

Geographic Data Science - Lecture IV

Mapping Data

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Today

- Mapping data
- MAUP
- Choropleths
 - Definition
 - Classes
- Cartograms
- Conditional maps
- Space-Time mapping

Mapping Data with Data maps

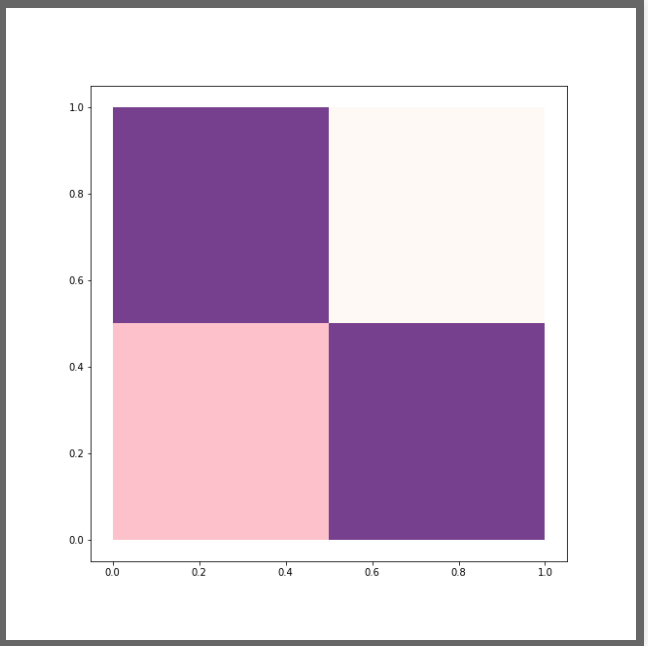
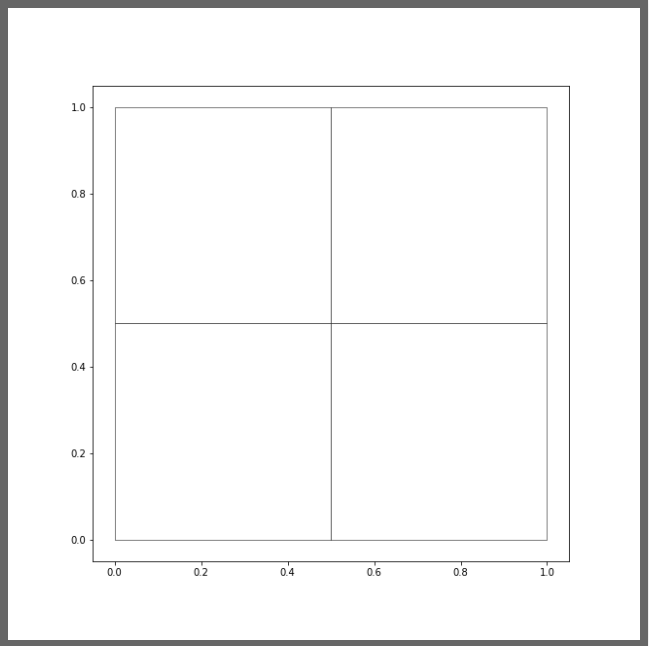
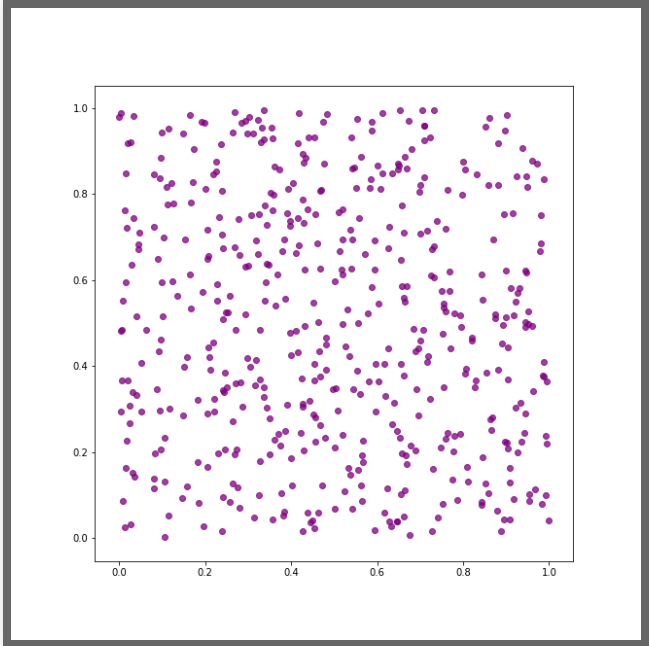
- Abstraction from the purely geographical map
- Representing numerical values within a spatial context
- A geographical approach to statistical visualization

