Geographic Data Science - Lecture IV

Mapping Data

Dani Arribas-Bel

Today

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

Data **maps**

- Abstraction from the purely geographical map
- Representing numerical values within a spatial context

Data **maps**

- Abstraction from the purely geographical map
- Representing numerical values within a spatial context

Mapping **data**

- A geographical approach to statistical visualization
- The spread of data is considered in its geographical dimension

Before we delve into different types of data maps…

MAUP

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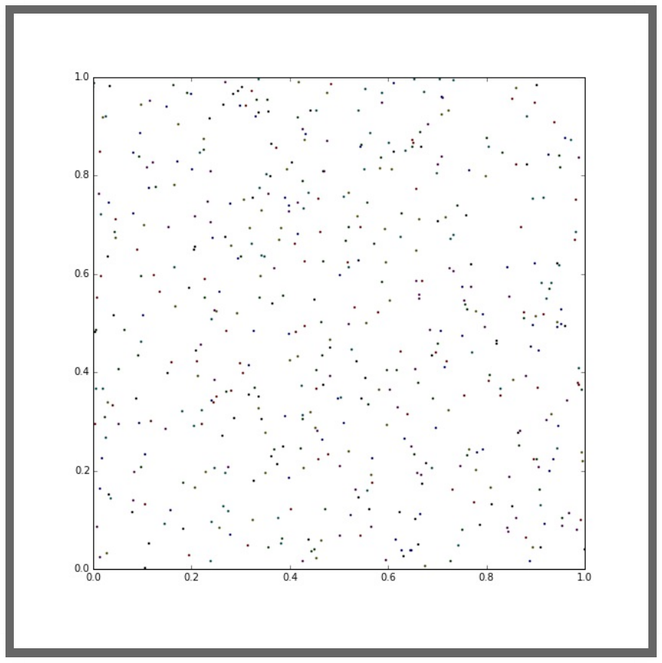
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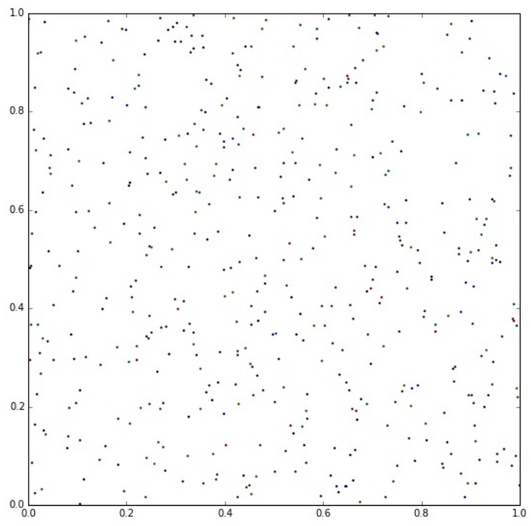
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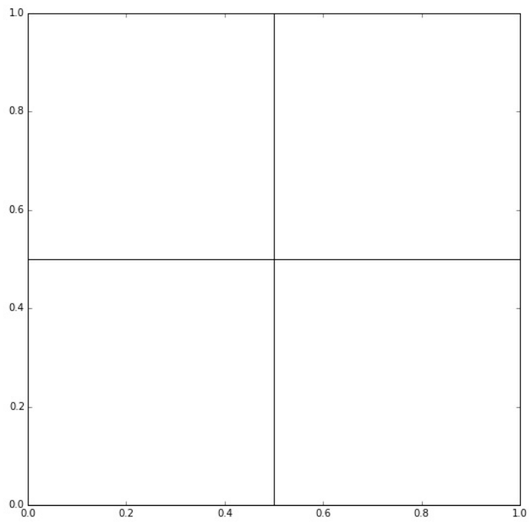
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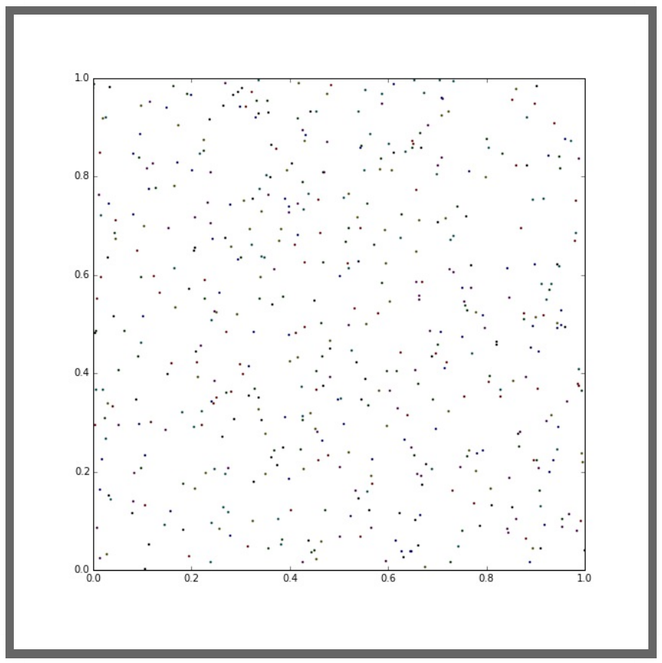
