

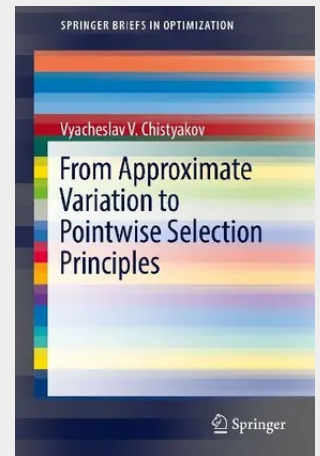
From Approximate Variation to Pointwise Selection Principles

The book addresses the minimization of special lower semicontinuous functionals over closed balls in metric spaces, called the approximate variation. The new notion of approximate variation contains more information about the bounded variation functional and has the following features: the infimum in the definition of approximate variation is not attained in general and the total Jordan variation of a function is obtained by a limiting procedure as a parameter tends to zero. By means of the approximate variation, we are able to characterize regulated functions in a generalized sense and provide powerful compactness tools in the topology of pointwise convergence, conventionally called pointwise selection principles. The book presents a thorough, self-contained study of the approximate variation and results which were not published previously in book form. The approximate variation is illustrated by a large number of examples designed specifically for this study. The discussion elaborates on the state-of-the-art pointwise selection principles applied to functions with values in metric spaces, normed spaces, reflexive Banach spaces, and Hilbert spaces. The highlighted feature includes a deep study of special type of lower semicontinuous functionals though the applied methods are of a general nature. The content is accessible to students with some background in real analysis, general topology, and measure theory. Among the new results presented are properties of the approximate variation: semi-additivity, change of variable formula, subtle behavior with respect to uniformly and pointwise convergent sequences of functions, and the behavior on improper metric spaces. These properties are crucial for pointwise selection principles in which the key role is played by the limit superior of the approximate variation. Interestingly, pointwise selection principles may be regular, treating regulated limit functions, and irregular, treating highly irregular functions (e.g., Dirichlet-type functions), in which a significant role is played by Ramsey's Theorem from formal logic.

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53,49 €

49,99 € (zzgl. MwSt.)

Lieferfrist: bis zu 10 Tage

Artikelnummer: 9783030873981

Medium: Buch

ISBN: 978-3-030-87398-1

Verlag: Springer

Erscheinungstermin: 23.10.2021

Sprache(n): Englisch

Auflage: 1. Auflage 2021

Serie: SpringerBriefs in Optimization

Produktform: Kartoniert

Gewicht: 166 g

Seiten: 86

Format (B x H): 155 x 235 mm