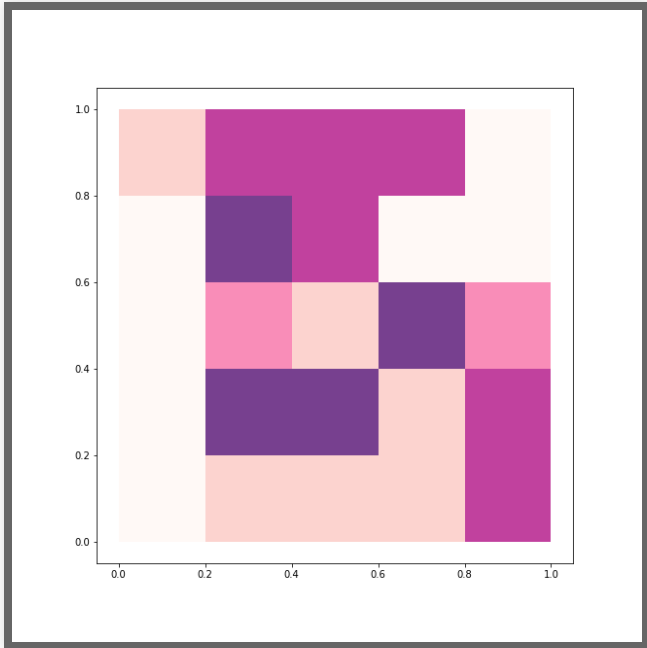
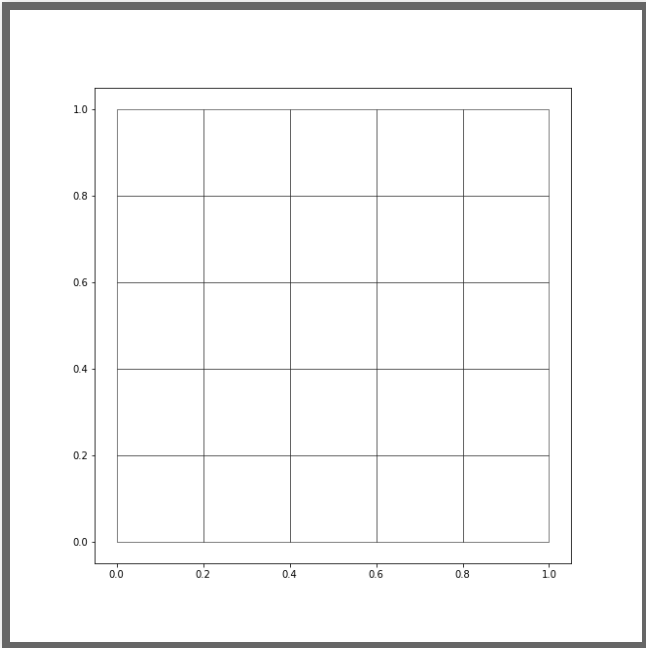
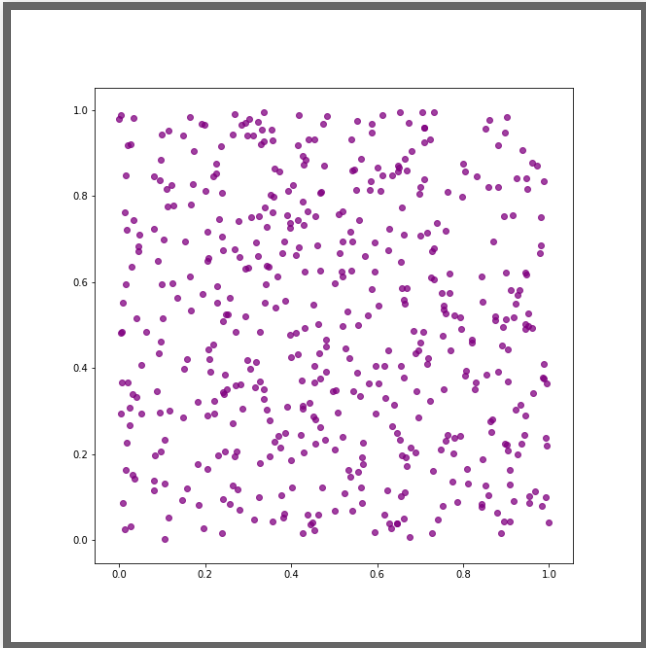
Key components

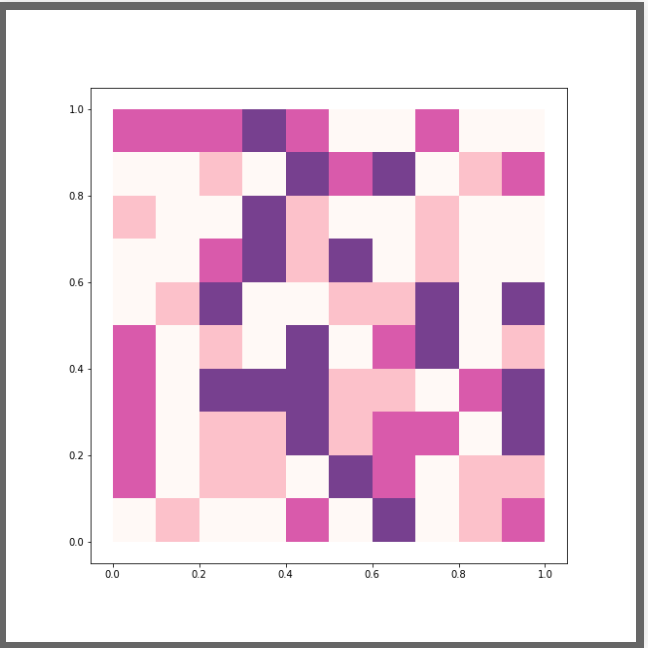
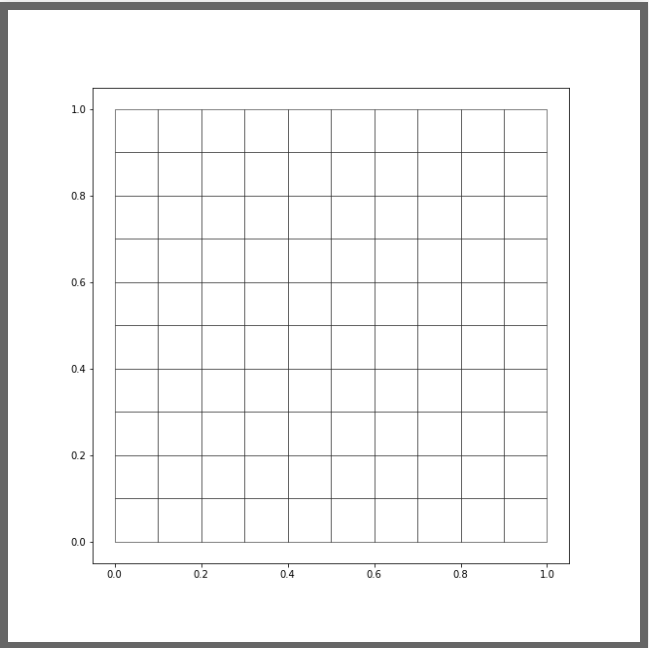
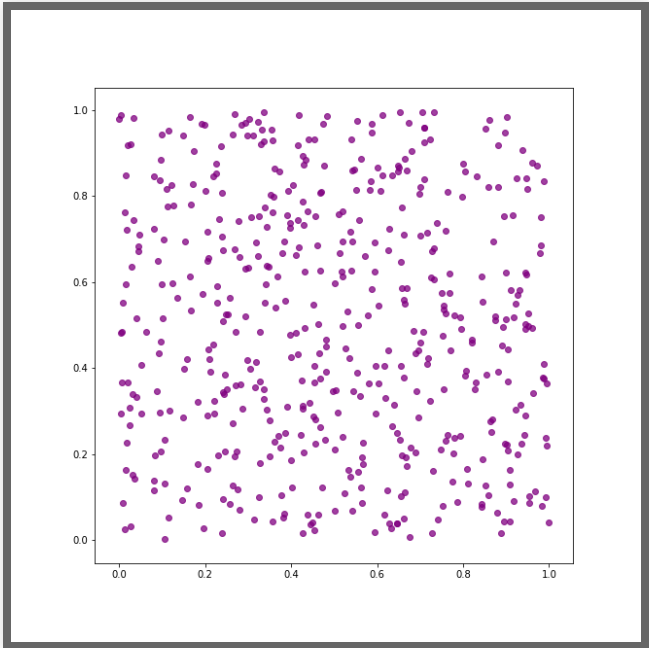
- “Container” geographies
- Choropleths: displaying data on maps
(choropleths)

