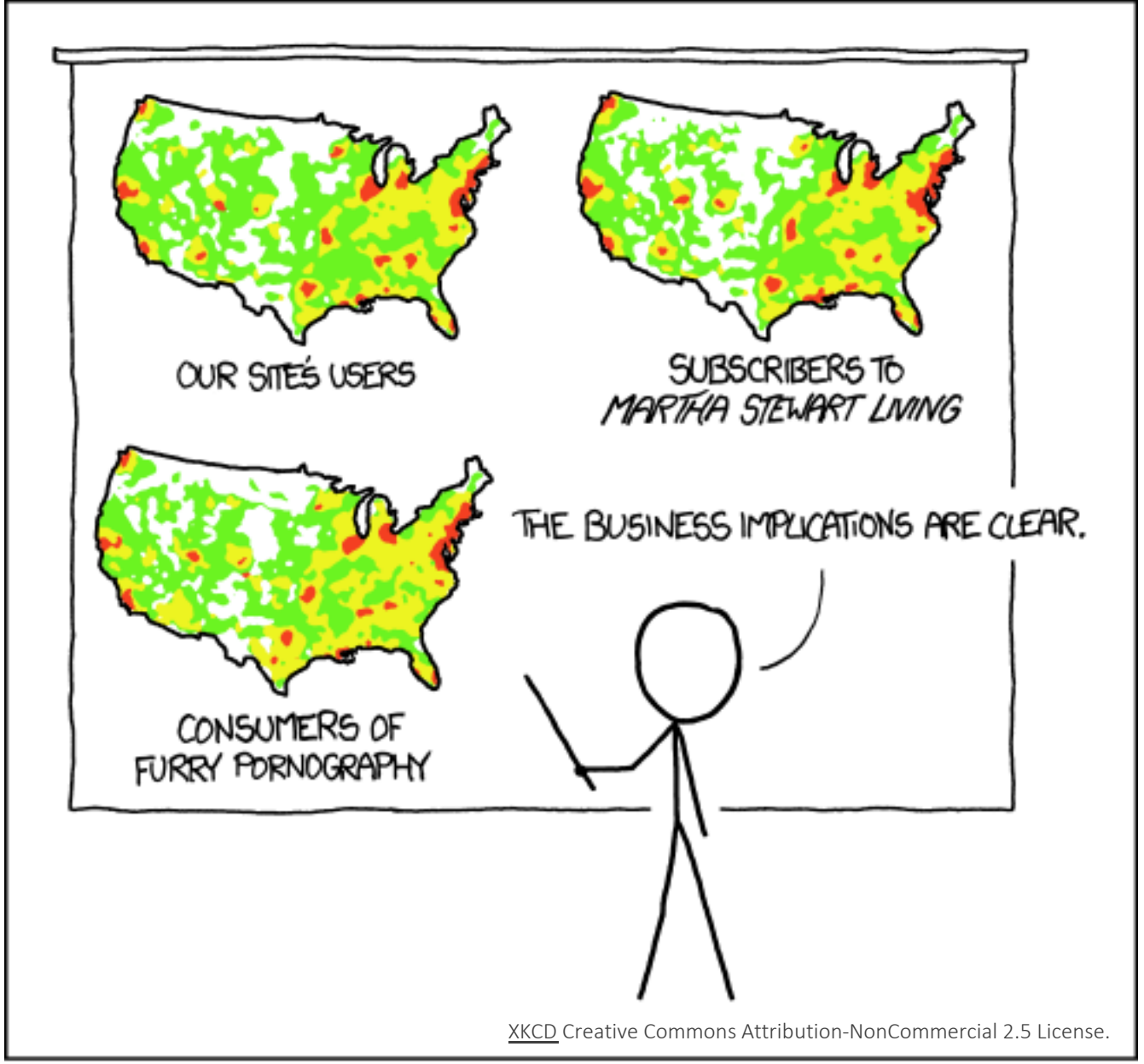
Spatial Data Science

Geo-Visualisation

(EPA122A)

Lecture 6

Trivik Verma



PET PEEVE #208:
GEOGRAPHIC PROFILE MAPS WHICH ARE BASICALLY JUST POPULATION MAPS

Quality of education

What do you think about this course?

What would you change if you were the course manager?

What are strong points you would keep?

Share it…

- With me, the lecturer
- With TAs, who have worked directly with so many of you
- With Curius
- With your fellow students who join the CRG (student panel evaluation group, halfway through the period)
- Fill in the questionnaire at the end of this course (in your mailbox) – called **Evasys**

Last Time

- History of Visualisations
- Exploratory Data Analysis
- Types of Visualisations
- Effective Visualisation

Design Exercise (Time: 10 min)

Q: How Do You Feel about doing Science?

Interest	Before	After
Excited (E)	19	35
kind of E	25	30
Ok	40	14
Not great	5	6
Bored	11	12

Instructions

1. **What do you want to do: Analyse data or Communicate an insight**
2. Sketch a visualisation (pen and paper is fine)
3. Take a photo and submit on Assignments in Brightspace under *Visualisation: Design Exercise* (.jpg, .jpeg, .png)
4. Submission deadline tonight by 2330
5. Discussion of some of your submissions follows in Lecture 06.
6. Exercise is ***not*** graded

After the pilot program,

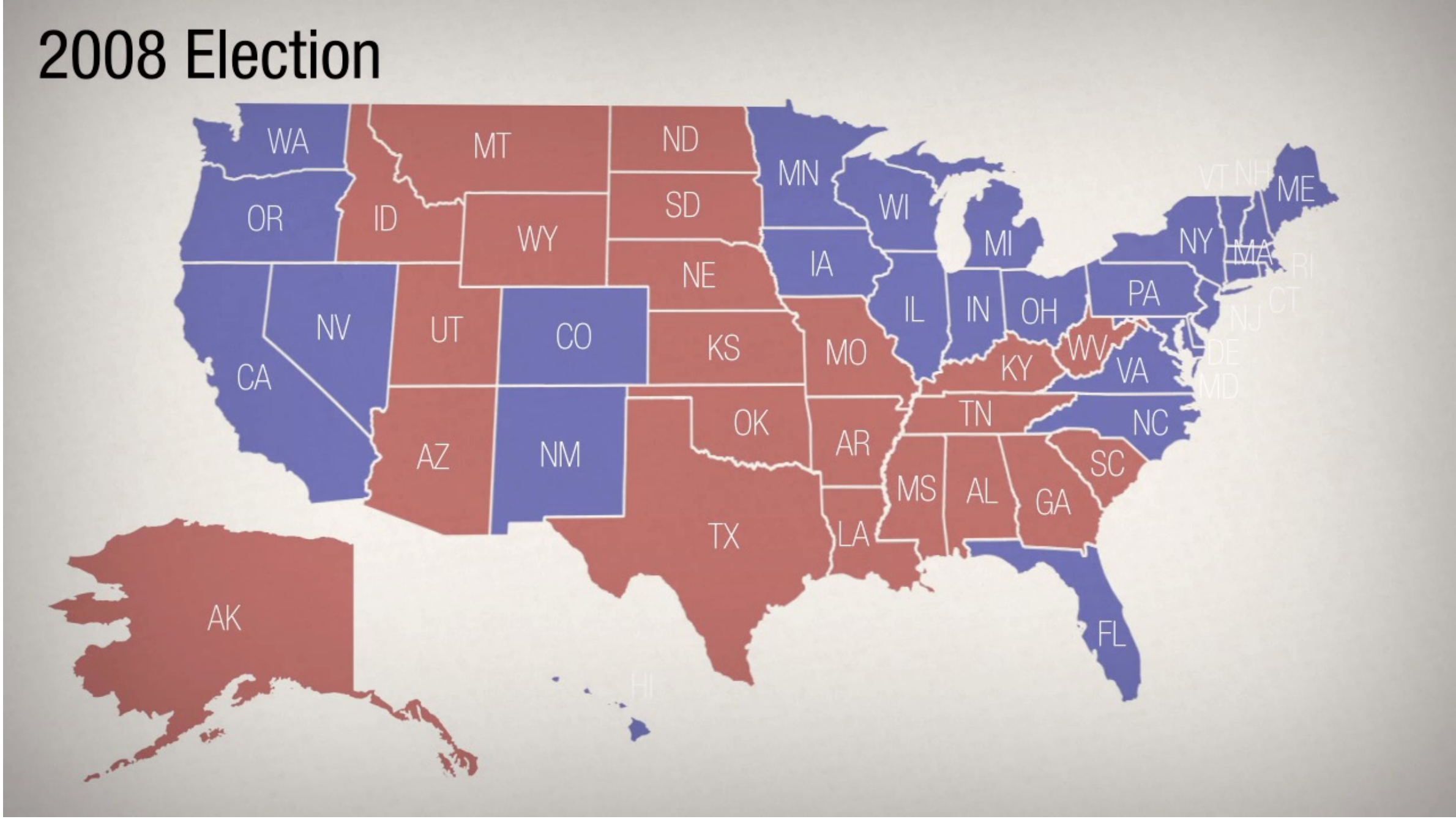
68%

of kids expressed interest towards science,
compared to 44% going into the program.

Your Submissions

Today

- Geo-Visualisation
- Dangers of Geo-Vis
- Mapping Data
  - MAUP
  - Choropleths



A Campaign Map, Morphed By Money

Geo-*V*isualisation

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."*

Geo Visualisation

- End goal is not to replace the human *in the loop*, but to augment **her.**
- 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