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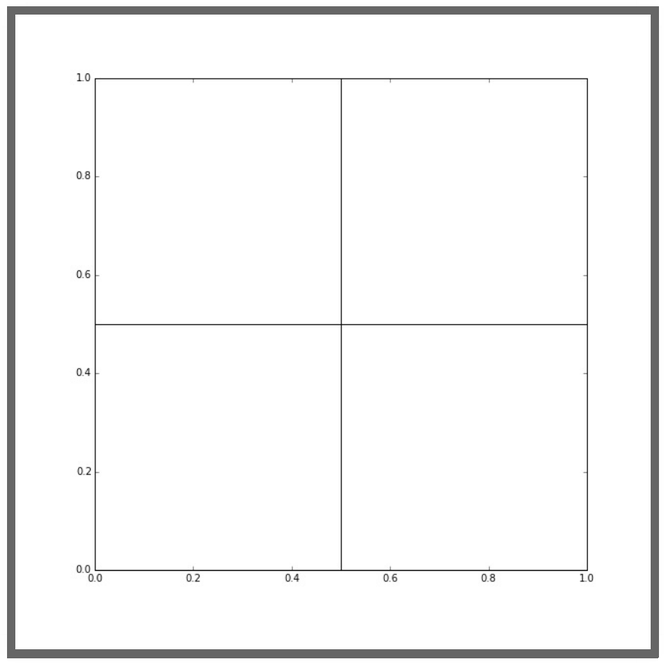
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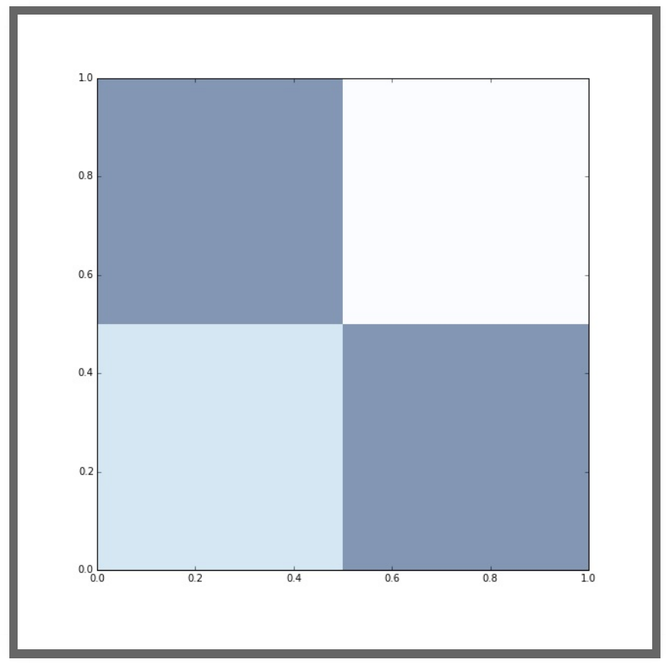
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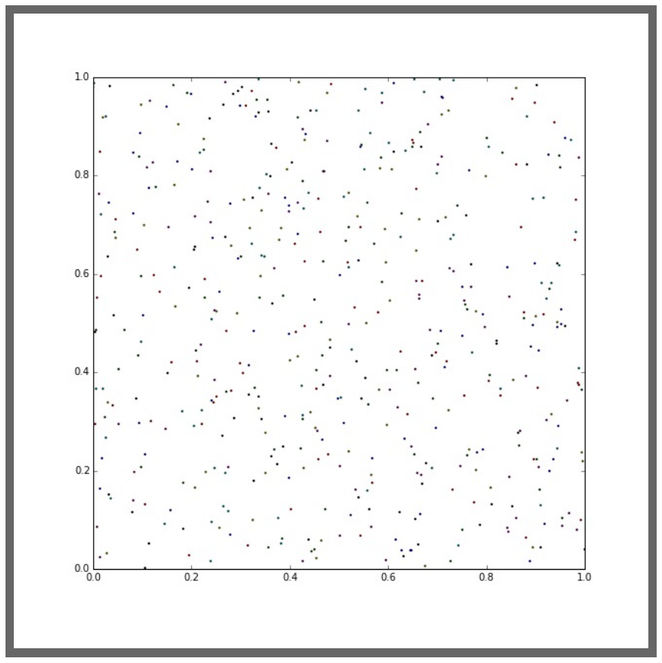
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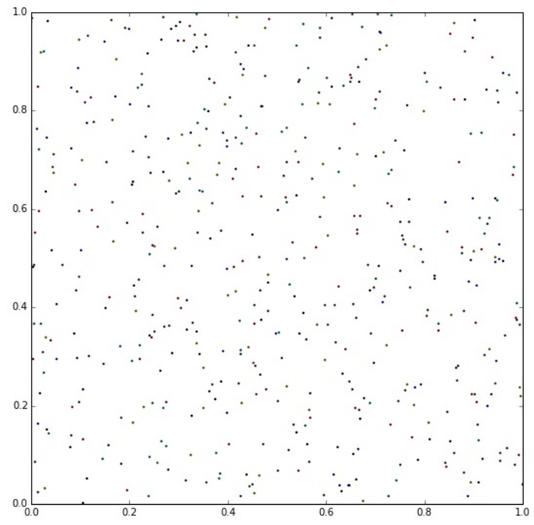
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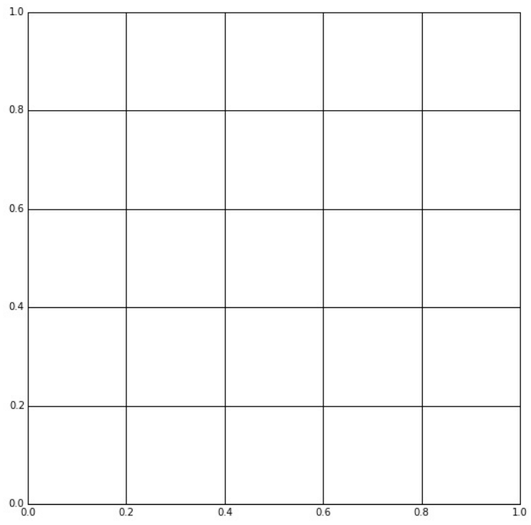