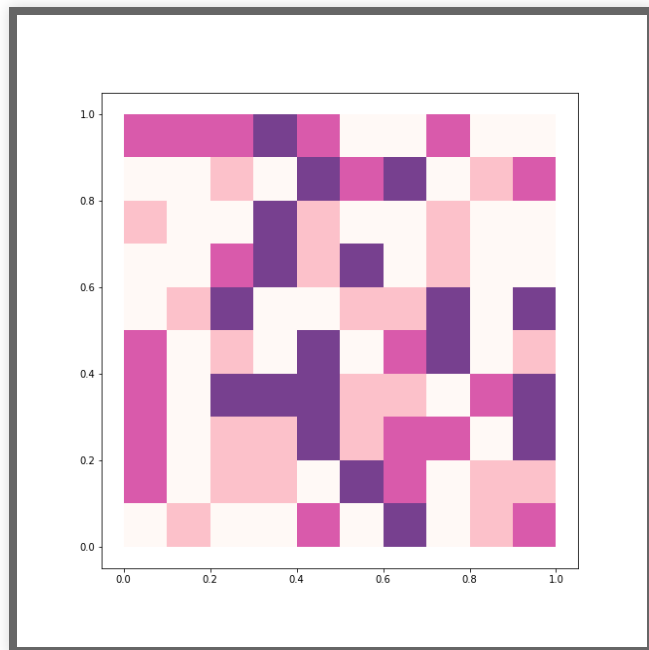
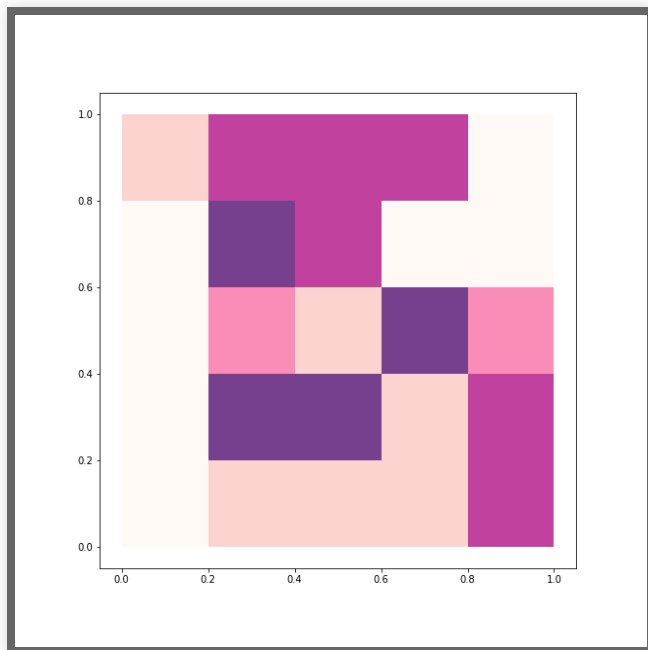
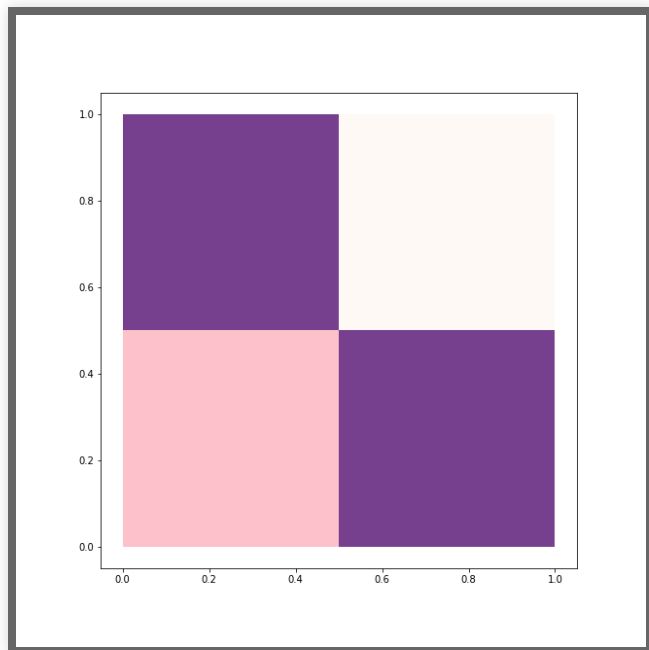
MAUP

Modifiable Areal Unit Problem (Openshaw, 1984)









MAUP

Scale and delineation mismatch between:

- Underlying process (e.g. individuals, firms, shops)
- 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 color gradient of some sort

- Counterpart of the histogram
- Values are classified into specific colors: value → bin
- Information loss as a trade off for simplicity

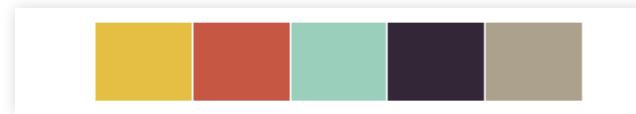
Classification choices

- Colors → in alignment with the goal of the map
- Bins → How many?
- Algorithm:
 - Unique values
 - Equal interval
 - Qua/Quintiles (equal count)
 - Fisher-Jenks
 - ...

Color schemes

Align with your purpose

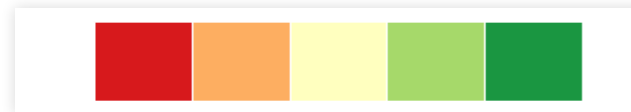
- Categories, non-ordered



- Graduated, sequential



- Graduated, divergent



Number of data classes: 3

[how to use](#) | [updates](#) | [downloads](#) | [credits](#)