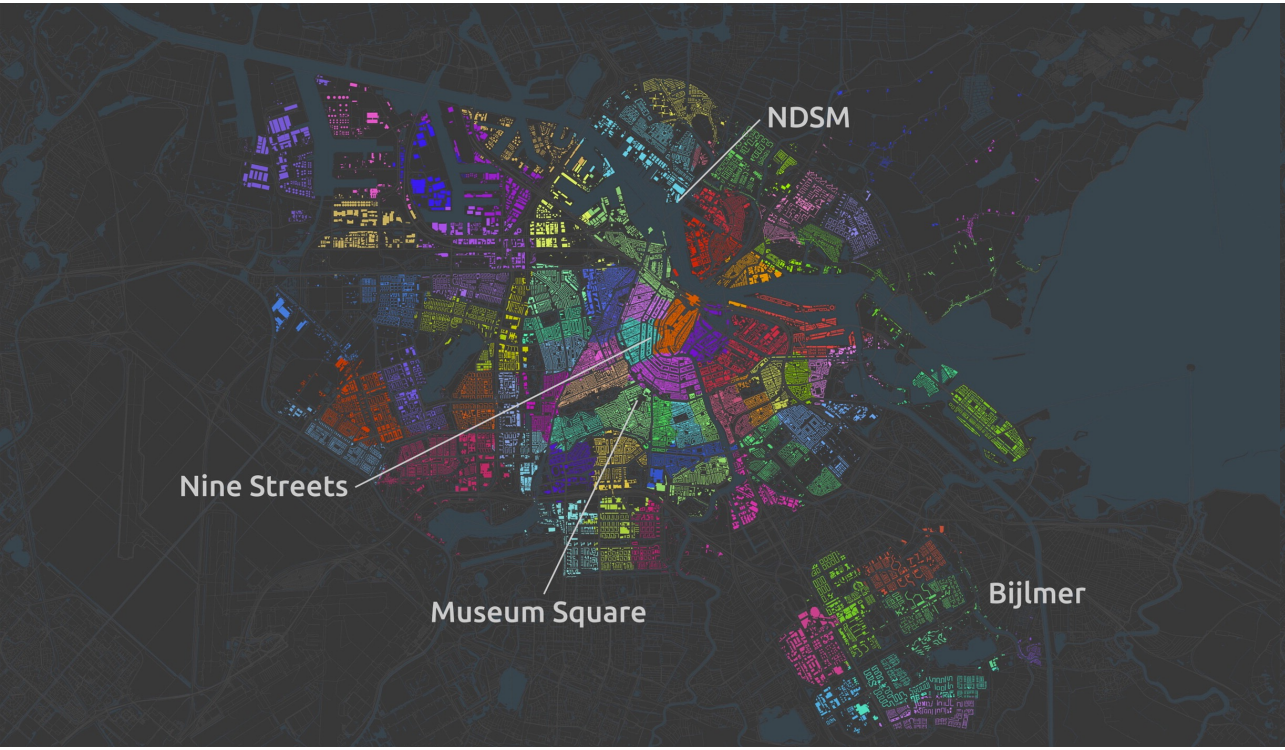
All plots are composed of

- ***Data*** that you want to visualize
- ***Layers*** made up of geometric elements
- ***Scales*** which map values to aesthetics
- ***Systems*** of coordinates
- ***Facets*** and their specification
- ***Themes*** controlling finer points

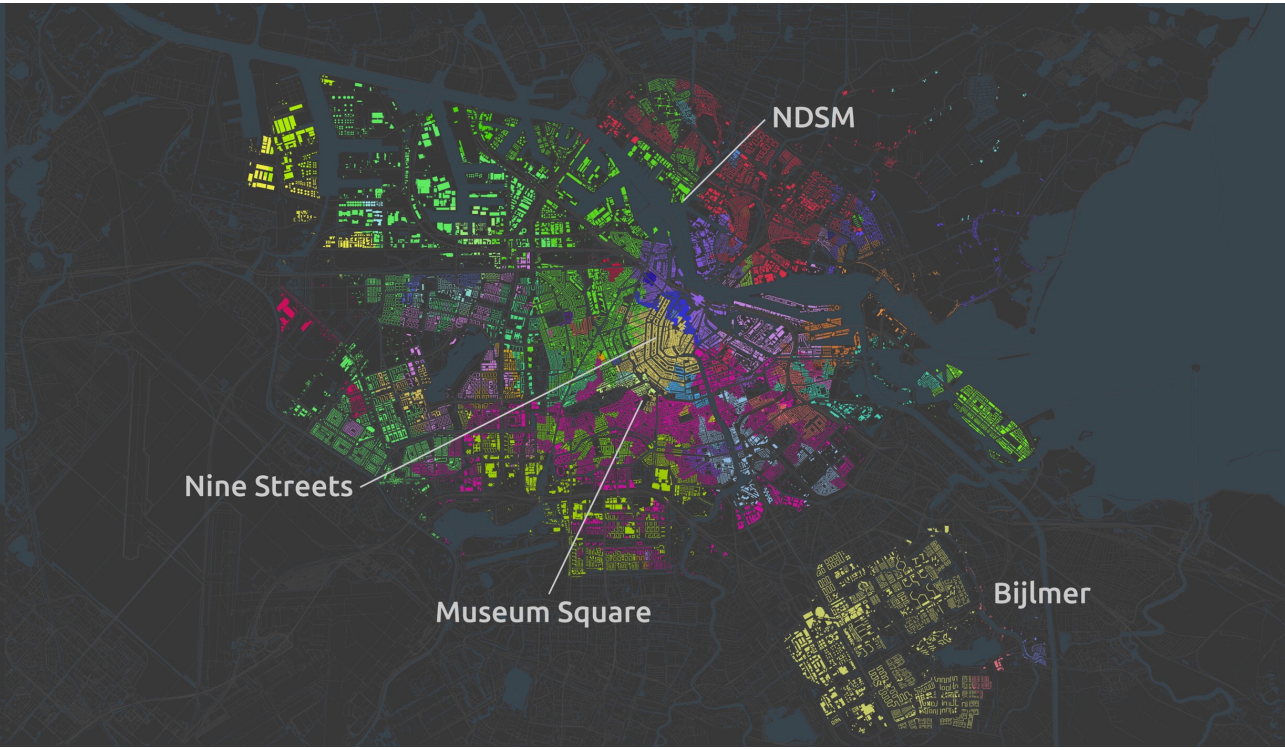
Un/known: ***fast*** and ***slow*** maps

[Source]

