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Explorations in Analysis, Topology, and Dynamics
An Introduction to Abstract Mathematics
by Alejandro Uribe A. and Daniel A. Visscher

This book grew out of a course for beginning math majors at the University of Michigan that used an inquiry-based-learning (or IBL) approach to teach introductory real analysis with forays into point-set topology and dynamical systems. The book starts with familiar material from high school mathematics, then leads students, using cleverly crafted sequences of questions and problems, to understand and internalize the rigorous theory behind familiar topics such as sequences, derivatives, and integrals. In less than 200 pages, the book even finds space and a natural progression of ideas to introduce students to advanced topics not usually covered in introductory courses, such as iterations of quadratic maps, the doubling map, fractals, and billiards.

Given that the active learning philosophy of IBL holds as a central principle that students learn better when they teach themselves through problem solving with judicious but minimal guidance, one may well wonder at the role of a textbook. This book is much more than a list of problems. It also establishes and maintains a powerful narrative arc, using repeated themes like nested intervals and iterations to create unity and inevitability as its story unfolds.

Another pleasing feature of the book is its innovative use of definitions and constructions to simultaneously simplify the exposition and make it more effective and memorable. For example, early in the book it asks students to show that a real number is rational if and only if it is commensurable to 1, presenting the dichotomy of rational and irrational numbers in a way that develops further meaning in later sections on rotations of the circle. In another example, the rational numbers between 0 and 1 are arranged in a pyramid to give at once a view of the rational numbers as an ordered sequence, and at the same time a view of the multitude of subsequences (corresponding to paths going down the pyramid) that converge to different limits.

With its friendly and clear style, clever pedagogical ideas, and finely honed organization, this book will appeal to instructors looking for a modern and creative approach to introducing students to higher mathematics.

Invitation to Ergodic Theory
by C. E. Silva

Ergodic theory, which originated in statistical mechanics, studies the long-term behavior of abstract dynamical systems using measure theory. This relatively young and still growing field has applications in probability theory, number theory, and topological dynamical systems. Silva’s book gives an appealing introduction to the subject aimed at undergraduates who have taken a first course in real analysis, and who would like to get a taste of its applications in an active research area.

The author does not assume any previous knowledge of measure theory, and spends a quarter of the book developing the Lebesgue measure and Lebesgue integration. In this way the book achieves a secondary purpose, giving an introduction to measure theory, putting it into a context and illuminating its connections to a broad range of applications.

The first chapter of the book gives a thorough treatment of Lebesgue measure, sigma algebras, and measure spaces. This is followed by a chapter on recurrence and ergodicity, presenting important examples like the Baker’s map, rotations of the circle, and the doubling map. The third chapter returns to the topic of Lebesgue integration, and is followed by a chapter on the Birkhoff Ergodicity Theorem and Weyl’s equidistribution theorem and a chapter on different notions of mixing, including a discussion of Chacón’s transformation.

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