



Topics in Measure Theory and Real Analysis: The Measure Extension Problem and Related Questions (Atlantis Studies in Mathematics)

Alexander Kharazishvili

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This book highlights various topics on measure theory and vividly demonstrates that the different questions of this theory are closely connected with the central measure extension problem. Several important aspects of the measure extension problem are considered separately: set-theoretical, topological and algebraic. Also, various combinations (e.g., algebraic-topological) of these aspects are discussed by stressing their specific features. Several new methods are presented for solving the above mentioned problem in concrete situations. In particular, the following new results are obtained: the measure extension problem is completely solved for invariant or quasi-invariant measures on solvable uncountable groups; non-separable extensions of invariant measures are constructed by using their ergodic components; absolutely non-measurable additive functionals are constructed for certain classes of measures; the structure of algebraic sums of measure zero sets is investigated.

The material presented in this book is essentially self-contained and is oriented towards a wide audience of mathematicians (including postgraduate students). New results and facts given in the book are based on (or closely connected with) traditional topics of set theory, measure theory and general topology such as: infinite combinatorics, Martin's Axiom and the Continuum Hypothesis, Luzin and Sierpinski sets, universal measure zero sets, theorems on the existence of measurable selectors, regularity properties of Borel measures on metric spaces, and so on. Essential information on these topics is also included in the text (primarily, in the form of Appendixes or Exercises), which enables potential readers to understand the proofs and follow the constructions in full details. This not only allows the book to be used as a monograph but also as a course of lectures for students whose interests lie in set theory, real analysis, measure theory and general topology.

- The Problem of Extending Partial Functions
- Some Aspects of the Measure Extension Problem
- Invariant Measures
- Quasi-Invariant Measures
- Measurability Properties of Real-Valued Functions
- Some Properties of Step-Functions Connected with Extensions of Measures
- Almost Measurable Real-Valued Functions
- Several Facts From General Topology
- Weakly Metrically Transitive Measures and Nonmeasurable Sets
- Nonmeasurable Subgroups of Uncountable Solvable Groups
- Algebraic Sums of Measure Zero Sets
- The Absolute Nonmeasurability of Minkowski's Sum of Certain Universal Measure Zero Sets
- Absolutely Nonmeasurable Additive Sierpiński-Zygmund Functions
- Relatively Measurable Sierpiński-Zygmund Functions
- A Nonseparable Extension of the Lebesgue Measure Without New Null-Sets
- Metrical Transitivity and Nonseparable Extensions of Invariant Measures
- Nonseparable Left Invariant Measures on Uncountable Solvable Groups

- Universally Measurable Additive Functionals
- Some Subsets of the Euclidean Plane
- Restrictions of Real-Valued Functions
- Appendices

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