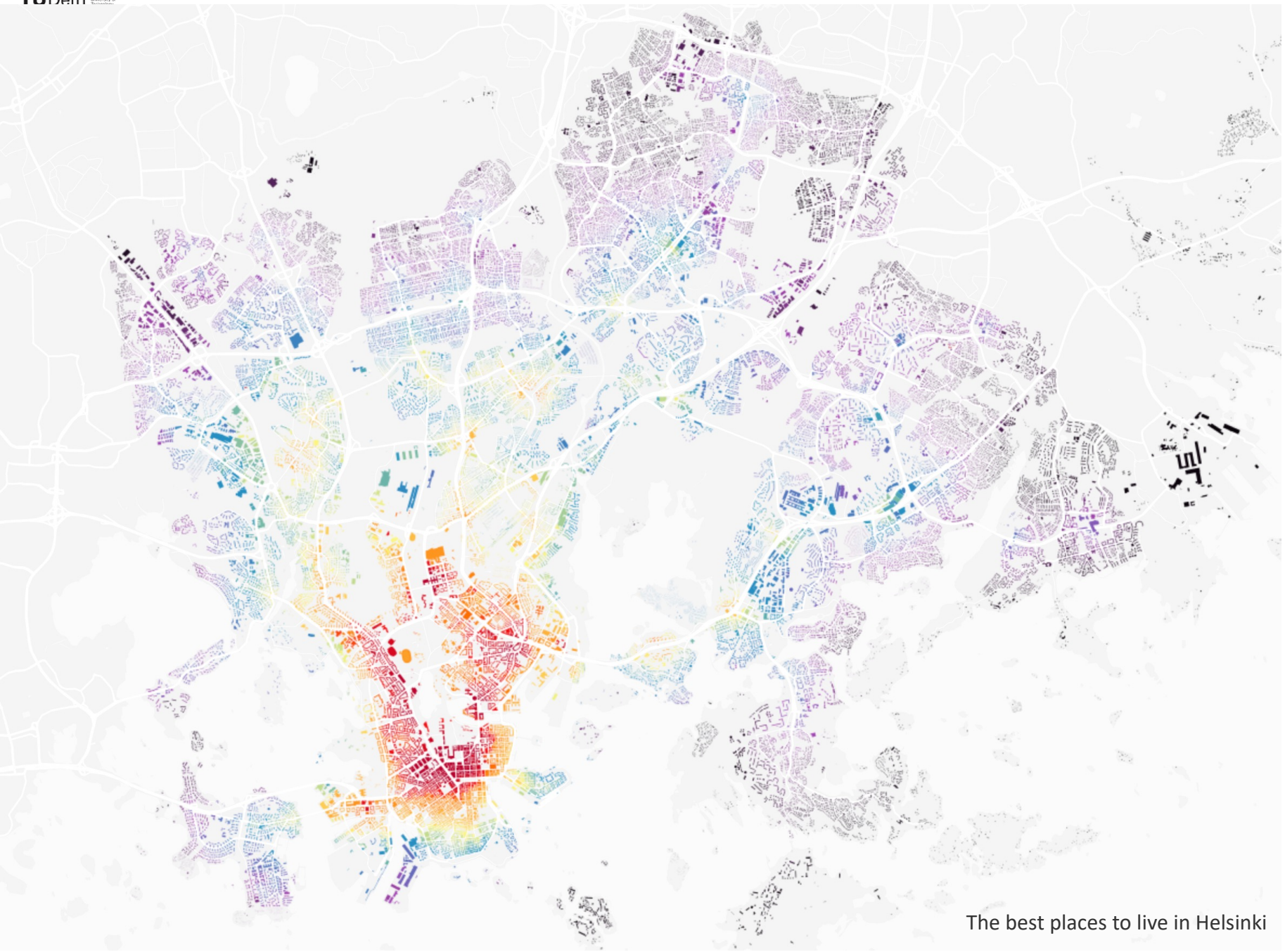
Digit postcodes : fast



Twitter : slow



Audience: ***easy*** and ***hard*** maps



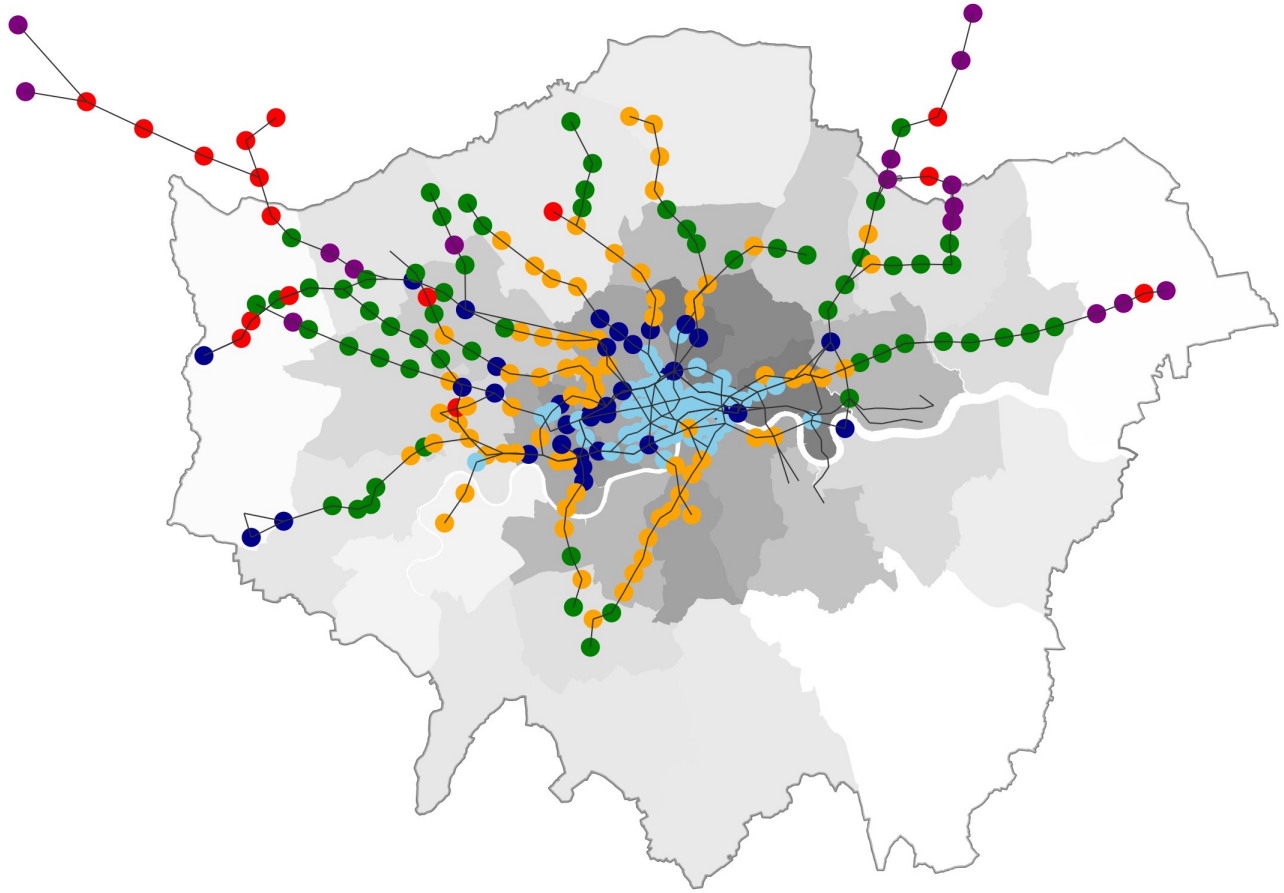
The best places to live in Helsinki

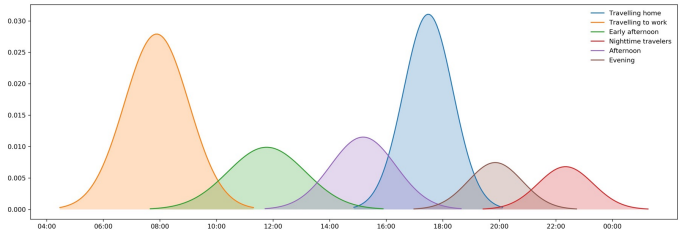
[source]

TUDelft

Greater London, TfL stations

hard map





Verma, Trivik, Mikhail Sirenko, Itto Kornecki, Scott Cunningham, and Nuno AM Araújo. "Extracting spatiotemporal commuting patterns from public transit data." *Journal of Urban Mobility* 1 (2021): 100004.

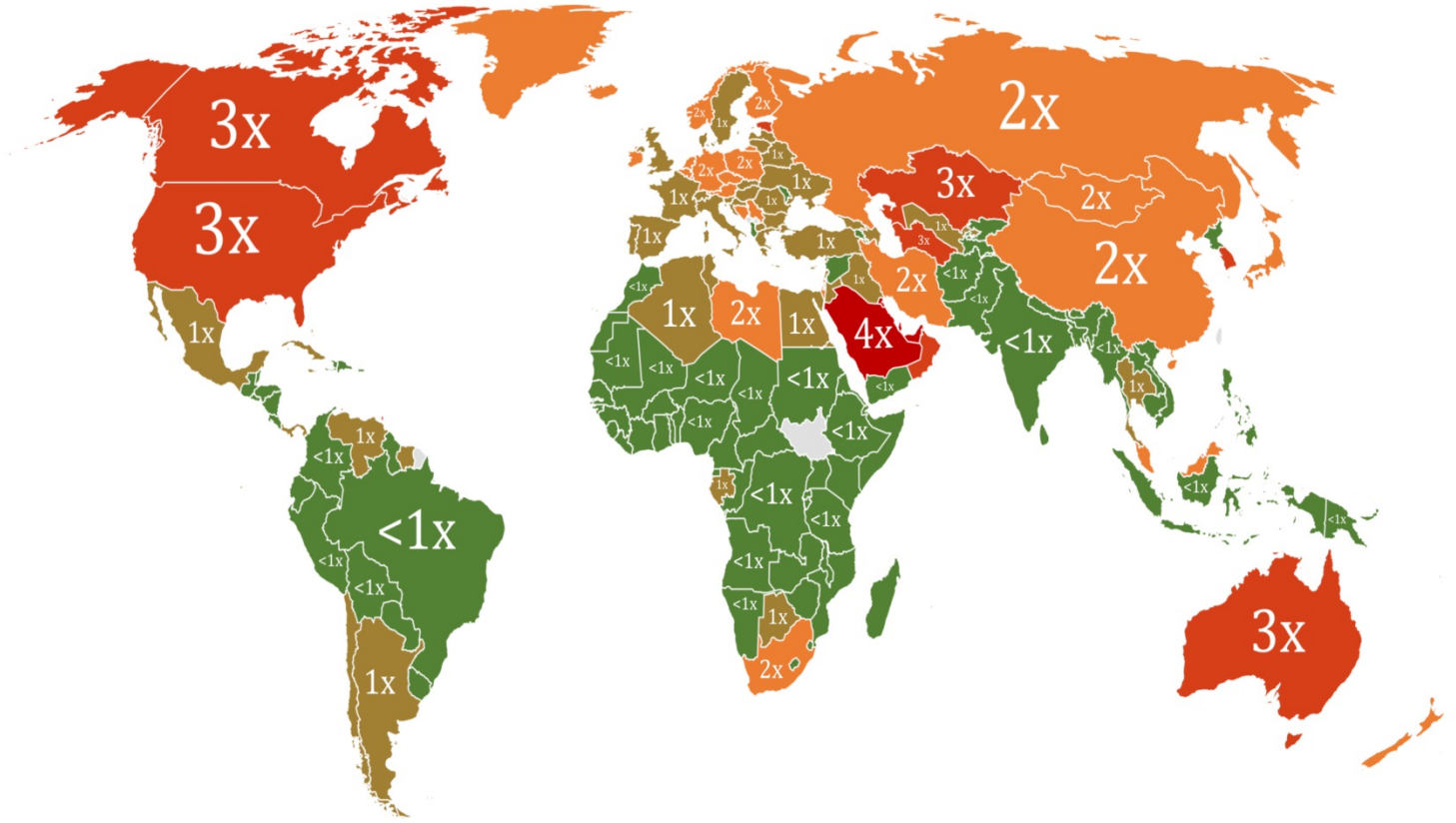
Interaction: ***one*** or ***many*** maps in one

TU Delft

static map

More Than Their Fair Share:

Which countries produce a greater proportion of global CO2 emissions than their proportion of the global population?



Ratio of Global Emissions Contribution to Share of Global Population

Muntean, M., Guizzardi, D., Schaaf, E., Crippa, M., Solazzo, E., Olivier, J.G.J., Vignati, E. Fossil CO2 emissions of all world countries
2018 Report, EUR 29433 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-97240-9, doi:10.2760/30158, JRC113738.

TUDelft

MAYOR OF LONDON

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Urban planning and construction > Our role in planning > Planning with WebCAT > WebCAT planning tool

WebCAT

Address or co-ordinates

Bromley, London, UK × Go

Access level (PTAL) | Time mapping (TIM)

TIM: a new measure, looking at how far you can travel in a given journey time.

Map key - Travel Time

< 15 mins	15 - 30 mins
30 - 45 mins	45 - 60 mins
60 - 75 mins	75 - 90 mins
90 - 105 mins	105 - 120 mins
120 - 135 mins	135 - 150 mins

Change travel time bands +

Map layers

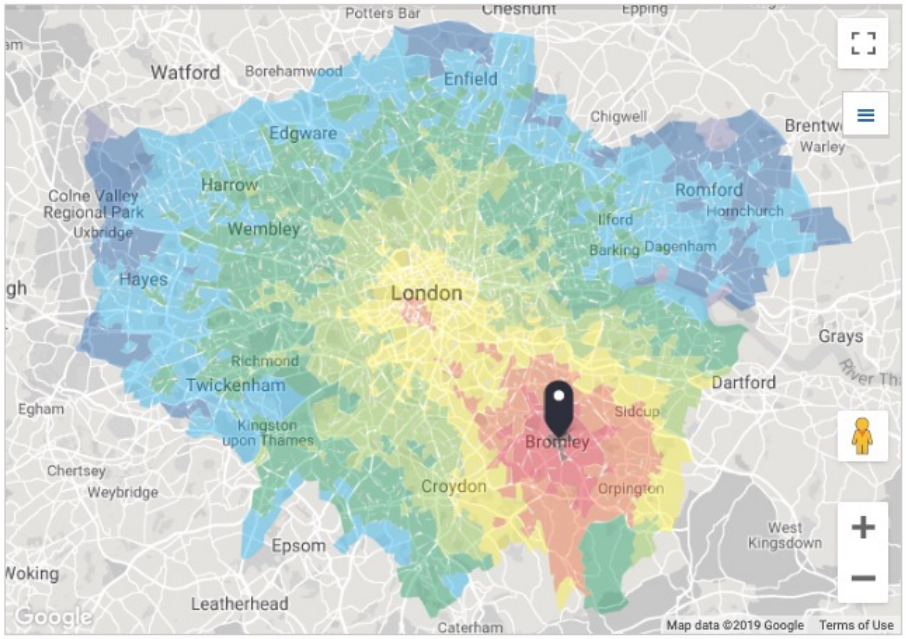
Travel Times

Scenario

Base Year

Mode

All public transport modes



You can click anywhere on the map to change the selected location.