COLORBREWER 2.0

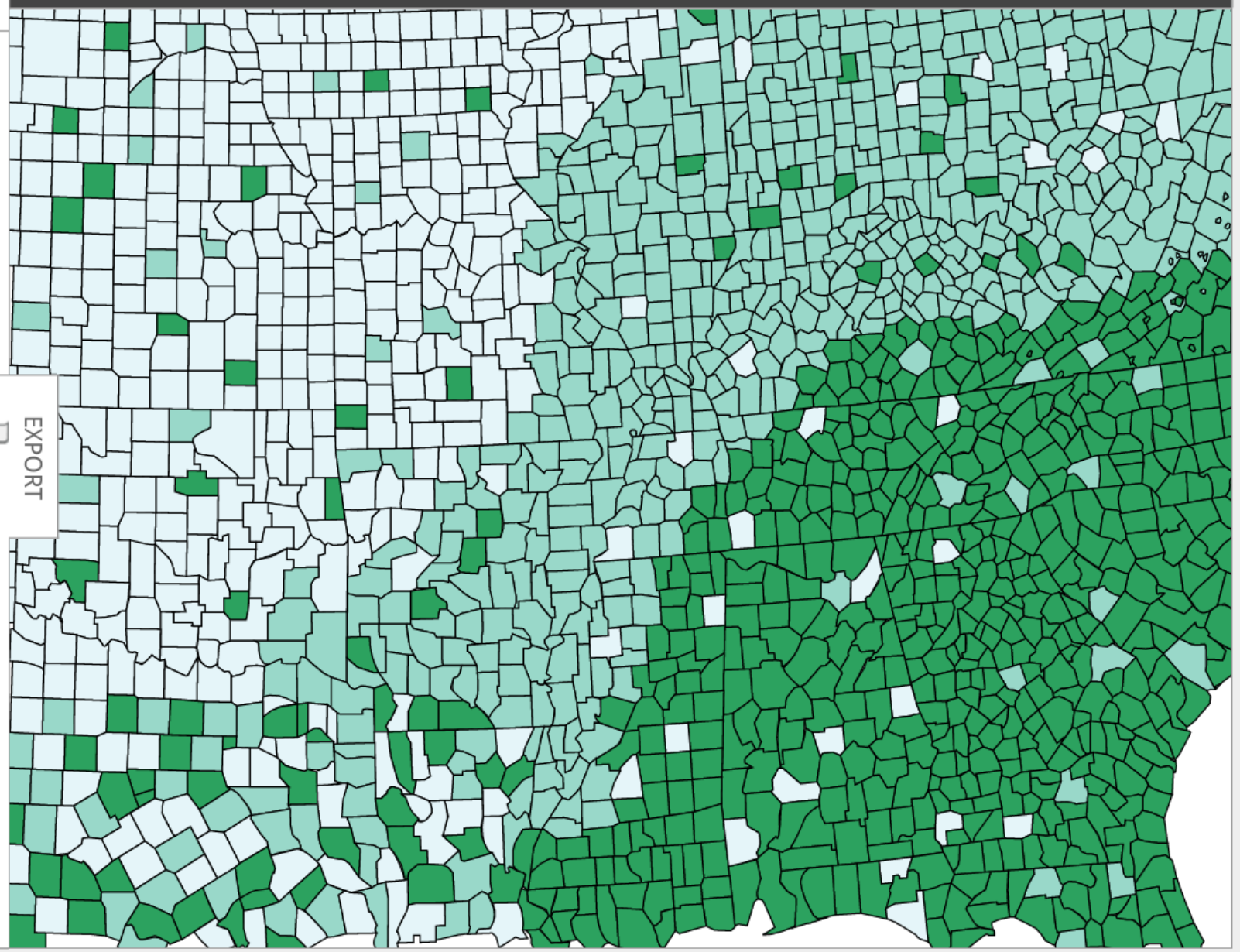
color advice for cartography

Nature of your data:

sequential diverging qualitative

Pick a color scheme:

Multi-hue: Single hue:



Only show: colorblind safe print friendly photocopy safe

Source

3-class BuGn

EXPORT

HEX

- #e5f5f9
- #99d8c9
- #2ca25f

Context:

roads cities borders

Background:

solid color terrain

color transparency

Classification algorithms

Unique values

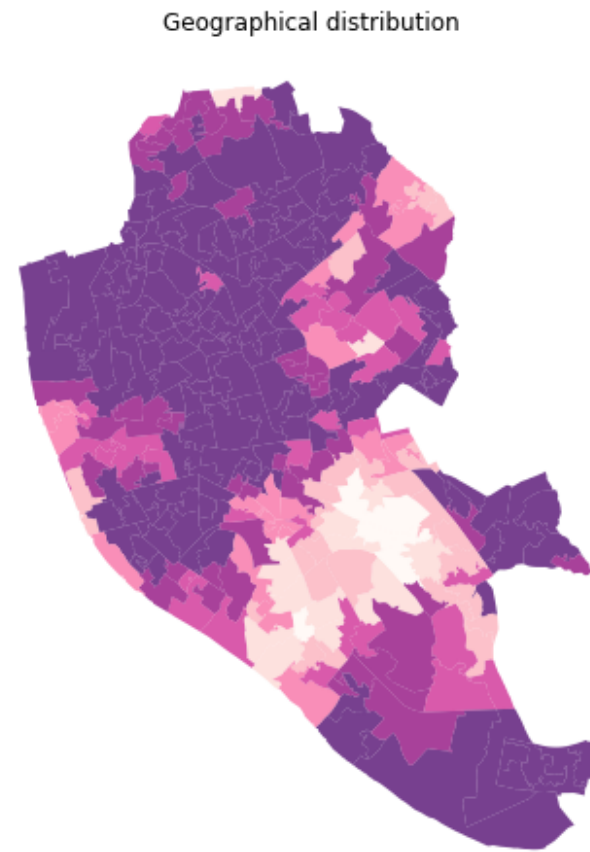
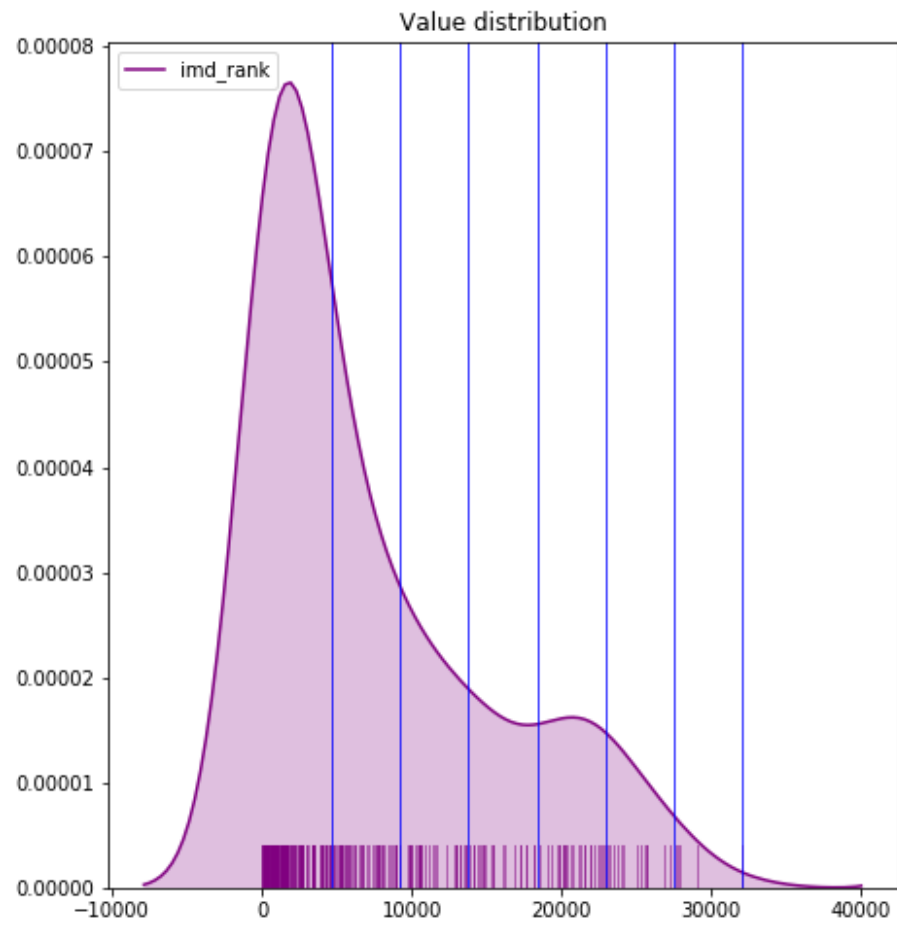
- Categorical data
- No gradient (reflect it with the color scheme!!!)
- Examples: Religion, country of origin...

