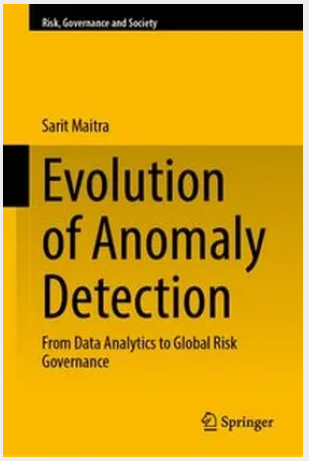
Maitra

Evolution of Anomaly Detection

From Data Analytics to Global Risk Governance



149,79 €
139,99 € (zzgl. MwSt.)

vorbestellbar, Erscheinungstermin ca. Februar 2027

This book offers a comprehensive and interdisciplinary exploration of anomaly detection, tracing its evolution from classical statistical methods to modern machine learning, deep learning, and hybrid AI approaches. Anomaly detection has become one of the most critical capabilities of the digital age. As societies increasingly rely on interconnected infrastructures, artificial intelligence, financial networks, and automated decision systems, small deviations in data can signal major threats, from cyberattacks and financial fraud to infrastructure failures and systemic crises. Yet despite its growing importance, anomaly detection remains fragmented across disciplines and application domains. Moving beyond purely technical perspectives, it demonstrates how anomaly detection functions as an essential component of risk governance, organizational resilience, and societal preparedness. Through a combination of theoretical foundations, practical case studies, and real-world applications, readers will learn how anomalies emerge, why detection systems fail, and how organizations can design more robust strategies for identifying and managing uncertainty. The book covers statistical approaches, adaptive thresholding, supervised and unsupervised learning, fraud detection, representation learning, contrastive learning, and governance-oriented frameworks for high-stakes environments. Bridging the worlds of data science, cybersecurity, risk management, and public policy, this book is an invaluable resource for researchers, graduate students, AI practitioners, risk professionals, and decision-makers seeking to understand and govern complex digital systems. Ultimately, it argues that anomaly detection is no longer merely a technical challenge, but a foundational capability for managing uncertainty and safeguarding modern society.

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Artikelnummer: 9783032434487
Medium: Buch
ISBN: 978-3-032-43448-7
Verlag: Springer
Erscheinungstermin: 24.02.2027
Sprache(n): Englisch
Auflage: Erscheinungsjahr 2027
Serie: Risk, Governance and Society
Produktform: Gebunden
Seiten: 229
Format (B x H): 155 x 235 mm

Kundenservice Verlag Dr. Otto Schmidt KG
Neumannstraße 10, 40235 Düsseldorf | kundenservice@otto-schmidt.de | 0221-93738-997 (Inland)