TIM output for Base Year

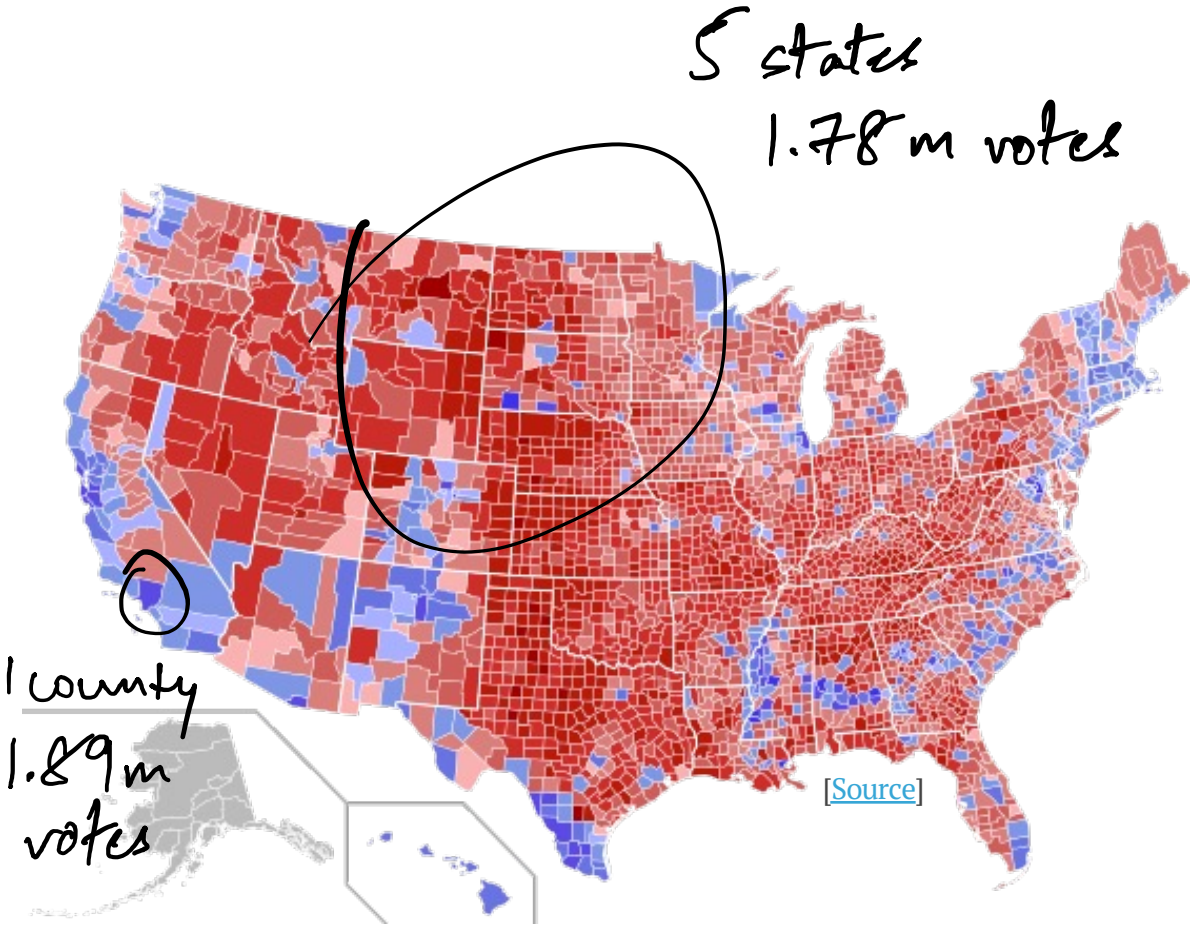
Scenario: **Base Year** Mode: **All public transport modes**, Time of day: **AM peak**, Direction: **From location**

Bromley
Bromley, UK
Easting: **540120**, Northing: **169366**

interactive map

Dangers of GeoVisualisation

2016 Presidential Election in the USA



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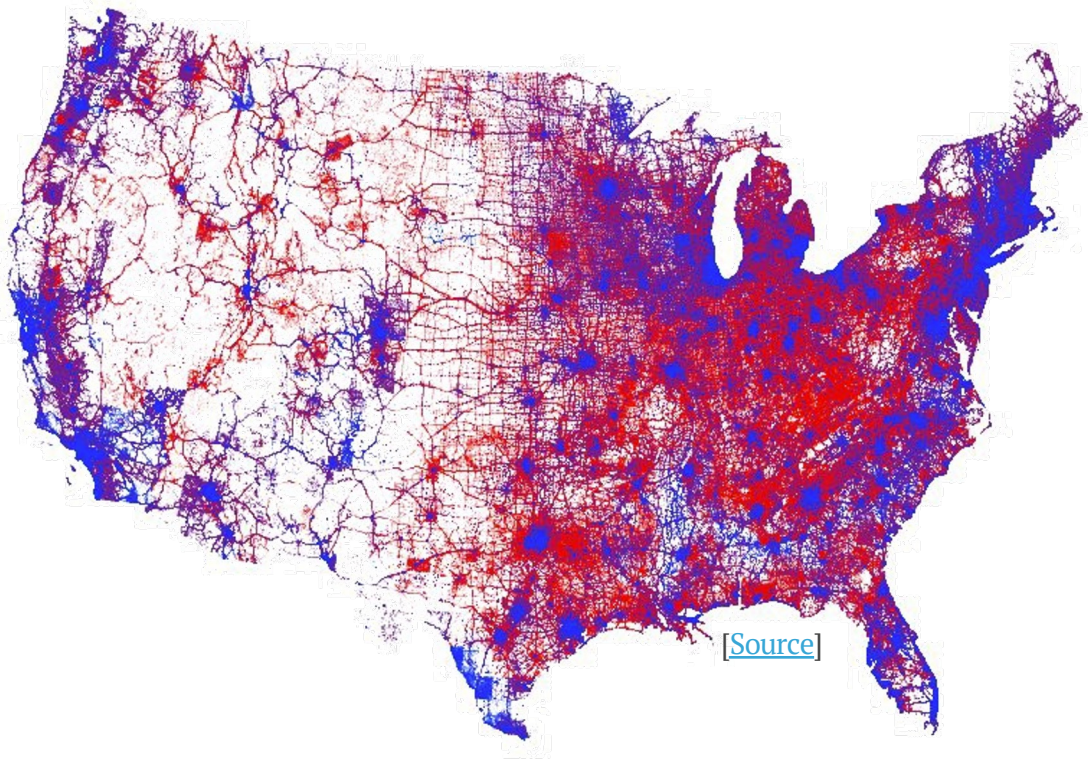


[Source]

*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

* kindly do not lie with maps

How to *be truthful* with maps

"With great power comes great responsibility"

Statistics to the rescue!!!

- Complement and enhance visuals
- Help disentangling **true** from **spurious** patterns
- **Reciprocity**: GeoVis can also enhance statistics and make them more useful

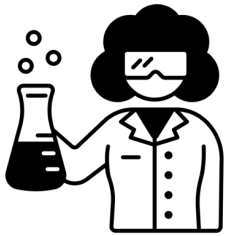
How to *be truthful* with maps

- What is the story?
- Who is the audience?
- Did the visual communicate the story?
- What story was not told?
- How are the design elements used?