Unique values

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

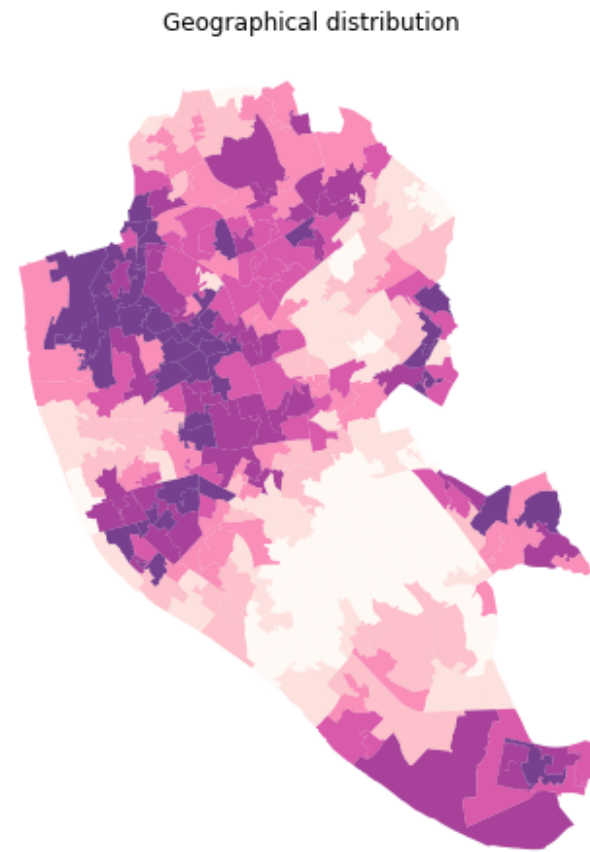
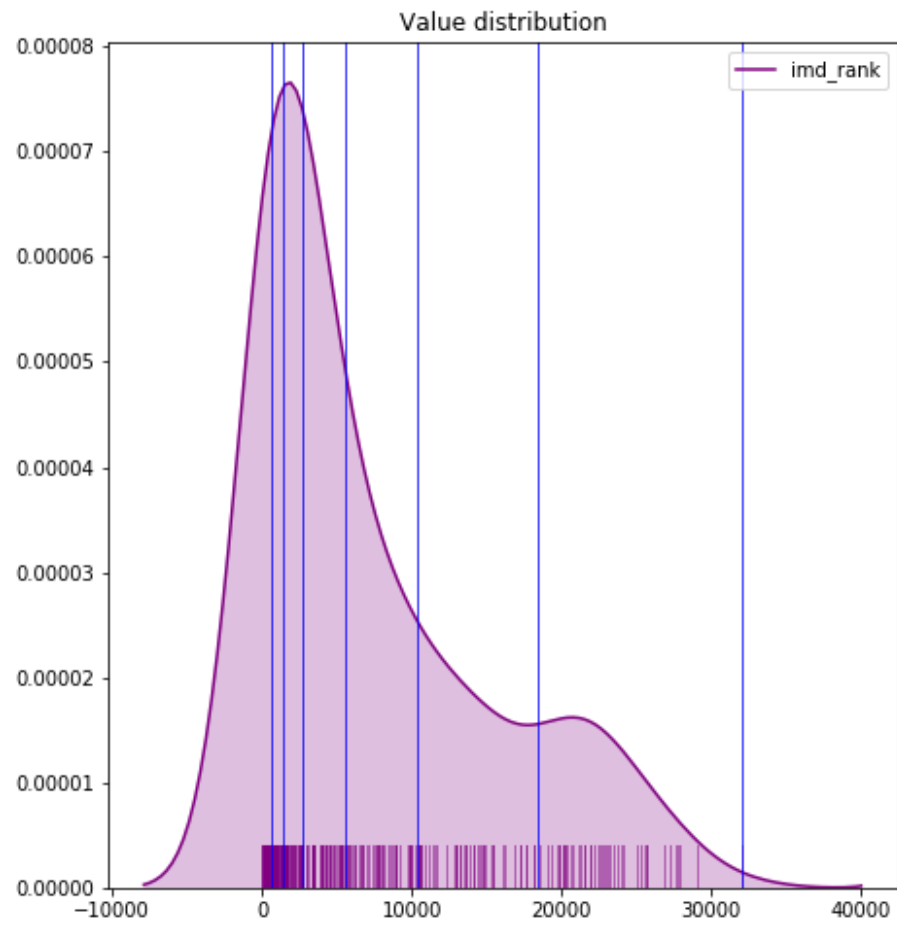
equal_interval



Quantiles

- Regardless of numerical values, split the distribution keeping the same amount 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



Other

- Fisher–Jenks
- Natural breaks
- Outlier maps: box maps, std. maps...

Tips

Different classification schemes can produce widely different maps as a result of:

- The distribution of the values
- The inherent simplification that a choropleth implies

