

# QUANTITATIVE GEOGRAPHY

## GGM 201: RESEARCH METHODS FOR DISSERTATIONS

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## DEFINITION

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**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

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- 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

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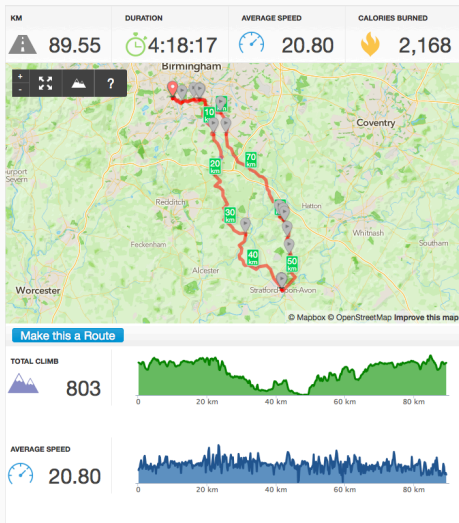
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Let's walk through each of those with an example...

“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**

## GPS (SOURCE: WIKIPEDIA)



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

## PHOTOGRAMMETRY (SOURCE: WIKIMEDIA)



# PHOTOGRAMMETRY (SOURCE: WIKIPEDIA)



- 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, meteorological data, ocean currents, desertification, ...

## REMOTE SENSING (SOURCE: WIKIPEDIA)



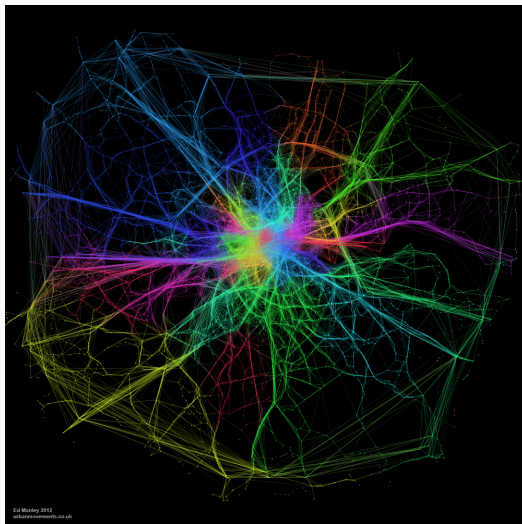
Algebra, geometry, calculus are at the core of much of Quantitative Geography.

## Prominent Examples

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



# MATHEMATICS AND OPTIMIZATION (SOURCE: ED MANLEY)



## 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)\*



## STATISTICS AND ESDA (SOURCE: WIKIPEDIA)\*



*Can you guess which pump was spreading the cholera bacteria?*

- 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

- Mainly:
  - database design
  - algorithm design
  - simulation processes
- Traditionally “*the playground of non-geographers*”
- Recently, a much more reciprocal relationship
- Using computation to create **spatial** knowledge
- Increasing in relevance as datasets grow and your “average” problem becomes more computationally intensive

## WHERE TO CONTINUE

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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

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- If you have any more questions...

## CREDITS

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This set of slides is based on these

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

- Fotheringham S., Brunsdon C., and Charlton M. 2000. Quantitative Geography: Perspectives on Spatial Data Analysis Quantitative Geography: Perspectives on Spatial Data Analysis, Sage
- 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.
- Pidwirny, M. 2006. "History of Physical Geography" Fundamentals of Physical Geography, 2nd Edition. Date Viewed.

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Materials available at [https://github.com/cstich/quant\\_geog](https://github.com/cstich/quant_geog)