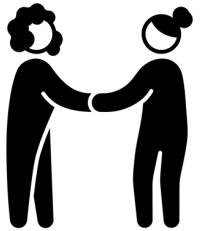
Break

CHILL

WALK



COFFEE OR TEA

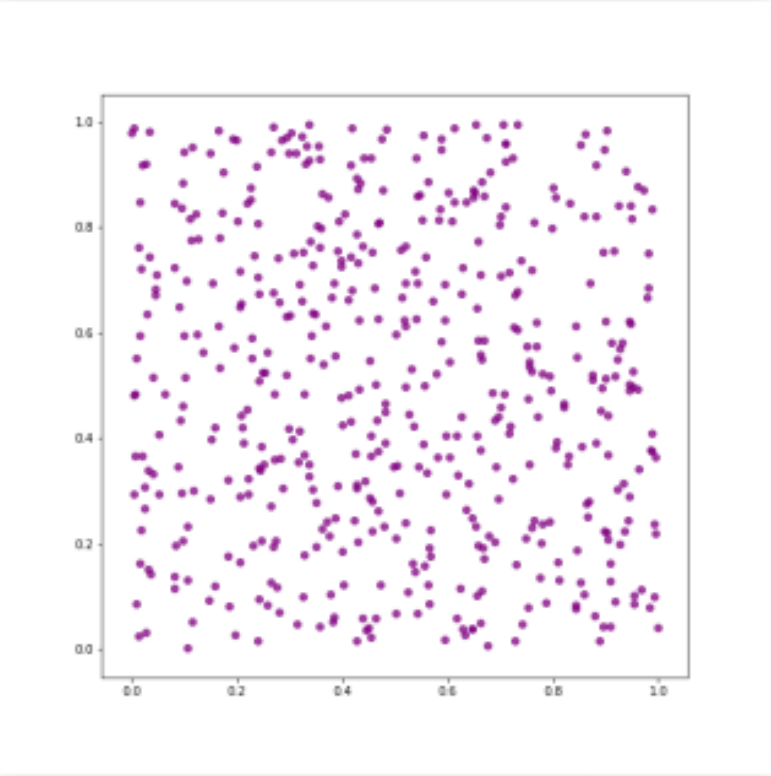


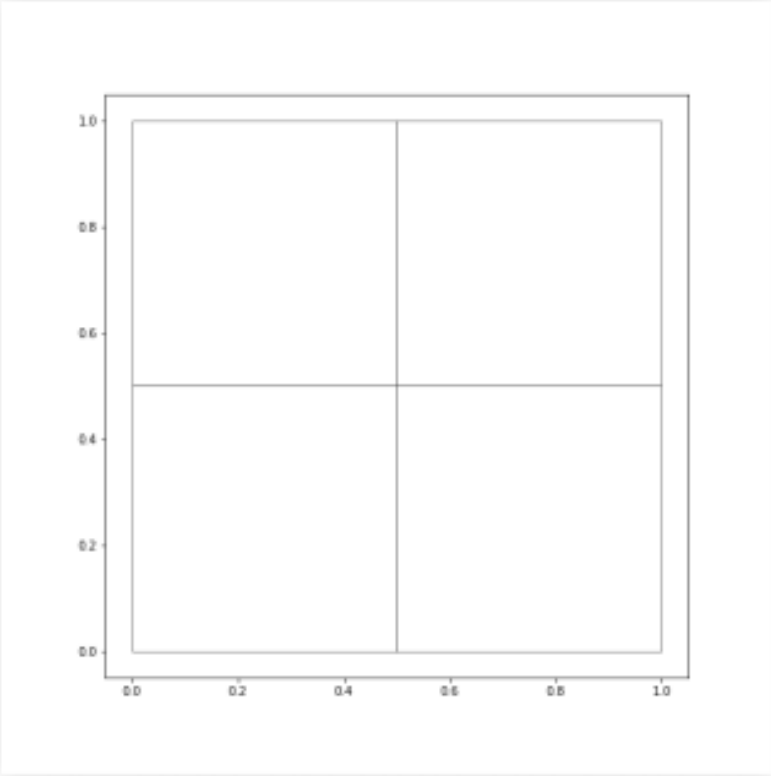
MAKE FRIENDS

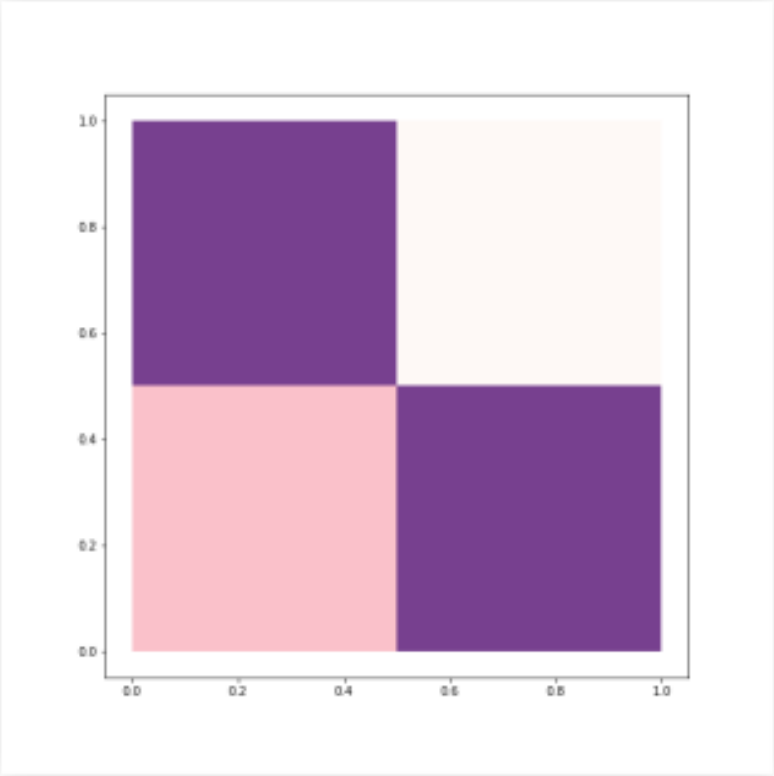
Making good data maps

- MAUP
- Choropleths

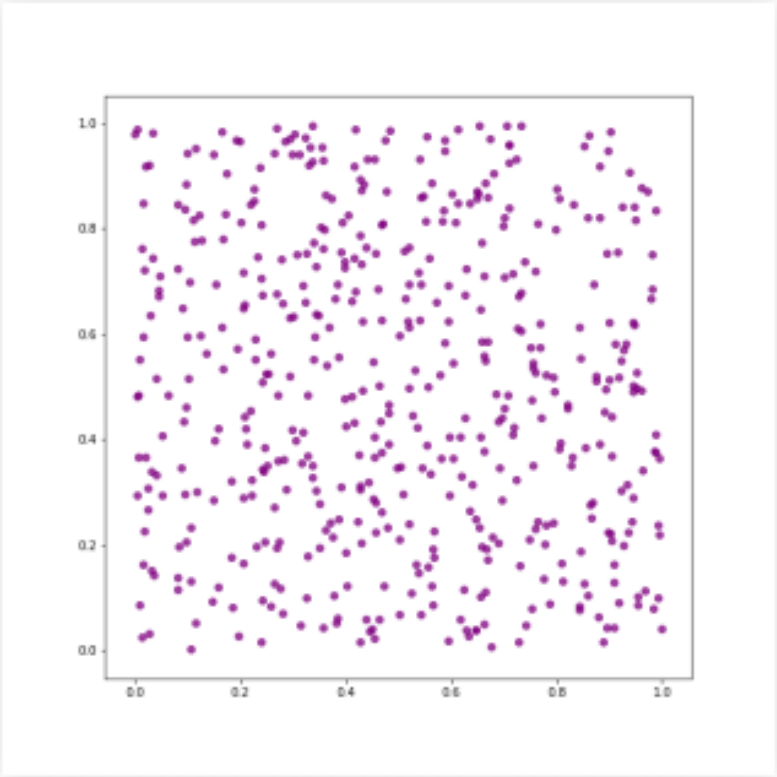
Modifiable Areal Unit Problem (Openshaw, 1984)

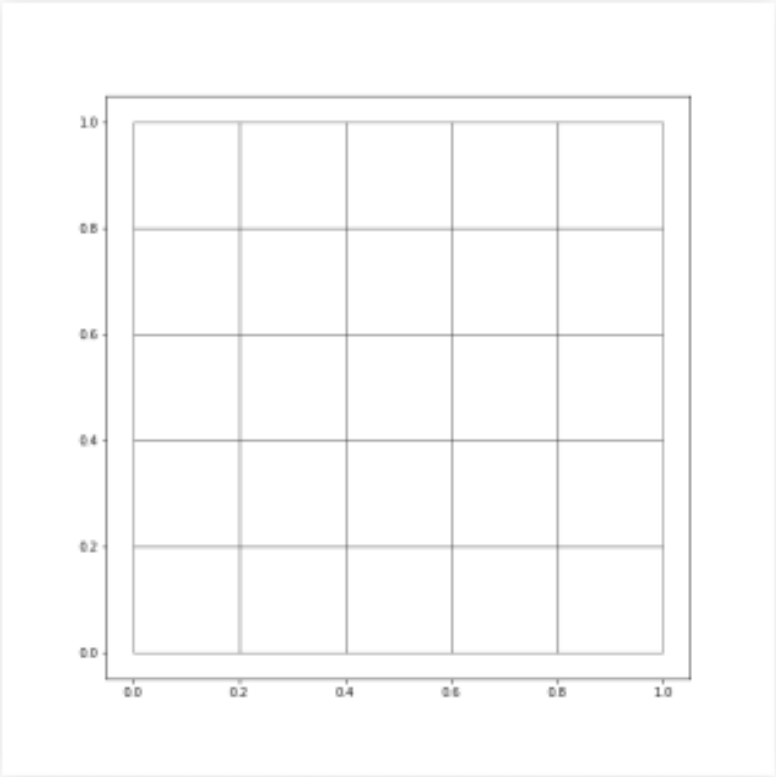


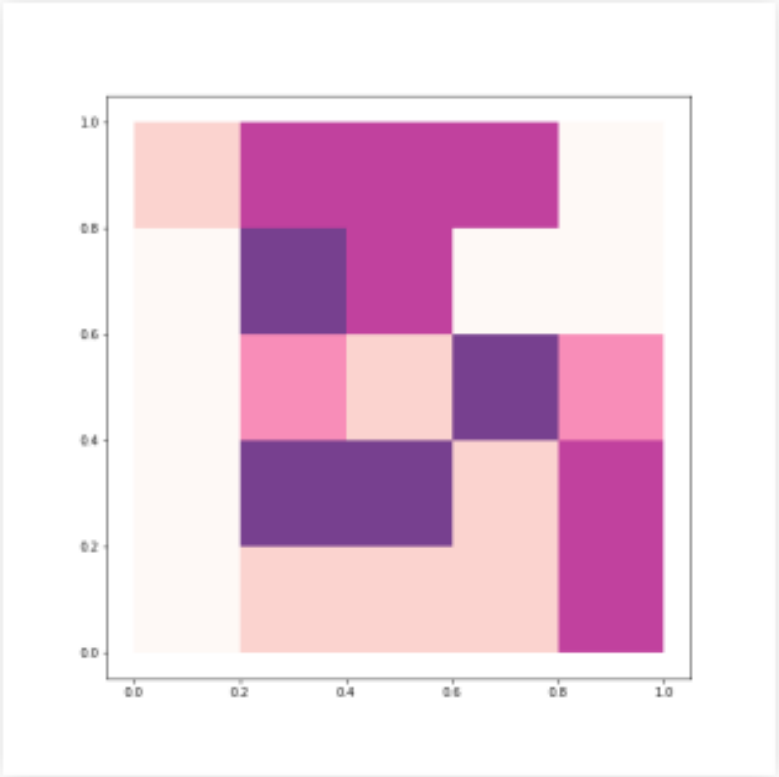




Images taken from: Arribas-Bel, D. (2019). A course on geographic data science. *Journal of Open Source Education*, *2*(16), 42.







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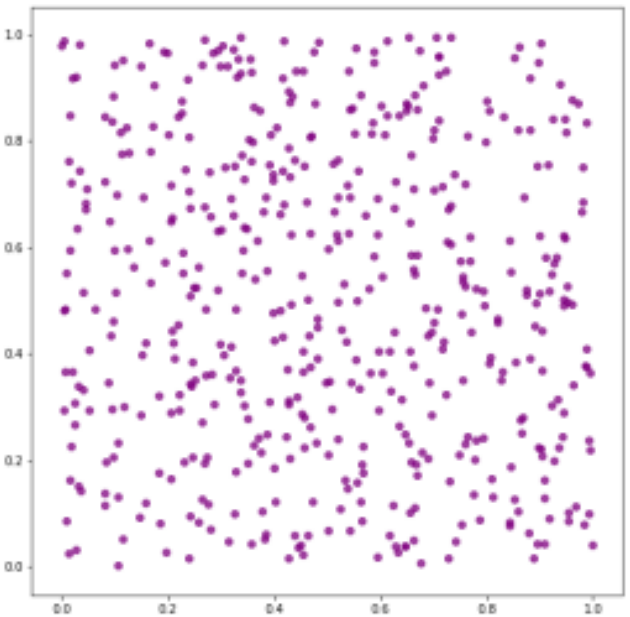

