

# Preface

The aim of this book is to review the theory of some basic topics in Analysis and accompany the theory with problems and their solutions. With the problems the reader can test his/her understanding of the theory and also discover extensions of the theory and additional results which are not so standard in the literature. The topics covered span a more or less standard advanced undergraduate and graduate curriculum in Analysis. More precisely, we focus on the following subjects:

1. Metric Spaces
2. Topological Spaces (here there is also some introductory material on Algebraic Topology)
3. Measure, Integration and Martingales (including  $L^p$ -spaces)
4. Measure and Topology (covering issues concerning the interplay between measure theory and topology)
5. Functional Analysis (with emphasis on basic Banach space theory).

Each one of the above five subjects corresponds to a different chapter. In the first part of each chapter, we present the basic theory, with all the main definitions and results. We also include comments and remarks expanding on the concepts and results, but no proofs. This review material will help the reader refresh his/her knowledge of the theory before tackling the problems. In each chapter the theory is followed by problems and their detailed solution. In each chapter, there are at least 170 problems, marked with  $\star$ ,  $\star\star$  or  $\star\star\star$  according to their difficulty. Some of those problems complement the theory, while the rest check the reader's understanding of the theory. We strongly encourage the reader to put some substantial personal effort in trying to solve the problem, before looking at the solution. Otherwise, they will get no benefit from reading the book. On the other hand, a serious

effort to solve the problem themselves and subsequently compare their solution with the one provided (or checking to see where they failed to come up with the right arguments to produce a solution) will help them to achieve a solid understanding of the theory.

It is not easy to provide the origin of each of the problems and of their solutions. They can be traced as problems included in the books mentioned in the literature (where they are stated without proofs), or they can be found in the problem books listed in the References, or they are standard exercises in the public domain, or they were accumulated through the years from teaching undergraduate and graduate courses on these or closely related subjects. In any case, the books mentioned in the References can be a valuable source for additional theoretical material and more problems. Our book is only the starting point (helpful we hope).

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Part 1

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