

QUANTITATIVE GEOGRAPHY

GGM 201: RESEARCH METHODS FOR DISSERTATIONS

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DEFINITION

Source: Oxford English Dictionary

Quantitative

- “That is, or may be, **measured** or assessed with respect to or on the basis of **quantity**; that may be expressed in terms of quantity; quantifiable.”

Geography

- “The field of study concerned with the **physical features of the earth** and its atmosphere, and with **human activity** as it affects and is affected by these, including the **distribution** of populations and resources and political and economic activities; also as a subject of educational study or examination.”

Fotheringham, Brunsdon, and Charlton (2000)

“One or more of the following activities:

- the analysis of numerical spatial data;
- the development of spatial theory;
- and the construction and testing of mathematical models of spatial processes”

Murray (2010)

“The collection of **methods** that are applied, or could/can be applied, by geographers and others to study **spatial** phenomena, issues and problems”

HISTORY

- As a practice, origin is very old and hard to pinpoint
- As a *movement*, 1950s/60s/70s → **Quantitative Revolution**
 - Focus on **quantification** and measurement
 - Adoption of the **scientific method**
 - Strong association with particular **methods**: statistics, modeling, mapping, mathematics, and hypothesis testing
 - Sprung out of a few epicenters (UW's "*space cadets*", Lund's T. Hagerstrand, also related to Isard's Regional Science)
 - One of the dominant strains in Physical Geography after the 1950s - Pidwirny (2006)

- 1980s/90s → Cultural turn in Human Geography and other social sciences
- 1990s/00s → Cross-pollination with and from other disciplines (economy, sociology, urban planning, public policy, ...)

- **[My view]** Nowadays → Back in fashion? Big Data revolution, Internet of Things, Computational Social Sciences, ...
- Intricate relationship with the available tools at the time
 - Mainframes, satellites, machine learning, ...

QUANTITATIVE GEOGRAPHY TODAY

(Spatial) methods that can be/have been applied to *human* and *physical* geography problems and issues.

- Geographic Information Systems (GIS)
- Airborne sensing
- Statistics and exploratory spatial data analysis (ESDA)
- Mathematics and optimization
- Regional analysis
- Computer science and simulation

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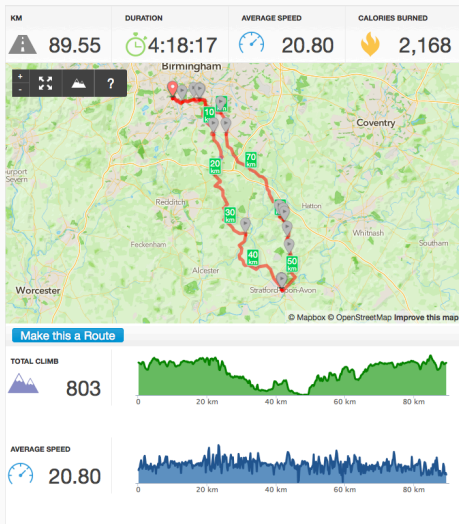
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Let's walk through each of those with an example...

“Collection of hardware, software, and associated procedures to support **spatial data**...

- acquisition,
- management,
- manipulation,
- analysis,
- and display”

GIS EXAMPLE: CYCLING TRACKING



Source: <http://www.runkeeper.com>

- **Acquisition:** collection of GPS traces (smartphone)
- **Management:** phone storage, transfer over server, orderly inserted into database
- **Manipulation:** transform traces (points) into an actual route (lines)
- **Analysis:** calculate distance, speed, climb, etc.
- **Display:** present information in an intuitive and efficient way

Other day-to-day examples of GIS?

“Geospatial sensing technologies that can be utilized for data collection and/or creation”

- Global position system (GPS)
- Photogrammetry
- Remote sensing

Commonalities:

- Not only geography but engineering, geodesy, and computer science
- Focus on **data collection**
- Importance of sensors
- Need for techniques to derive spatial information from raw measurements
 - Data doesn't just "talk" on its own

Systems (satellites, base stations and individual receivers) that enable (relative) accurate and fast measurements of **position** and **time**

- Capture, analysis, and interpretation of aerial photographs that represent spatial information
- Camera on balloons, planes, helicopters, drones, ...

