

Heil, Christopher

Introduction to real analysis. (English) Zbl 1426.26001

Graduate Texts in Mathematics 280. Cham: Springer (ISBN 978-3-030-26901-2/hbk; 978-3-030-26903-6/ebook). xvii, 400 p. (2019).

The book presents an extended lecture notes written on the base of lectures delivered by the author at the Georgia Institute of Technology, Atlanta, USA. It covers the material of a two-semester course on real analysis.

The main aim of the author is to clarify the central ideas of modern analysis. To achieve this aim, several technical innovations are proposed. First, the preliminary chapter contains the basic material of calculus in a clear and straightforward form. Second, the main text is supplied by a series of illustrative examples, pictures and remarks. For interested readers, a number of problems is presented at the end of most sections. Hints for the solution of the selected problems are given at the end of the book. Last but not the least, a map of some extra online material is described in the preface.

The main part of the book consists of 9 chapters. It starts with basic notions and results on metric and normed spaces (Chapter 1). Chapters 2–4 constitute the core of the book. From the Lebesgue measure through measurable functions, the reader arrives easily to the definition of the Lebesgue integral. Though the material is more or less standard, the author found a way to make the presentation as simple as possible. In opposite to classical analysis, one of the main questions in Lebesgue integration theory is how to define and develop differentiation of the integral (Chapter 5). This is a preparation to the understanding of the notion of absolute continuity and the following fundamental theorem of calculus (Chapter 6). A natural continuation of the theory is the discussion of function spaces (L_p -spaces) in Chapter 7 and the Hilbert L_2 -space in Chapter 8). The last chapter is devoted to the presentation of the material which looks not too standard, namely, the discussion of convolution and Fourier transform. But it opens the door to possible applications of the theory presented in the book. In particular, it touches some basic questions of harmonic and wavelet analysis.

The book is really a textbook full of intermediate motivated questions addressed to the audience and step-divided discussions. It can be suitable for first-year students in mathematics, for well-prepared undergraduate mathematical majors, and for graduate students from a variety of engineering and scientific applications.

Reviewer: Sergei V. Rogosin (Minsk)

MSC:

26-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to real functions

- 42Axx Harmonic analysis in one variable
- 42A38 Fourier and Fourier-Stieltjes transforms and other transforms of Fourier type
- 46B25 Classical Banach spaces in the general theory
- 46C05 Hilbert and pre-Hilbert spaces: geometry and topology (including spaces with semidefinite inner product)
- 28-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to measure and integration

Keywords:

real analysis; Lebesgue measure; Lebesgue integral; fundamental theorem of calculus; L_p -spaces; Fourier transform

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