COMPLETE SET OF PRE-PUBLICATION REVIEWS

Spatial Mathematics: Theory and Practice through Mapping

Sandra Lach Arlinghaus and Joseph Kerski

- **Waldo Tobler**, Ph.D., Professor of Geography and Professor of Statistics Emeritus, University of California Santa Barbara: â€œTwo ancient texts had a profound and lasting impact on the literate world. The first of these was Euclid's Elements, whose importance lasted until about 1800. Then it was overtaken by advances in mathematics, including calculus, Gauss's differential geometry, and the writings of Riemann, and eventually the influence of Einstein. This phase of 'continuous' mathematics is slowly being replaced by 'discrete' analysis, heavily impacted by digital computers. Finite mathematics was never completely ignored but it is now ascendant, as is amply illustrated in this book by Arlinghaus and Kerski.

  The second text with profound impact was the rediscovery in the 1400's of Ptolemy's Geography from 150 AD. Combined with "the net of Meridians and Parallels cast over the world", to paraphrase J. Donne, the impact of Ptolemy's work lasted rather beyond the discoveries of Columbus. These coordinates, first proposed by Hipparchus in about 150 BC, were not often used in medieval Europe nor anywhere else. But this grid provides the basis for the use of geographic maps as a form of graph paper to be used to solve terrestrial problems. Foremost amongst these was Mercator's warping to assist ocean navigation. A contemporary distortion, the London Underground map, preserves the topology to assist with a modern navigation problem. Now, in this book, additional insight for the mathematical solution of geographical tasks is provided. The pedagogical orientation is especially worthy of comment.

- **Michael Batty**, Ph.D., Bartlett Professor of Planning at University College London and Director, Centre for Advanced Spatial Analysis at University College London. Comments provided in a set of four parts presumably to suit different publishing marketing outlets.

  Teaching mathematics can be tough but here is a book that is a gentle introduction to the mathematics of the spatial world through the medium of mapping. The use of QR codes to access additional map-based material is clever and innovative, and provides a nice link to the very technologies that this mathematics supports.

  This innovative book not only develops mathematics for spatial analysts through ideas about mapping but does so by assuming the reader is able to draw more practical material from the web using a smart phone with a QR code application. A fascinating way to teach a tough subject and something of a first in this field.

  To read this book, you need a smart phone with a QR code application from which you can access the maps that support the underlying mathematics of spatial analysis. Most of those reading this book are likely to have such a phone and thus this is triumph of innovative teaching for all those wishing to explore new methods of mapping in the 21st century.

This is the first time a book in the field of geographic information science requests the reader to use a smart phone to download supplementary material using QR codes that can be read from a smart phone. This approach to spatial analysis is full of innovative techniques that enable readers to grasp the underlying mathematics of the spatial world.

- **Michael Goodchild**, Ph.D., Jack and Laura Dangermond Professor of Geography and Director of UCSB's Center for Spatial Studies. Now, Research Professor of Geography Emeritus, University of California Santa Barbara: Mathematics underpins geography in many ways, especially in this new era of computerized mapping and geographic information systems. Geography can also be an exciting and relevant way of teaching many of the basic concepts of mathematics, from geometry and topology to statistics. So this book on spatial mathematics as applied to mapping is both timely and welcome. The wealth of practical examples and the enthusiasm of its authors will fill an important niche in a mapping literature that often underplays the importance and relevance of mathematics.

  It is particularly refreshing to see the book begin with the mathematics of the Earth's curved surface, and deal only later with the complexities of flattening the Earth through the use of map projections. We have grown so used to the distortions inherent in map projections "the enormity of Greenland when viewed on a Mercator projection, for example" that it is easy to forget that the Earth is actually round. Google Earth did much to restructure our view of the Earth when it was released in 2005; this book will without doubt make another step in that direction.

- **Marc Schlossberg**, Ph.D., Associate Professor of Planning, Public Policy and Management, and Co-Director Sustainable Cities Initiative, University of Oregon: If a picture is worth a thousand words, then a map is worth exponentially more. Underneath the colors of a modern electronic map is an enormous amount of math and science, from how to represent a three dimensional globe on a two dimensional surface to how to produce and represent color itself in a way to communicate meaning and make sense of complex data. This book is both all about the map and all about the math behind the map, using what has become ubiquitous on our smart phones and in our vehicles as a vehicle itself to teach complex math concepts in accessible ways. The book's use of modern, socially pressing issues as the basis of understanding spatial math further augments its goal to make complex concepts accessible, meaningful, and useful for students.

- **Karl Donert**, Ph.D., University of Salzburg, Z-GIS, Director European Centre (EUROGEO): An excellent textbook mainstreaming geoinformation perspectives through mathematical education, ***Spatial Mathematics*** has a clearly developed theoretical approach with great exercises and practical hands-on activities.

- **Mark Hogrebe**, Ph.D., Institutional Research, Washington University in St. Louis: *Spatial Mathematics: Theory and Practice Through Mapping* sets the standard for explaining the relationship between mathematics, geography, and GIS technologies. Innovative practical applications use smartphones and web resources, with concepts presented in a clear, common-sense approach. Teachers will discover a gold mine of opportunities and numerous

examples for inquiry-based activities in mathematics and geography as well as in the life and social sciences. A benchmark book for interdisciplinary teaching and learning.

- **Bob Coulter**, Ph.D., Director, Litzsinger Road Ecology Center, Missouri Botanical Garden: In this important work, Drs. Arlinghaus and Kerski fill an important need in the geospatial literature with their accessible introduction to spatial mathematics. While there are many more advanced books illustrating complex techniques, this offering frames concepts in a way that is accessible to new learners who may not have an advanced math background. This accessibility should not be confused with simplicity, however. In successive chapters, the authors build an intellectually challenging description of the math underlying geospatial analysis. Throughout, easy to follow activities help make the concepts clear and relevant. If we are to build a generation of spatial thinkers (and not just people trained in GIS and GPS), we need foundational understanding like this book supports. Highly recommended!