

A Map-matical Framework for Quantitative Analysis of Mapped Data

...Map Analysis and GIS Modeling for Understanding and Communicating Spatial Patterns and Relationships within STEM Discipline Contexts

Hosted by

University of Denver

Center for Statistics and Visualization and Department of Geography and the Environment

Friday, February 20, 2015 — 12:00 - 1:00pm — Anderson Academic Commons, Room 152

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Most of Geospatial Technology's recent growth has been in its capabilities as a "technical tool" for corralling vast amounts of spatial data and providing near instantaneous access to remote sensing images, GPS navigation, interactive maps, asset management records, geo-queries and awesome displays. However, GIS as an "analytical tool" hasn't experienced the same meteoric rise—in fact it might be argued that the analytic side of GIS has somewhat stalled over the last decade. But the future of GIS is moving from a "down the hall and to the right" specialist's role providing mapped data, to a broader and more active role providing spatial information through map analysis and modeling that directly interacts with research, policy formation, planning and management decisions. The shifting emphasis from data-centric tools for mensuration (*Where is What*) to application-specific constructs of prescriptive mapping (*Why, So What and What If*) infuses consideration of geographic patterns and relationships within problem-solving contexts. This paradigm shift also provides for the development of a comprehensive *Spatial/STEM* approach for teaching and communicating fundamental spatial analytical/statistical concepts and tools by extending current math/stat procedures into the spatial realm. By reorganizing existing GIS capabilities into the common mathematical framework, spatial reasoning can be infused into critical thinking and problem solving in STEM discipline teaching and research.

This presentation describes a comprehensive framework for map analysis and modeling concepts and procedures as direct spatial extensions of traditional mathematics and statistics enabling individuals with minimal or no GIS background to develop spatial reasoning and problem solving skills—thinking with maps. (50 minute presentation and 40 minute follow-on informal discussion)

References: (PowerPoint slides and live URL links to references are at www.innovativegis.com/basis/Present/Mapemantics2015/)

- **Simultaneously Trivializing and Complicating GIS** — white paper describing a mathematical structure for Spatial Analysis/ Statistics.
http://www.innovativegis.com/basis/Papers/Other/SpatialSTEM/TrivializingComplicating_GIS.pdf
- **SpatialSTEM: a mathematical/statistical framework for understanding and communicating grid-based map analysis**, paper presented at ASPRS 2013 Annual Conference, Baltimore, Maryland, March 28, 2013.
http://www.innovativegis.com/basis/Papers/Other/ASPRS13_sSTEM/
- **A Math/Stat Framework for Grid-based Map Analysis and Modeling** — Topic 10, book IV GIS Modeling in the online Beyond Mapping Compilation Series of the Beyond Mapping columns published in GeoWorld since 1989.
http://www.innovativegis.com/basis/BeyondMappingSeries/Beyondmapping_IV/Topic10/BM_IV_T10.htm
- **A Brief History and Probable Future of Geotechnology** — white paper on the evolution and future directions of GIS technology.
http://www.innovativegis.com/basis/Papers/Other/Geotechnology/Geotechnology_history_future.htm
- **Education Outside the Traditional Lines** — Topic 6, book IV GIS Modeling in the online Beyond Mapping Compilation Series of the Beyond Mapping columns published in GeoWorld since 1989.
http://www.innovativegis.com/basis/BeyondMappingSeries/Beyondmapping_IV/Topic6/BM_IV_T6.htm
- **Beyond Mapping Compilation Series** — a compilation of over 300 "Beyond Mapping" columns appearing in GeoWorld 1989 to 2013 organized into three online books.
<http://www.innovativegis.com/basis/BeyondMappingSeries/>



Joseph K. Berry is a leading consultant and educator in the application of Geographic Information Systems (GIS) technology. He is the author of the "Beyond Mapping" column for GeoWorld magazine since 1989, written over two hundred papers on the theory and application of map analysis techniques, and is the author of the popular books *Beyond Mapping* (Wiley, 1993), *Spatial Reasoning* (Wiley 1995), *Map Analysis* (GeoTec Media, 2007) and *GIS Modeling* (BASIS Press, 2014). Since 1976, he has presented college courses and professional workshops on geospatial technology to thousands of individuals from a wide variety of disciplines.

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