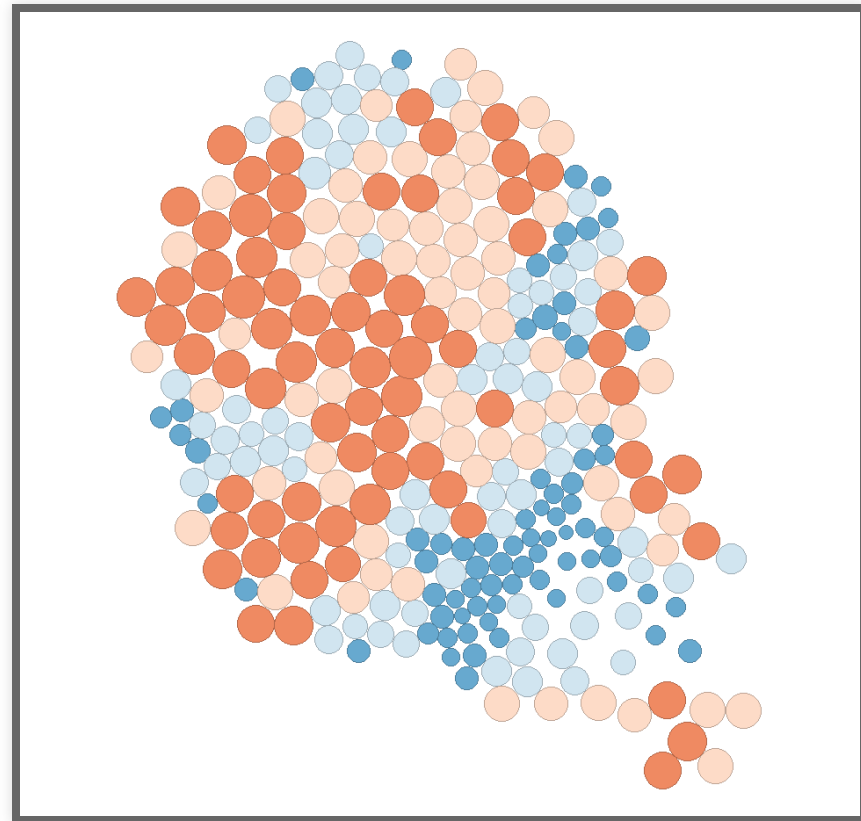
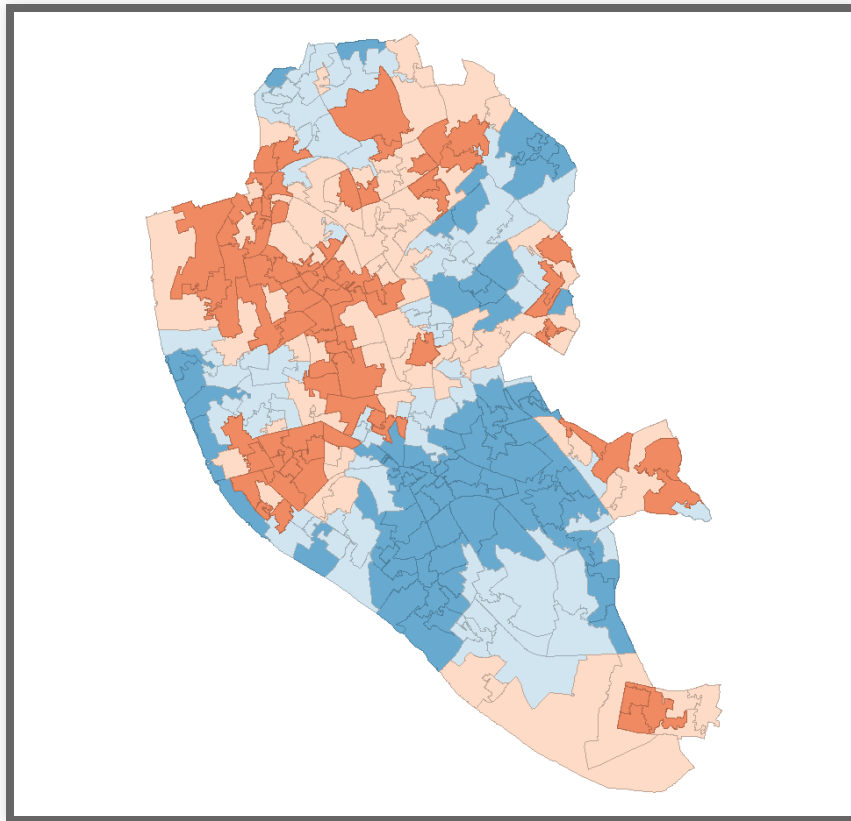
Best advice is to **explore** different ones and **combine** choropleths with other graphical devices like histograms or density plots

Cartograms

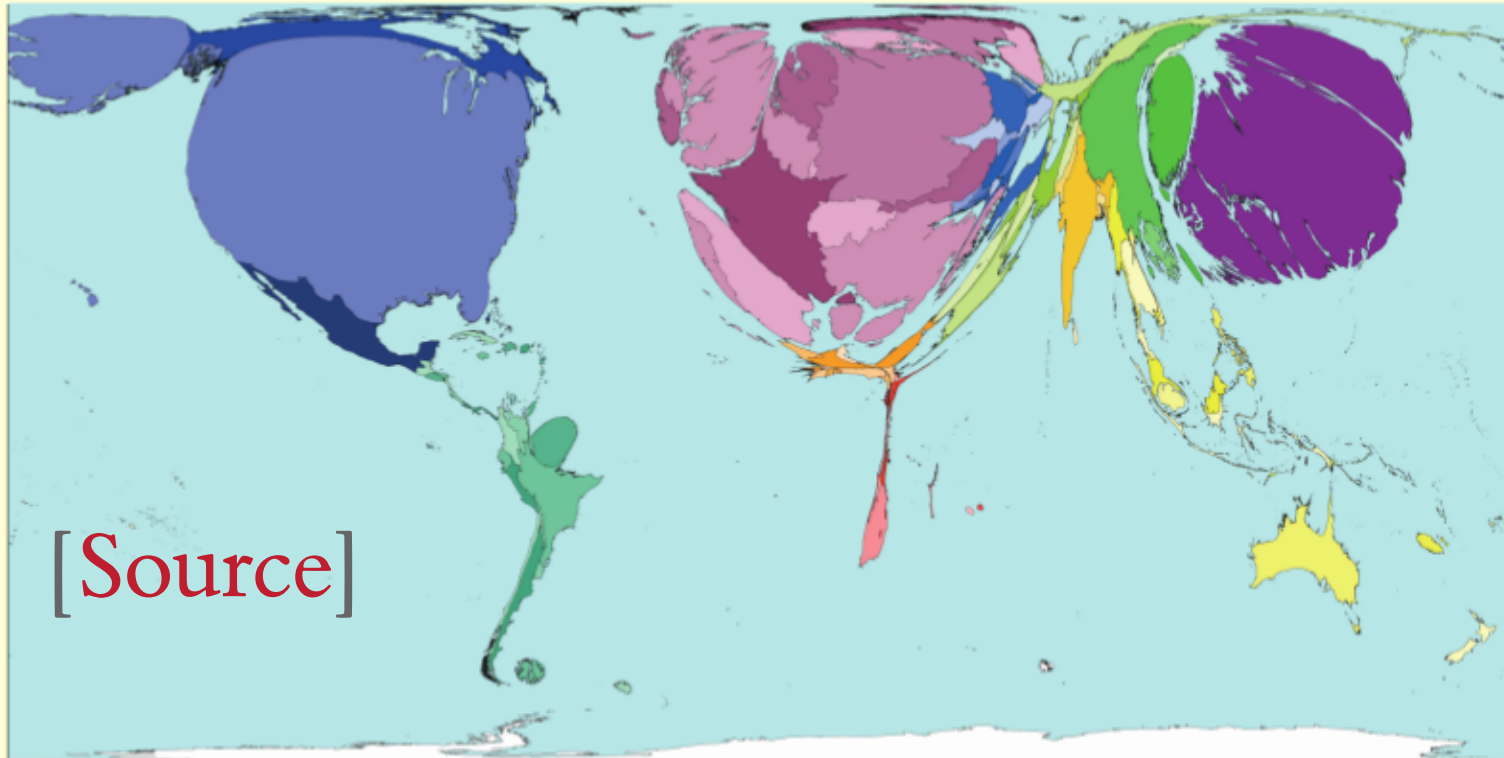
*“Data maps where the variable is encoded, not by a color gradient, but by **distorting the shape/size** of the geographical objects”*

