget's Theory of Cognitive Development 272
5.6 Theory Dynamics 278
5.6.1 Lakatos' Model of Theory Revision 278; 5.6.2 Theory Evaluation and Theory Progress 281

Complementary and Advanced Topics
5.7 Instrumentalism and Realism: The Ontology of Scientific Theories 291
5.7.1 Versions of Instrumentalism and Realism 291; 5.7.2 No Miracles Argument versus Pessimistic Meta-Induction 294; 5.7.3 Empirical Underdetermination and Use-Novel Evidence 295; 5.7.4 Intertheoretical Correspondence, Structural Realism and the Justification of Abduction 296
5.8 The Ramsey Sentence of a Theory: (Non-) Eliminability of Theoretical Concepts 299
5.8.1 Ramsey Sentence and Carnap Sentence 299; 5.8.2 Instrumentalist Interpretation of the Ramsey Sentence 301; 5.8.3 The Realist Interpretation of the Ramsey Sentence 303; 5.8.4 Lewis Definitions 305
5.9 Criteria for Theoreticity and Empirical Significance 307
5.9.1 Pre-Theoretical and Theoretical Concepts 307; 5.9.2 Empirical Significance 311
5.10 General Accounts of Confirmation 313
5.10.1 Hypothetico-Deductive Confirmation 314; 5.10.2 Bayesian Probabilistic Confirmation 318; 5.10.3 Bayesian Pseudo-Confirmation through Content-Cutting 320; 5.10.4 Latent Variables, Parameter Fitting and Use-Novel Evidence 322; 5.10.5 Curve Fitting 326; 5.10.6 Genuine Probabilistic Confirmation 329; 5.10.7 Goodman's Paradox 331; 5.10.8 Confirmation and Acceptance 333
5.11 Non-Confirmational Accounts of Theory Evaluation 336
5.11.1 Truthlikeness 336; 5.11.2 Unification, Coherence and Simplicity 340; 5.11.3 The Problem of Language Dependence 342
5.12 Introductory Literature and Exercises 345

6 In Search of Causes: Explanation and All That Goes With It 348
6.1 The Deductive-Nomological Model of Explanation 348
6.2 Explanation versus Prediction and Justification 351
6.2.1 Predictions without Explanatory Function 352; 6.2.2 Causality and Lawlikeness 353; 6.2.3 Explanations without Predictive Function 355; 6.2.4 Logical Problems of Irrelevance and Redundancy 356
6.3 Probabilistic Explanation Models 357
6.3.1 Inductive-Statistical Explanation 357; 6.3.2 Maximal Specificity 359; 6.3.3 Probabilistic and Causal Relevance Models 361; 6.3.4 Conflicting Intuitions about the Height of Explanatory Probabilities 362

6.4 Normic Explanations and the Explanation of Human Actions 365
6.5 Expectation, Causation and Unification: Explanation as a Prototype Concept 367

Complementary and Advanced Topics
6.6 Lawlikeness 370
6.6.1 Laws of Nature versus System Laws 371; 6.6.2 Lawlikeness in the Wide versus Narrow Sense 372; 6.6.3 Lawlikeness i.w.s., Counterfactuals and Inductive Projectibility 373; 6.6.4 Spatiotemporal Universality and Maxwell's Condition 375; 6.6.5 The Best System Account 377; 6.6.6 Physical Necessity and Independent Possibility Knowledge 380
6.7 Causality 382
6.7.1 Singular and General Causality 382; 6.7.2 Regularity Accounts 384; 6.7.3 Counterfactuals and Causal Powers 385; 6.7.4 Causation and the Direction of Time 386; 6.7.5 Causal Processes and Mechanisms 387; 6.7.6 Interventionist Accounts 388; 6.7.7 Causality as a Theoretical Concept 389; 6.7.8 Axioms of Causality: C-connection, Productivity and Faithfulness 395; 6.7.9 Causal Discovery 402; 6.7.10 Empirical Content of GTC 403; 6.7.11 From Variables to Events: Overdetermination and Causal Pre-emption 406
6.8 Introductory Literature and Exercises 407

Bibliography 411

Solutions to Selected Exercises 435

Index of Names 440

Index of Subjects 447