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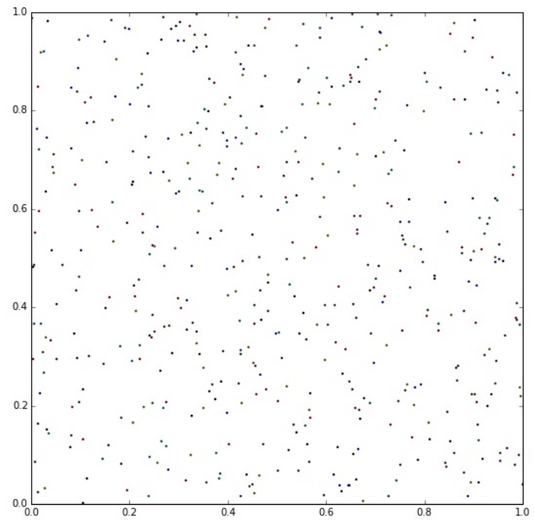
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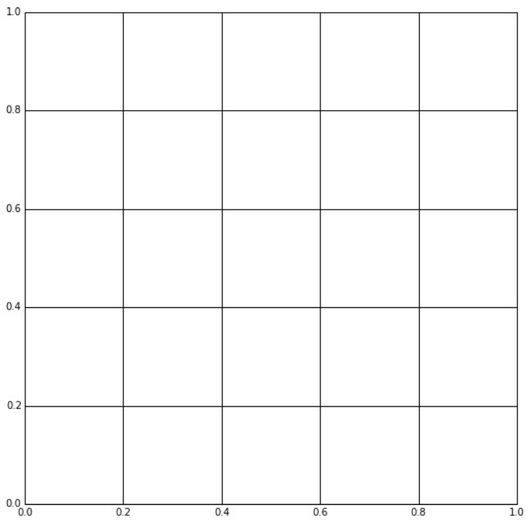
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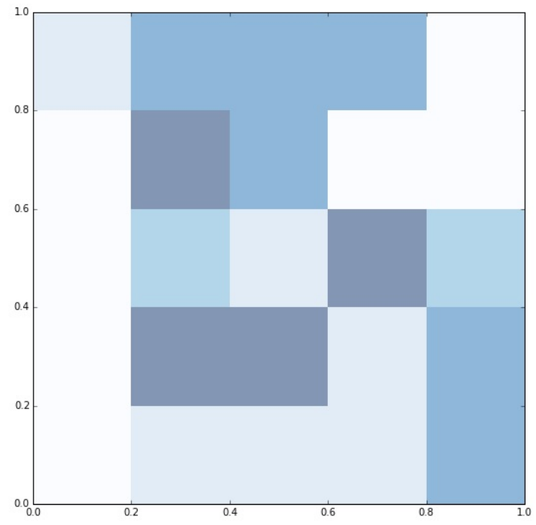
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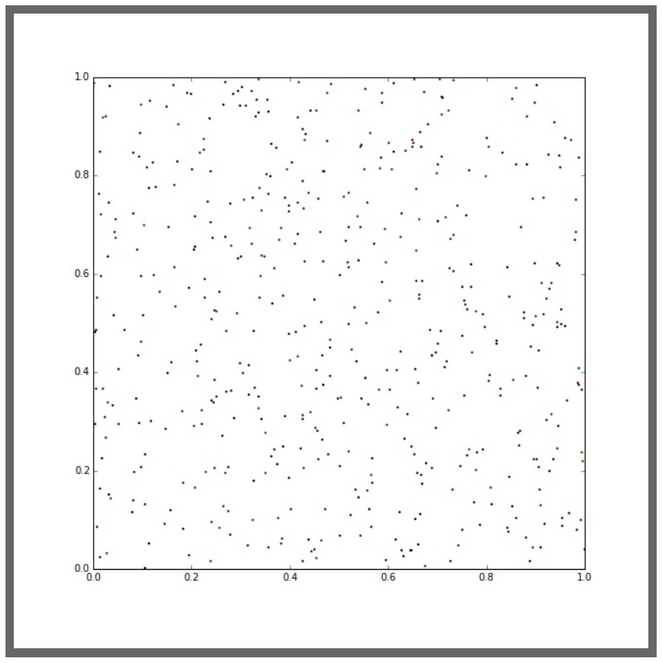
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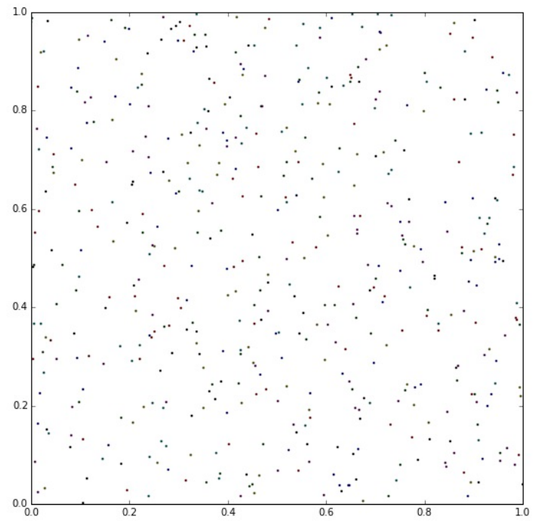