- Useful in cases where the natural size/shape induces to wrong interpretation, or obscures the intended representation.
- If not done carefully, it can distort the message in unintended ways

Cartograms



Capital Consumption

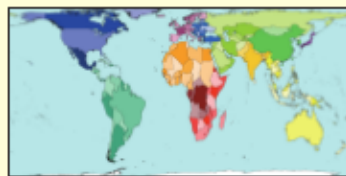


[Source]

Shown here is the cost of maintaining fixed assets and replacing them when necessary. Fixed assets include buildings, vehicles, communication and transport infrastructures. Deterioration occurs due to use, time, and becoming outdated. Fixed capital consumption is the cost of preventing this deterioration.

Large, technologically advanced infrastructures are likely to cost more to maintain than those that are small and simple. The United States, Japan, Germany and France have the highest absolute costs of fixed capital consumption. Costs per person are high in Norway, Switzerland and Denmark - roughly one thousand times higher than in Nepal, Ethiopia and Burundi.

Territory size shows the proportion of all fixed capital consumption that occurred there.



Land area

Technical notes

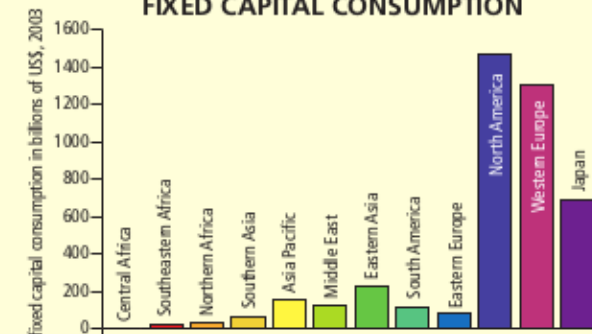
- Data are from the World Bank's 2005 World Development Indicators.
- See website for further information.

HIGHEST AND LOWEST FIXED CAPITAL CONSUMPTION

Rank	Territory	Value	Rank	Territory	Value
1	Norway	7.0	191	Eritrea	0.0126
2	Switzerland	6.2	192	Sierra Leone	0.0112
3	Japan	5.4	193	Malawi	0.0101
4	Denmark	5.1	194	Guinea-Bissau	0.0099
5	United States	4.5	195	Liberia	0.0091
6	Finland	4.4	196	Haiti	0.0072
7	Sweden	4.0	197	Democratic Republic Congo	0.0070
8	Netherlands	4.0	198	Nepal	0.0058
9	Austria	3.9	199	Ethiopia	0.0055
10	Germany	3.8	200	Burundi	0.0054

Fixed Capital Consumption in thousands of US\$ per person per year, 2003

FIXED CAPITAL CONSUMPTION



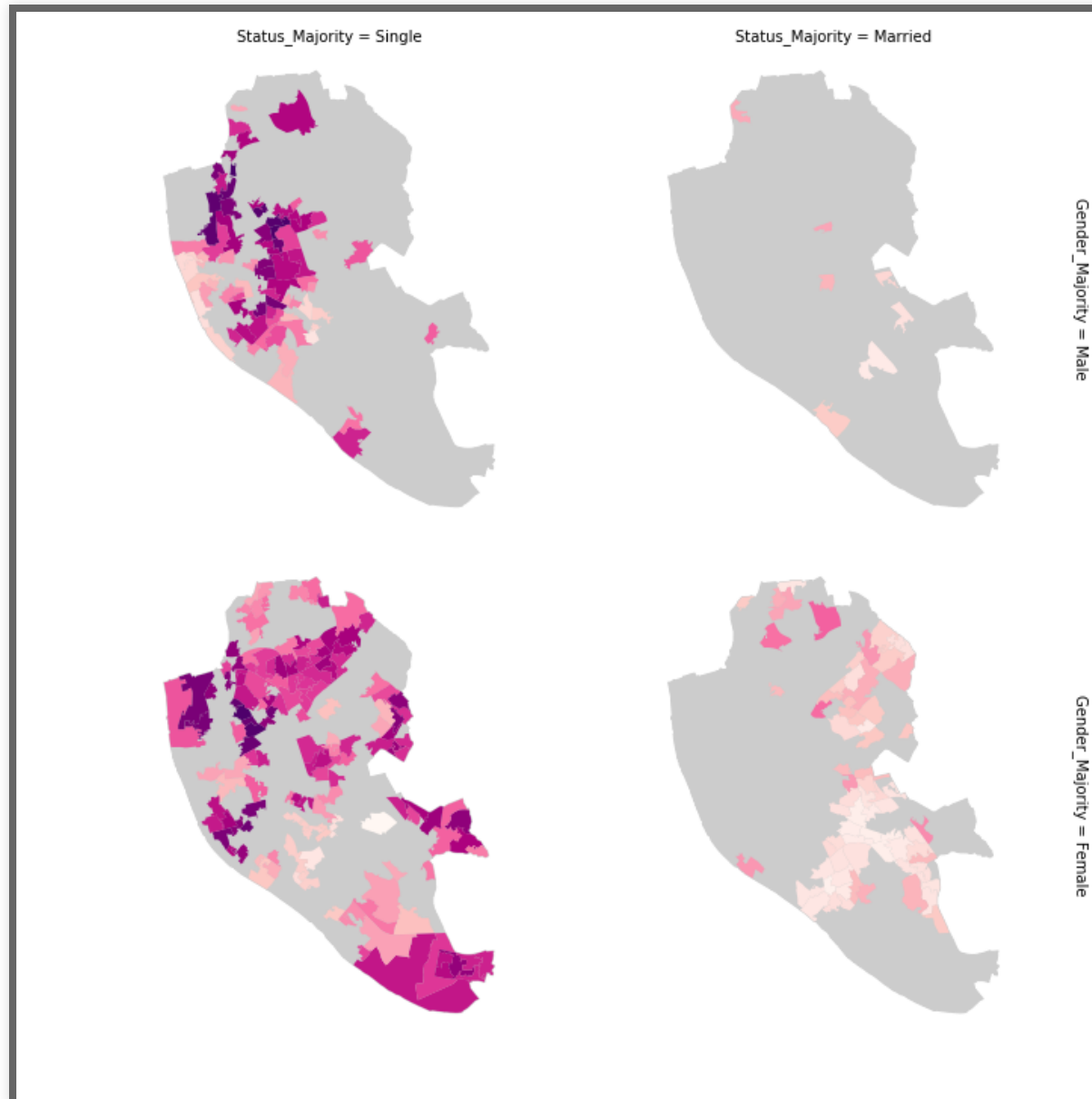
“... it will be more expensive in the long run if we let existing infrastructure become so run down, that it must eventually be replaced at great costs.”
 Education and Training Unit (South Africa), 2007

