

Geographic Data Science - Lecture III

(Geo-)Visualization

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Today

- Visualization
 - *What* and *why*
 - History
 - Examples
- Geovisualization
 - *What*
 - "A map for everyone"
 - Dangers of geovisualization

Visualization

*"Data graphics visually display measured quantities by means of the **combined use** of points, lines, a coordinate system, numbers, symbols, words, shading, and color."*

The Visual Display of Quantitative Information. Edward R. Tufte.

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[Source]

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[Source]

A bit of history

Maps

A bit of history

Maps --> Data Maps (XVIIth.C.)

A bit of history

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Scatter plots

A bit of history

Maps --> Data Maps (XVIIth.C.) --> Time series (1786) -->
Scatter plots

- Surprisingly recent: 1750-1800 approx. (much later than many other advances in math and stats!)
- **William Playfair's** *"linear arithmetic"*: encode/replace numbers in tables into visual representations.
- Other relevant names throughout history: Lambert, Minard, Marey.

Visualization

The Visual Display of Quantitative Information. Edward R. Tufte.

- By **encoding information visually**, they allow to present **large amounts** of numbers in a **meaningful** way.
- If well made, visualizations provide leads into the processes underlying the graphic.

Learning by seeing time...

Time series (XVIIIth. C.)

Lambert plot on soil temperature, depth under the surface

Bar chart

Playfair's bar chart in *The Commercial and Political Atlas*

Lambert line abstract line plot

Fig. 5 Lambert, measured rate against temperature, 1769

Examples

"It may well be the best statistical graphic ever drawn"

Minard map --> French export of wines (1864) (full screen)

Geovisualization

Tufte (1983)

"The most extensive data maps [...] place millions of bits of information on a single page before our eyes. No other method for the display of statistical information is so powerful"

MacEachren (1994)

Geographic visualization can be defined as the use of concrete visual representations --whether on paper or through computer displays or other media--to make spatial contexts and problems visible, so as to engage the most powerful human information processing abilities, those associated with vision.

GeoVisualization

- End goal is not to replace the human *in the loop*, but to **augment** her/him.
- Augmentation here comes through engaging the pattern recognition capabilities that our brain inherently has.
- Combines:
 - Traditional maps
 - Statistical maps
 - Statistical devices of other kind (charts, scatter plots, etc.)
- Different roles in the analysis process...

A map for everyone

Maps can fulfill several needs

Depending on which one we want to stress, the best map will look very different

MacEachren & Kraak (1997) identify three main dimensions:

- Knowledge of what is being plotted
- Target audience
- Degree of interactivity

A map for everyone

[MacEachren & Kraak (1997) map cube]

Un/known: *fast* and *slow* maps

Fast maps

[Amsterdam postcode polygons]

Slow maps

[Amsterdam twitterhoods final]

Audience: *easy* and *hard* maps

The larger and non-specialized the audience, the less you can assume about what they know, hence less information can be emedded

Highly specialized maps are not particularly compelling to the general eye, but they contain a lot of specific information that can be easily decoded by the trained eye

This changes with statistical/geographic literacy (the minimum grows)

Pro-tip: know your audience and optimize for it

Easy map

[easy map figure: screenshot of where train stations are]

Hard map

[hard map figure: Arribas-Bel & Gerritse (2012)]

Interaction: one or many maps in one

Talk about interaction, opportunity for discovery, and the end-user as explorer rather than mere consumer

Interactivity, however, not always desired: sometimes you need one-message, clear maps to make a case and you don't have time for rich interactive one. It also takes much more time (although changing)

Static map

[static map figure: LA choropleth]

Interactive map

[Interactive map figure: LA interactive map]

Choropleths

See next lecture

Examples of Geo Visualization n

Box maps - Outliers

[Create box map]

Examples of Geo Visualization n

Cartograms

[Look for Danny Dorling examples]

Examples of Geo Visualization n

Conditional maps/
Examples of
Geo Visualization
n

Space-Time maps: animations

CartoDB/Torque example

Examples of Geo Visualization

n

Interactivity

Bokeh linked views

Examples of Geo Visualization

Surfaces

Pollution/weather map

See lecture on points

Examples of Geo Visualization n

How to lie with maps

[How to lie with maps cover with Pinnochio]

Dangers of GeoVisualization n

How to lie with maps

[Map of UK with the same variable, different classifications]

Dangers of Geo Visualization

How to lie with maps

The human brain is so good at picking up patterns...

... that it finds them even where they don't exist!

- Patternicity (Shermer, 2008)

The tendency to find meaningful patterns in meaningless noise

- Apophenia (Konrad, 1958)

The experience of seeing patterns or connections in random or meaningless data

Dangers of GeoVisualization n

Twitter clusters

[Map of random points on the UK]

Dangers of Geo Visualization n

How to *be truthful* with maps

"With great power comes great responsibility"

Statistics to rescue!!!

- Complement and enhance visuals
- Help disentangling true from spurious patterns (a.k.a. identifying the "Jesus on the toast")
- Reciprocity: GeoVis can also enhance statistics and make them more useful

Dangers of Geo Visualization n

Statistics for Twitter clusters

[Show a spatial statistic can disentangle]

Dangers of Geo Visualization n

Recapitulation

Recapitulation



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