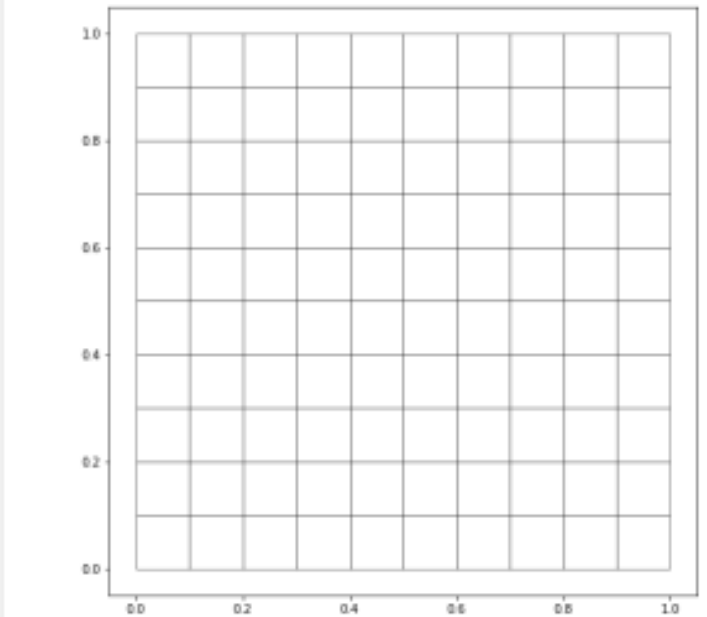

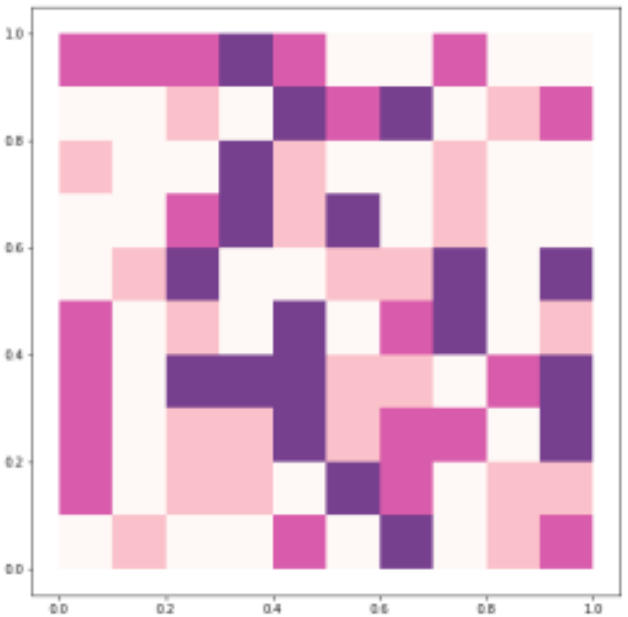

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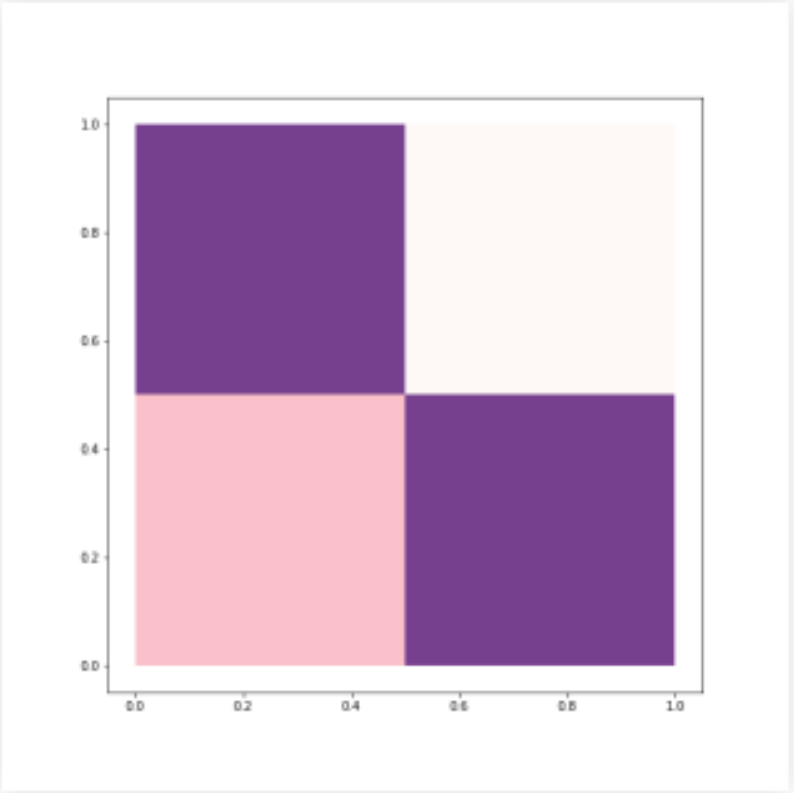

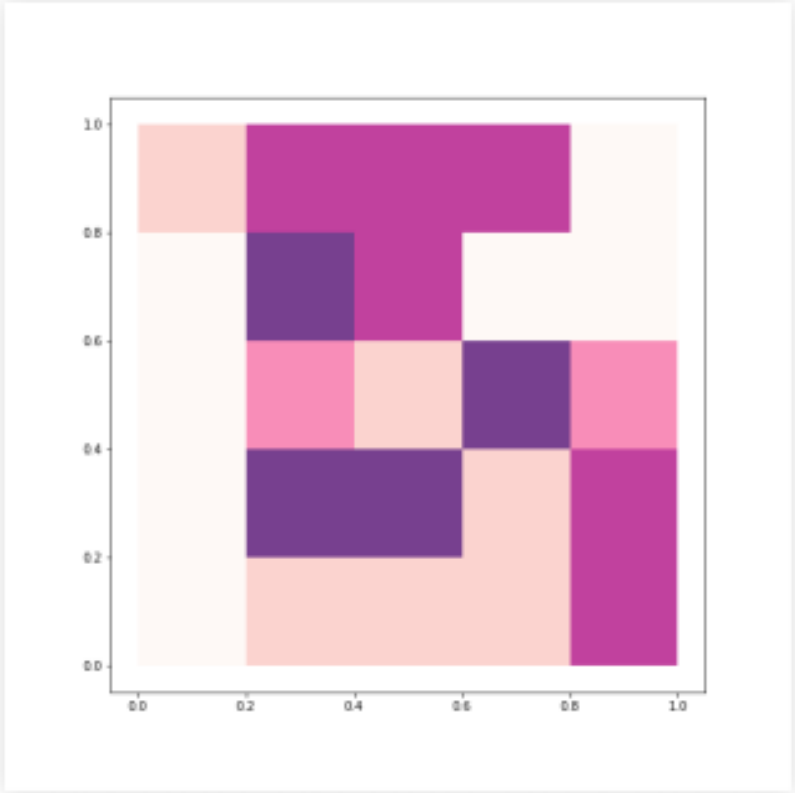

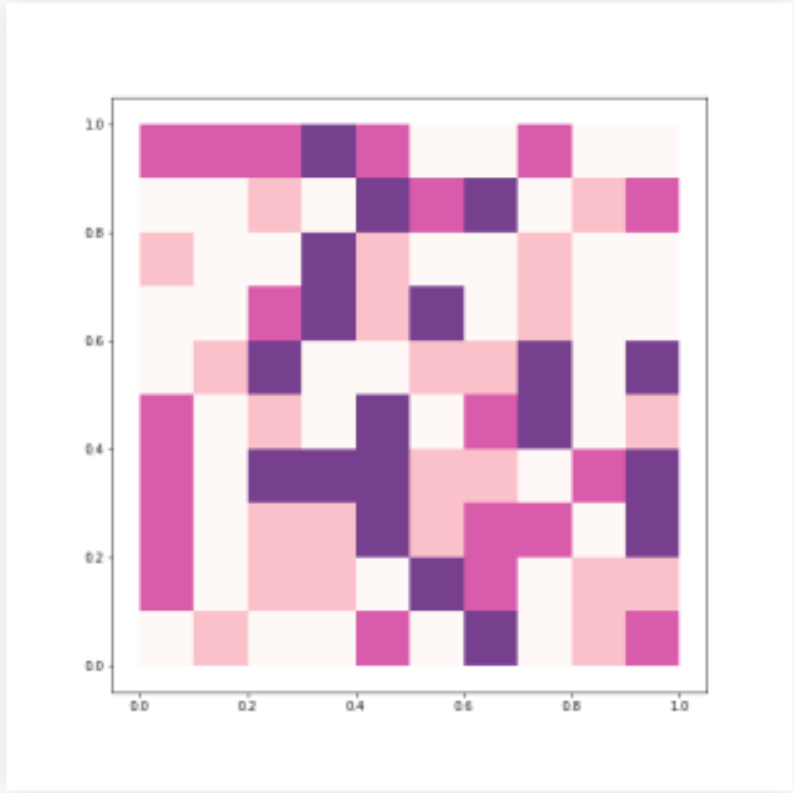

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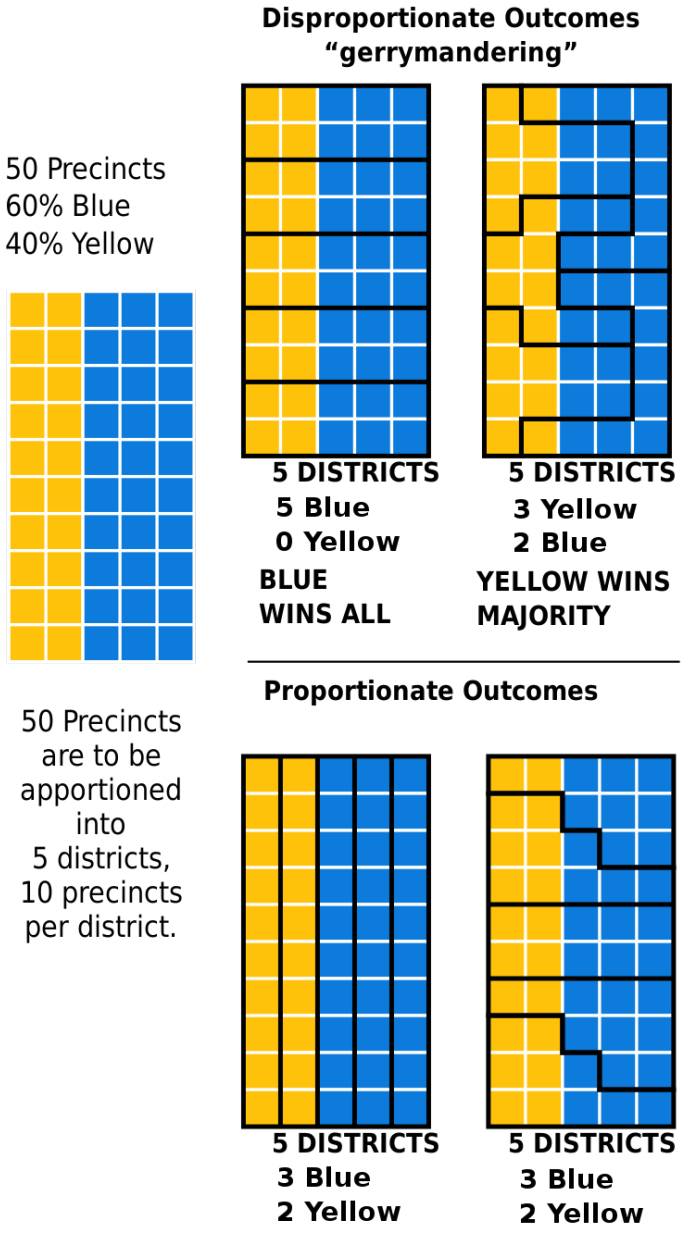
Why is it a problem?

Gerrymandering: drawing different maps for electoral districts produces different outcomes



Source: Wikipedia

MAUP

Scale and **delineation mismatch** between:

- Point-based measures
  - Underlying process (e.g. individuals, firms, shops)
- Aggregated in space
  - Unit of measurement (e.g. neighborhoods, regions, etc.)

In some cases, it can **seriously mislead** analysis on aggregated data (e.g. *FLINT, MI*)

Always keep MAUP in mind when exploring aggregated data!!!

