

# Preface

Mathematical analysis is a huge field that lies at the core of contemporary sciences. It provides theories and algorithms enabling the specialists to solve a number of problems of utmost importance in a series of domains that touch our everyday life: optimal allocation of resources, market equilibria, signal processing, mass transportation, weather forecasting, celestial mechanics, and so on. The abstract character of mathematics amplifies this. Once a problem is solved, an entire family of related problems is also solved. So the implications run broad and deep.

Understanding analysis is thus crucial in the twenty-first century! Large groups of students are now interested to prepare themselves for careers in engineering, banking, medicine, law, and numerous other fields where analytical skills are very much desirable. However, as many people have already noticed, teaching analysis to such a diverse audience less familiar with the nature of axiomatic arguments is quite a challenging task.

The role of the first course in analysis which follows elementary calculus is thus critical. It should provide a mathematically rigorous approach to the study of functions of one real variable, to develop mathematical intuition, to make understandable the importance and limits of computer facilities, and much more.

The book is intended to familiarize the reader with the basic concepts, principles, and methods of analysis and to smoothen the access to more advanced topics. It focuses mainly on topics of one real variable case (with additions concerning continuity in metric spaces, complex power series, and some elements of functional analysis), because this material offers the reader the necessary background for any further serious studies and also a glimpse into the aims, scope, and evolution of mathematics.

Contrary to popular belief, the mathematical analysis of one real variable is still an active domain, continuing to surprise us with unexpected new results. Also, many interesting problems are waiting for an answer, some of which are mentioned in our text. Meanwhile, this field has become a valuable source of inspiration for much of contemporary research in mathematics. Indeed, many new results and methods of higher mathematics originate in the one real variable mathematical analysis, revealing a new understanding of some old classical results.

The writing of the present book started in 2005, when the second author prepared a first version for his graduate students at the University of Craiova. A year later, a collaboration of the two authors began at Abdus Salam School of Mathematical Sciences in Lahore, and the whole material was rearranged and expanded to make the text more versatile.

Indeed, the book contains plenty of material both for seminars and independent study, and the instructor can choose from a large variety of options. Every section ends with exercises (of medium and high level) and every chapter ends with a section of notes and remarks that provides historical information and supplementary material devoted to a better understanding of the present state of art. For more flexibility, the three appendices at the end of the book add material on one-dimensional dynamical systems, applications of Lebesgue's differentiation theorem, and Stieltjes integral.

The core material, Chaps. 1–10, accompanied by Appendices A and C, is suitable for a year-long course devoted to senior undergraduate students, while Chaps. 11 and 12, accompanied by Appendix B, cover a one-semester graduate course on Lebesgue integral and its applications. The background assumed for using this text is decent courses in both calculus and linear algebra.

The book uses well-established notations such as:  $\mathbb{N}, \mathbb{Z}, \mathbb{R}, \mathbb{C}$  (for the sets of natural, integer, real, and complex numbers respectively),  $\mathbb{N}^*$  (for the set of all positive natural numbers),  $\mathbb{R}_+$  (for the set of all nonnegative real numbers).

The sign  $\square$  designates the end of a proof.

For the convenience of the reader, a List of Symbols and an Index of terminology are supplied at the end of the book.

An accompanying problem book is in preparation and a dedicated web page will be available at [http://math.ucv.ro/~niculescu/Real\\_Analysis\\_On\\_Intervals.html](http://math.ucv.ro/~niculescu/Real_Analysis_On_Intervals.html) to keep our readers updated.

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A.D.R. Choudary  
Constantin P. Niculescu

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Choudary, A.D.R.; Niculescu, C.

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