

# Contents

<b>Preface</b>	<i>page</i>	<i>ix</i>
<b>1 Introduction</b>		
1.1 What this book is all about		1
1.2 Shift from classical probability		4
1.3 Physics		10
1.4 The final stage, 1919–1933		18
<b>2 Pathways to modern probability</b>		
2.1 First steps in measure theoretic probability.		
Axiomatization		27
(a) Gylden's problem in continued fractions		27
(b) Hilbert's sixth problem: the axiomatization of probability		32
2.2 Borel and the intrinsic properties of reals		36
(a) Foundations of mathematics		37
(b) Philosophy of probability		41
(c) Borel's denumerable probabilities		46
2.3 Strong laws of large numbers		57
2.4 Continuous distribution problems. Weyl's view of causality		61
(a) The equidistribution theorem of reals mod (1)		61
(b) 'The rigid pressure of nature's causality'		68
<b>3 Probability in statistical physics</b>		
3.1 Concepts of probability in classical statistical physics		71
(a) The definition of probability		71
(b) The dilemma of irreversibility		84
3.2 Ergodic theory		93
(a) Ergodic theory in statistical mechanics		93
(b) The way to a probabilistic theory		106
3.3 Einstein's views on probability		114
3.4 Brownian motion and random processes		123
(a) Brownian motion		124
(b) Continuous time random processes		132
3.5 Radioactivity before its explanation in quantum theory		137

<b>4</b>	<b>Quantum mechanical probability and indeterminism</b>	
4.1	Probability in the old quantum theory	142
4.2	The probabilistic interpretation of quantum mechanics	147
4.3	The uncertainty relation	157
<b>5</b>	<b>Classical embeddings of probability and chance</b>	
5.1	Subjective or objective probability: a philosophical debate	164
5.2	The early phase of a theory of objective probability	168
5.3	The theory of Hopf	174
<b>6</b>	<b>Von Mises' frequentist probabilities</b>	
6.1	Mechanics, probability, and positivism	179
6.2	Foundations of probability: the theory of random sequences	183
6.3	A purely probabilistic physics	189
6.4	The fate of collectives	192
<b>7</b>	<b>Kolmogorov's measure theoretic probabilities</b>	
7.1	Foundations and philosophy of mathematics	198
7.2	The meaning of probability. Earliest results	204
7.3	Random processes and statistical physics	207
7.4	The <i>Grundbegriffe</i>	214
	(a) The background	214
	(b) Axioms for finitary probability theory	217
	(c) The application of probability	219
	(d) Experiments	226
	(e) Infinite fields of probability	228
	(f) The impact of the 'Grundbegriffe'	230
7.5	The curious reappraisal of von Mises' theory	233
<b>8</b>	<b>De Finetti's subjective probabilities</b>	
8.1	'Probability does not exist'	238
8.2	Exchangeability and the representation theorem	245
	(a) The notion of exchangeability	245
	(b) The 'characteristic function of a random phenomenon' of 1928	247
	(c) Extensions of exchangeability	252
	(d) Of generalizations and connections and the ability to notice them	255
8.3	Stochastic processes: the renunciation of determinism	258
8.4	Foundations for the theory of probability	264
	(a) Quantitative probability as based on the notion of coherent bets	264

(b) The axiomatization of qualitative probability	273
8.5 The problem of denumerable additivity	276
<b>Supplement: Nicole Oresme and the ergodicity of rotations</b>	
1 The question of the periodicity of the universe	279
2 The density of rotations of a circle by an irrational angle	281
3 Frequentist probability	285
<b>Bibliography</b>	289
<b>Index of Names</b>	317
<b>Index of Subjects</b>	321