Choropleths

Choropleths

Thematic map in which values of a variable are encoded using a colour gradient of some sort

- Counterpart of the histogram
- **Values** are **classified** into specific colours: value –> bin
- **Information loss** as a trade off for **simplicity**

Classification Choices

- No. of bins
- How to bin?
- Colours

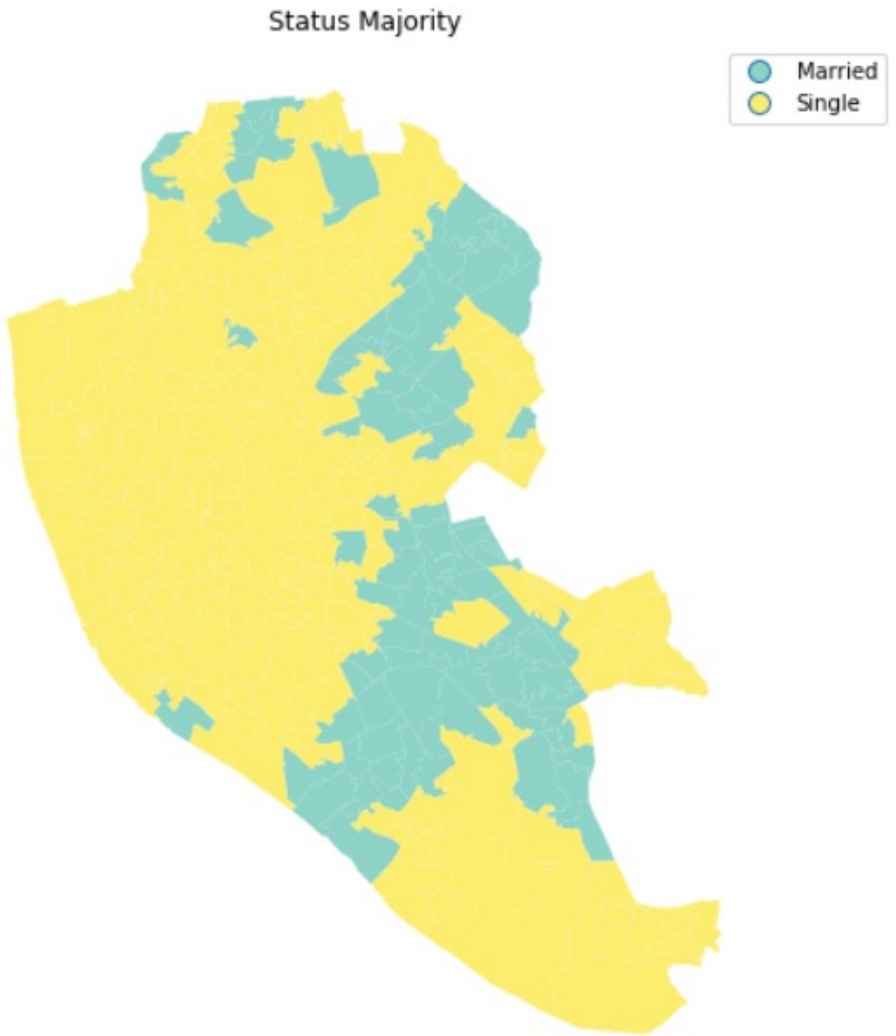
How many bins

- Trade-off: detail vs cognitive load
- Exact number depends on purpose of the map
- Usually not more than 12

How to bin?

Unique values

- Categorical data
- No gradient (reflect it with the colour scheme!!!)
- Examples: Religion, country of origin…



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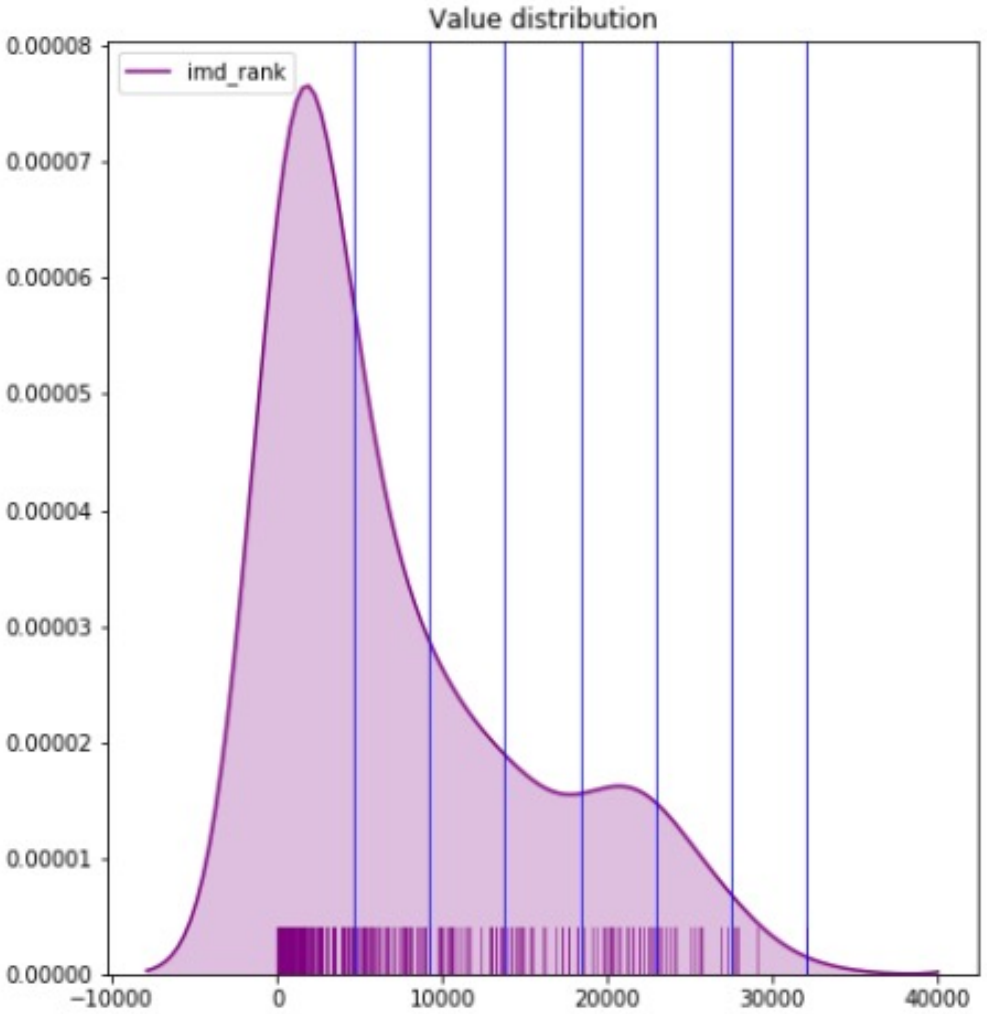
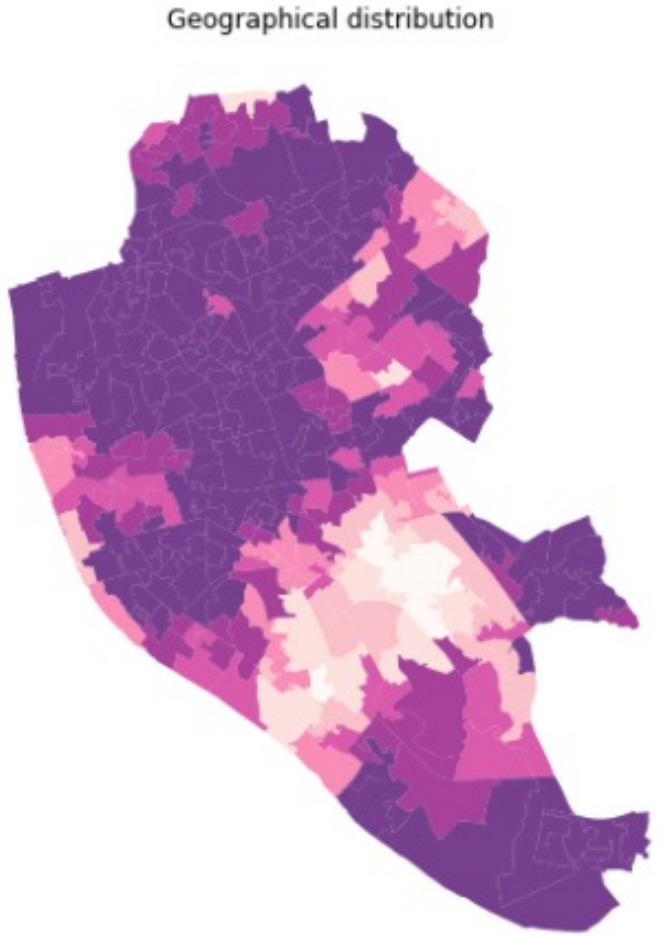
Equal interval

- Take the **value** span of the data to represent and split it equally
- **Splitting** happens based on the **numerical value**
- Gives more weight to outliers if the distribution is skewed

