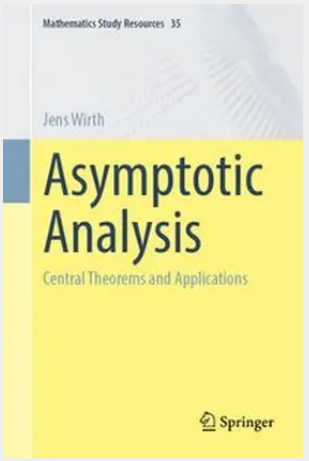
Wirth

Asymptotic Analysis

Central Theorems and Applications



This book is based on a lecture on asymptotic analysis that the author has given multiple times. It is aimed both at students who want to learn about asymptotic methods and at practitioners seeking new inspiration for their work. After a brief introduction to asymptotic concepts, the book focuses particularly on asymptotic expansions and how to compute with them. Standard techniques for proving asymptotic formulas – such as Laplace's method and the method of steepest descent for estimating complex contour integrals – are discussed using examples. A recurring theme is the relationship between the asymptotic behaviour of a sequence or function on the one hand, and the analytic continuation of an associated object obtained via a transformation on the other. In this context, generating functions are introduced and used to solve recurrence relations. The book also develops the theory of Laplace and Mellin transforms to help understand differential equations and to formulate basic Abelian and Tauberian theorems. Dirichlet series are then used to study number-theoretic functions and to prove the prime number theorem. In addition, the final chapter covers analytic perturbation results for the zeros of polynomials and for eigenvalues. It also discusses differential equations with regular and irregular singular points and investigates the asymptotic behaviour of solutions near these points. This book is a translation of the original German edition Asymptotische Analysis - Zentrale Sätze und Anwendungen, published by Springer-Verlag GmbH Germany, part of Springer Nature in 2026. The translation was done with the help of an artificial intelligence machine translation tool. A subsequent human revision was done primarily in terms of content, so that the book might read stylistically differently from a conventional translation.

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40,65 €
37,99 € (zzgl. MwSt.)

vorbestellbar, Erscheinungstermin ca. Februar 2027

Artikelnummer: 9783662743812
Medium: Buch
ISBN: 978-3-662-74381-2
Verlag: Springer
Erscheinungstermin: 24.02.2027
Sprache(n): Englisch
Auflage: Erscheinungsjahr 2027
Serie: Mathematics Study Resources
Produktform: Kartoniert
Seiten: 142
Format (B x H): 155 x 235 mm