- Hardware, software and techniques for semi-automated spatial data collection
- Using aerial sensors to detect a propagated signal (e.g. electromagnetic radiation)
- Allows for collection of land cover, land uses, vegetation type...

AIRBORNE SENSING (SOURCE: WIKIPEDIA)



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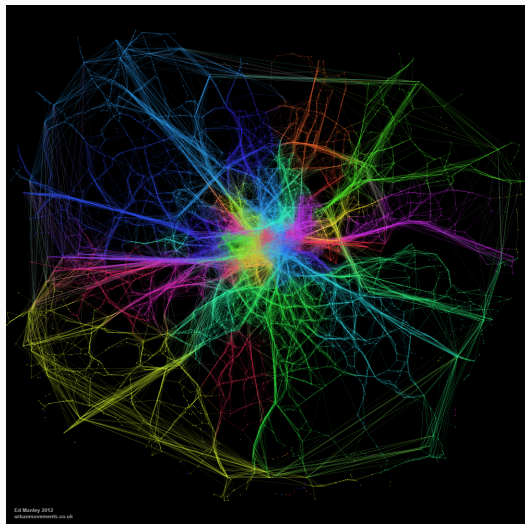
AIRBORNE SENSING (SOURCE: WIKIPEDIA)



Algebra, geometry, calculus are at the core of much of Quantitative Geography.

Prominent Examples

- Spatial interaction models (trade, commuting, etc.)
- Spatial optimization (real world examples?)
- Network analysis (spatial networks: rivers, streets, the internet, ...)



ESDA: Exploratory Spatial Data Analysis

- One of the most extensive areas of Quantitative Geography
- Builds on non-spatial statistics, but incorporates **space** explicitly in its framework
- Main areas:
 - Surveying and sampling
 - Point pattern analysis
 - Spatial autocorrelation
 - Spatial statistics (regression, interpolation...)
 - Exploratory Spatial Data Analysis (ESDA) and interactive data exploration

STATISTICS AND ESDA (SOURCE: WIKIPEDIA)*



- Techniques to support the understanding of urban and regional economies in a quantitative manner
- Obtain insights about:
 - Industry interactions
 - Impacts on sectors of the economy
 - Regional interdependencies
- Intimately connected to economic geography, **regional science** and economics

- Traditionally “*the playground of non-geographers*”
- Recently, a much more balanced two-way relationship
- Using computation to create **spatial** knowledge
- Huge potential in taking advantage of future computing advances, distributed networks and parallel processing (hardware and software advances)
- Increasing in relevance as datasets grow and your “average” problem becomes more computationally intensive

WHERE TO CONTINUE

If you like how all of this sounds, find more of it at GEES scattered in:

- [Y2] *Understanding neighborhood poverty*, by Dr. Lee
- [Y2] *Geomatics for Geographers* , by Dr. Chapman
- [Y2] *The Urban and Regional Economy* , by Dr. Tranos.
- [Y3] *Network Geographies*, by Dr. Tranos.

Or talk to:

- Dr. Tranos
- PhD candidate Stich

DISCUSSION AND QUESTIONS

- Questions
- Discussion

CREDITS

This set of slides is based on

- Arribas-Bel, D. 2014. "A 1h. lecture on Quantitative Geography for second-year Geography students"

- Haggett, P. 2008. "The Local Shape of Revolution: Reflections on Quantitative Geography at Cambridge in the 1950s and 1960s," *Geographical Analysis*, 40, 336–352.
- Murray, A. T. 2010. "Quantitative Geography," *Journal of Regional Science*, 50, 1, 143-163.
- Add the missing reference!

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Materials available at https://github.com/cstich/quant_geog