Conditional maps

Split a dataset in *buckets* by *conditioning* on additional variables, then create a map for each *bucket*

- If no association, maps should look the same
- But, if the conditioning variables are somewhat related to the outcome we are mapping, the spatial distribution can vary substantially
- Exploration of multivariate relationships

Conditional maps

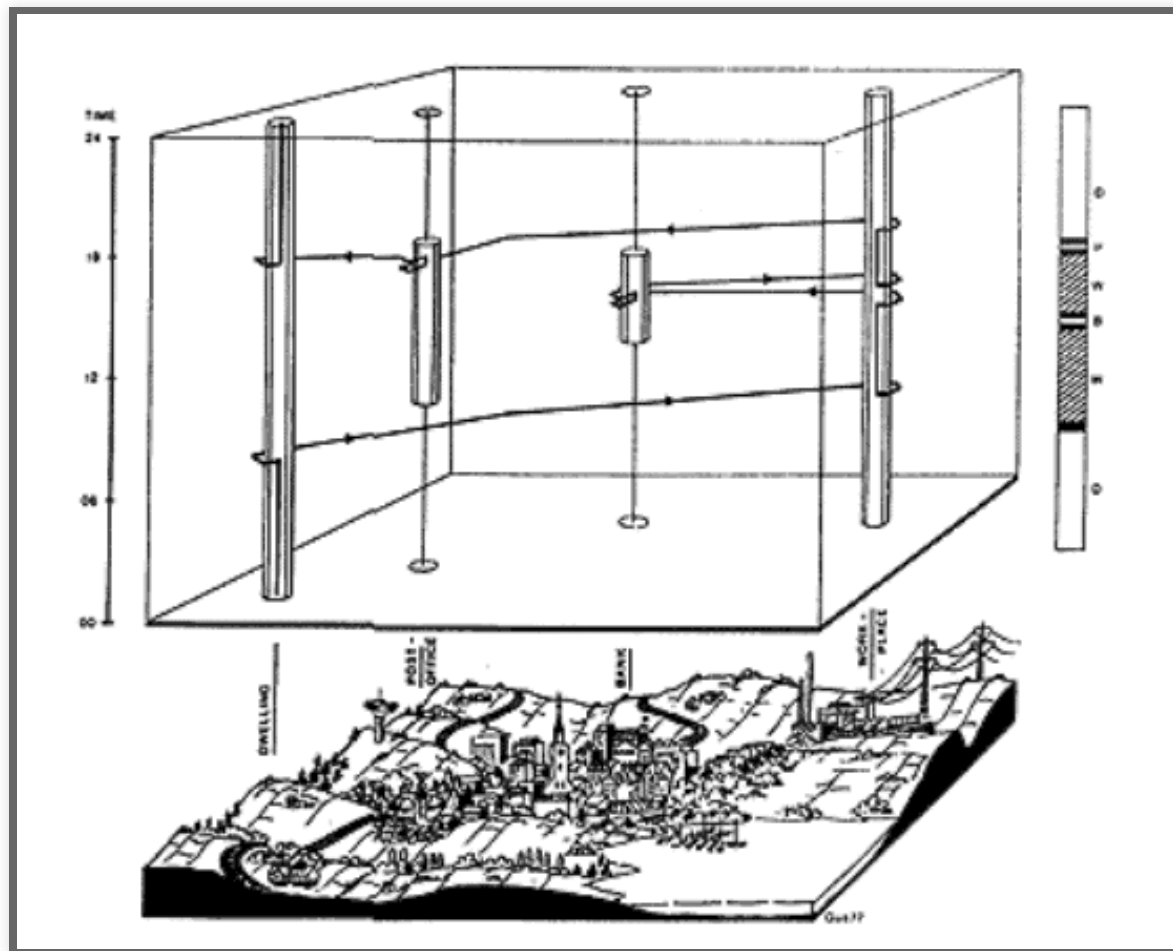


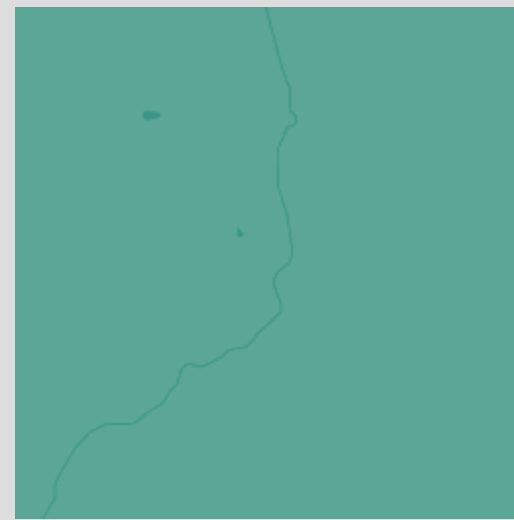
Space-Time mapping

Space-Time mapping

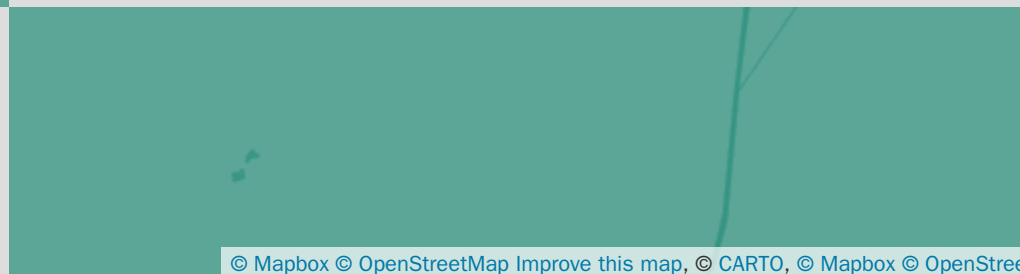
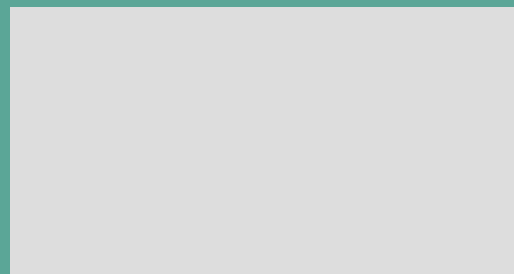
- Bringing time into a spatial 2D context is “tricky” (it’s really 3D!)
- Traditionally \rightarrow sequence of time periods, 3D plots
- More recently \rightarrow animation and interactivity

[Source]





[Source]





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