equal_interval



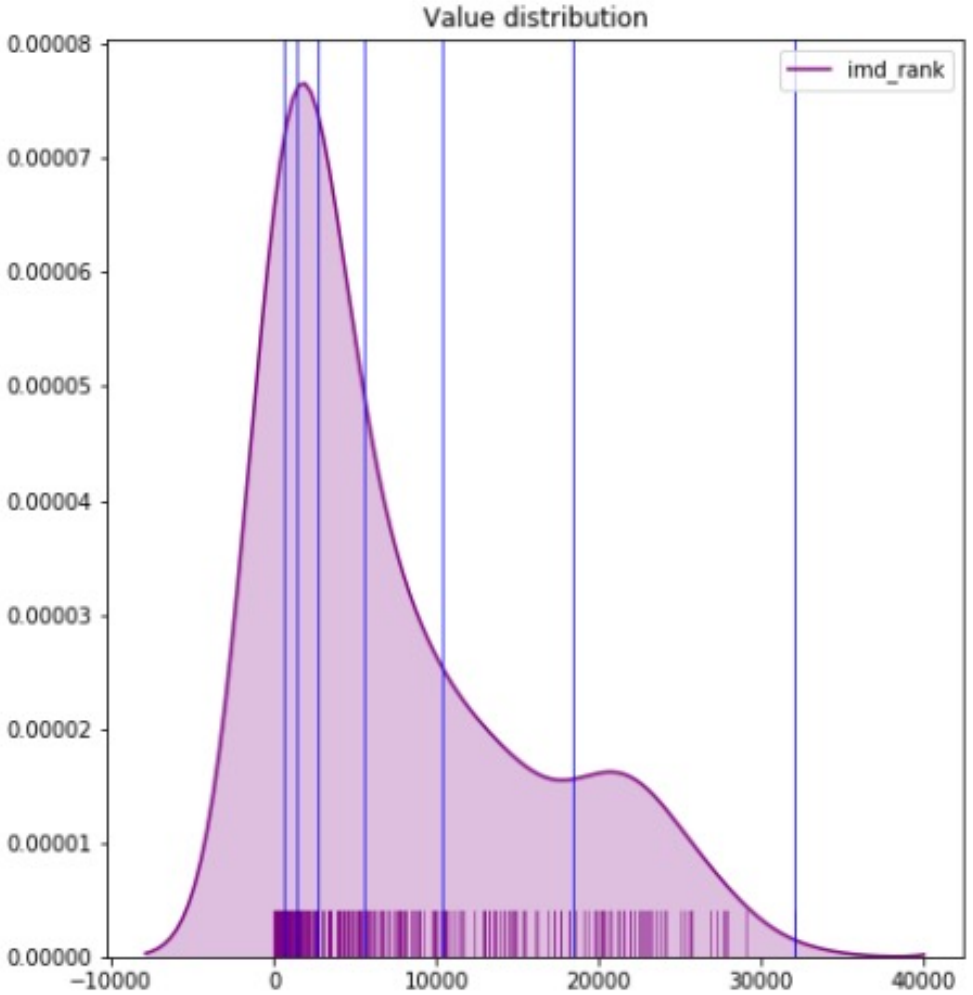


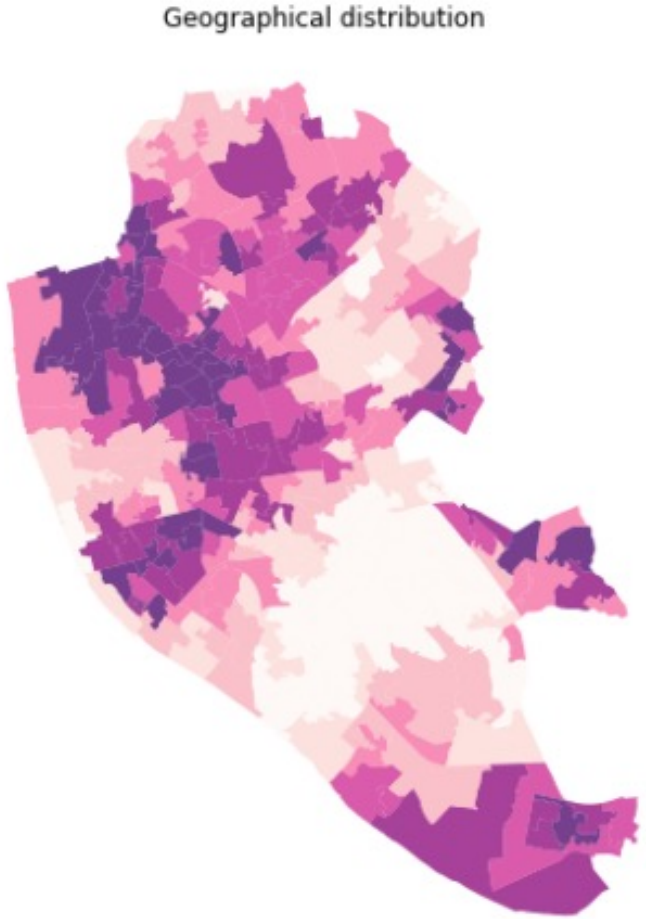
Images taken from: Arribas-Bel, D. (2019). A course on geographic data science. *Journal of Open Source Education*, *2*(16), 42.

Quantiles

- Regardless of numerical values, split the distribution keeping the same number of values in each bin
- **Splitting** based on the **rank** of the value
- If distribution is skewed, it can put very different values in the same bin

quantiles

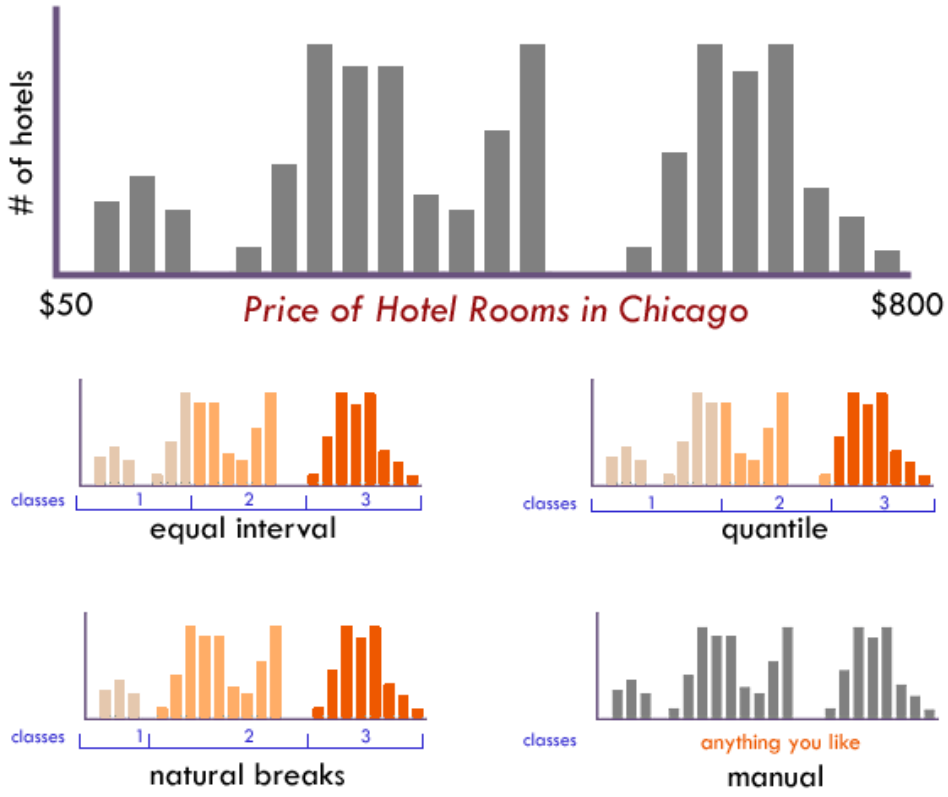




Images taken from: Arribas-Bel, D. (2019). A course on geographic data science. *Journal of Open Source Education*, *2*(16), 42.

+ Other..

- ❑ Unique
- ❑ Equal Interval
- ❑ Quantiles
- ❑ Fisher-Jenks or Natural breaks
- ❑ Manual



[**Important – please read me**: Basics of Data Classification on Maps]

Colour Schemes

Align with your purpose

- **Categories**, non-ordered 
- Graduated, **sequential** 
- Graduated, **divergent** 

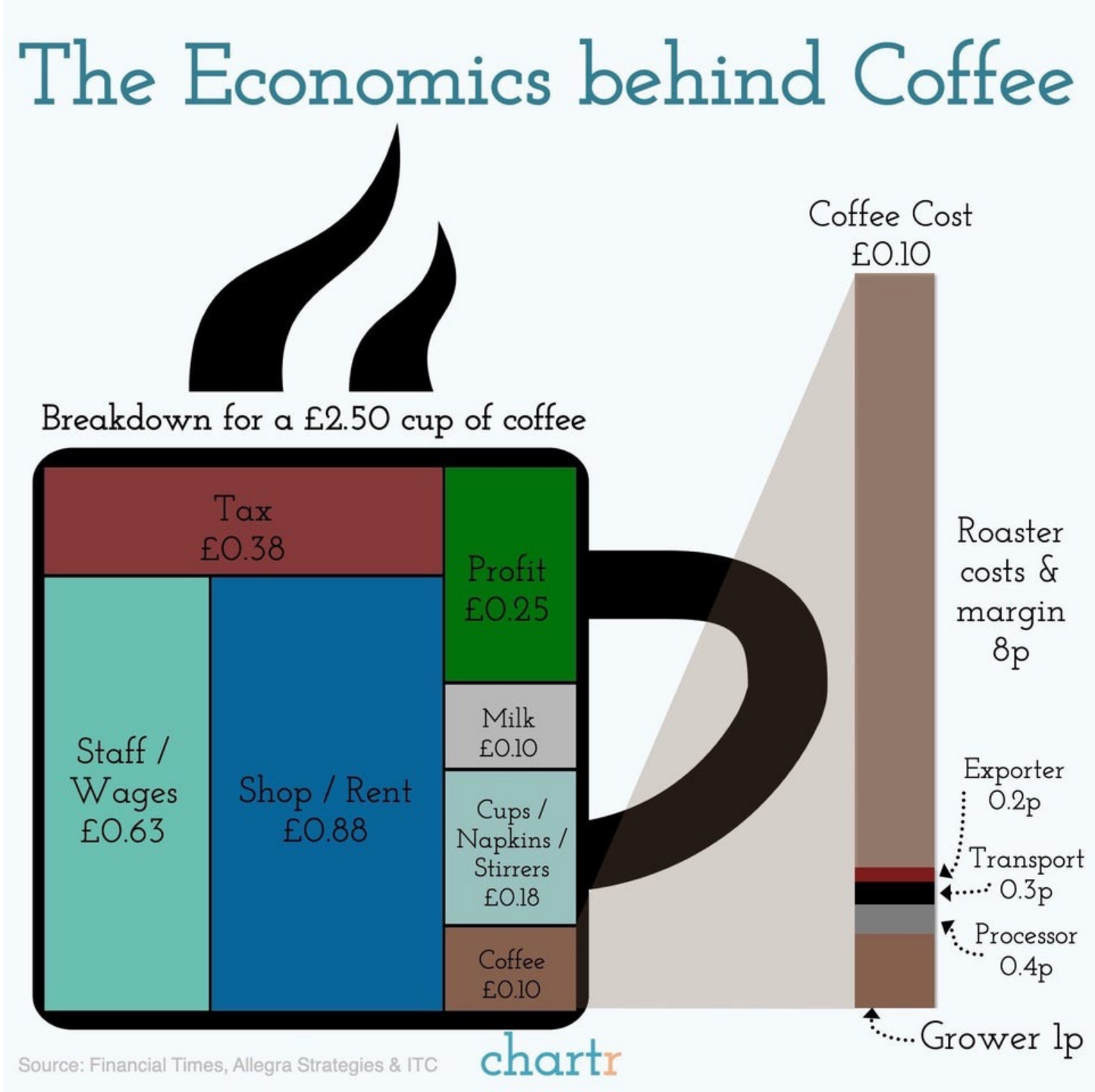
TIP: check ColorBrewer for guidance

Tips

- Think of the purpose of the map
- Explore by trying different classification alternatives
- Combine (Geo)-visualisation with other statistical devices

Recap

- Visualization of statistical data is a recent phenomenon.
- Needs of the audience are key.
- Data can tell more than one story at a time.
- Its power comes from engaging and augmenting the human in the loop, rather than replacing her.
- Its power can be misused, so think twice.



For next class..

Finish Labs to practice programming

Complete Homework for more practice

Check Assignment contents and due date

See “To do before class” for next lecture (~ 1 hour of self-study)