

Ergodic Theory with a view towards Number Theory

The book is an introduction to ergodic theory and dynamical systems. Some topics have been selected with the applications to number theory in mind, but contains some others to aid motivation and to give a complete picture of ergodic theory.

The book is organized into 11 chapters. The first chapter contains some motivating examples and results from ergodic theory. Chapter 2 introduces measure-preserving transformations and some basic facts on the notions of ergodicity, weak-mixing and strong-mixing. Continued fractions decompositions of real numbers, continued fraction map and Gauus measure are introduced in chapter 3, as well as some classical results on Diophantine approximations.

Chapter 4 has to do with the existence of invariant measures for continuous maps on compact metric spaces, ergodic decomposition and unique ergodicity. The proof of Weyl's theorem on uniform distribution of polynomials is included in this chapter.

Chapter 5 provides more advanced background in measure theory which is used in chapter 6, where factors and joinings of measure-preserving systems are discussed and a proof of the ergodic decomposition result is given.

The ergodic proof of Szemerédi's theorem on arithmetic progressions, due to Furstenberg, is included in chapter 7. This is the first example of how the ergodic methods lead to results in combinatorics.

The ergodic theory for group actions is studied in chapter 8. The analysis of actions on locally homogeneous spaces is introduced in chapter 9 by studying the geodesic flow on hyperbolic surfaces. Chapter 10 is devoted to rotations on quotients of nilpotent groups and to the study of the continuous Heisenberg group.

The last chapter deals with the ergodicity of the horocycle flow and its properties. lattices in $SL(2, \mathbb{R})$, the Mautner phenomenon, the Howe-Moore theorem, rigidity of invariant measures for the horocyclic flow and the equidistribution of horocyclic orbits.

The book is intended for graduate students and researchers with some background in measure theory and functional analysis. Definitely, it is a book of great interest for researchers in ergodic theory, homogeneous dynamics or number theory.

Reviewer: Antonio Díaz-Cano Ocaña

Affiliation:

Instituto de Matemática Interdisciplinar (IMI), Departamento de Álgebra, Facultad de Ciencias Matemáticas, Universidad Complutense de Madrid, E-28040 Madrid, Spain

Book details

This book is a rigorous introduction to ergodic theory and dynamical systems, paying special attention to the understanding of certain applications of ergodic theory to problems in number theory. Among other applications we can find Weyl's theorem on uniform distribution of

polynomials, the ergodic proof of Szemerédi's theorem on arithmetic progressions or the proof of the equidistribution of horocycle orbits.

Author: [Manfred Einsiedler](#) [Thomas Ward](#)

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Categorisation

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