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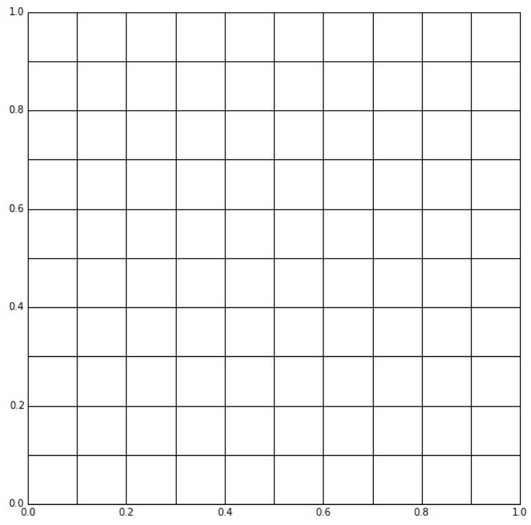
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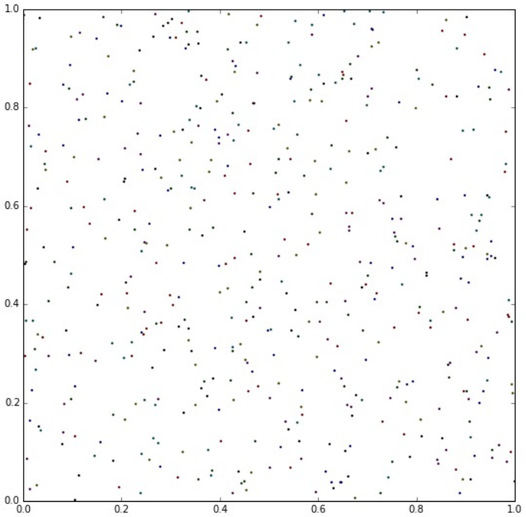
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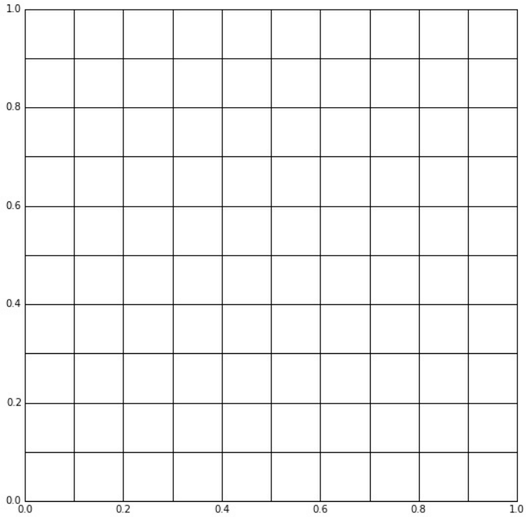
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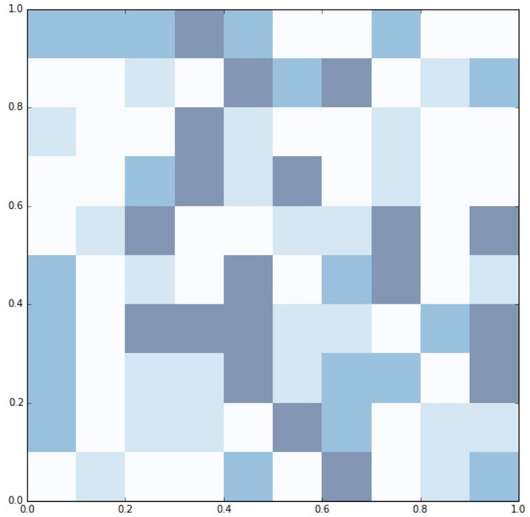
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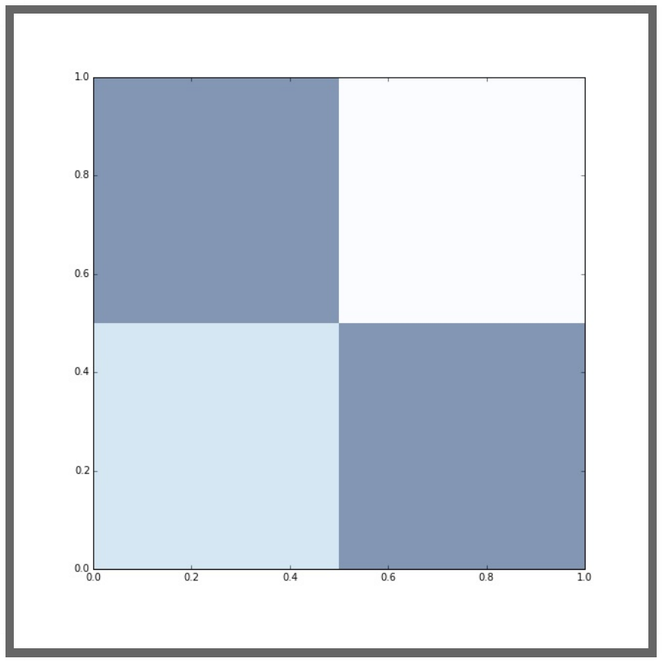
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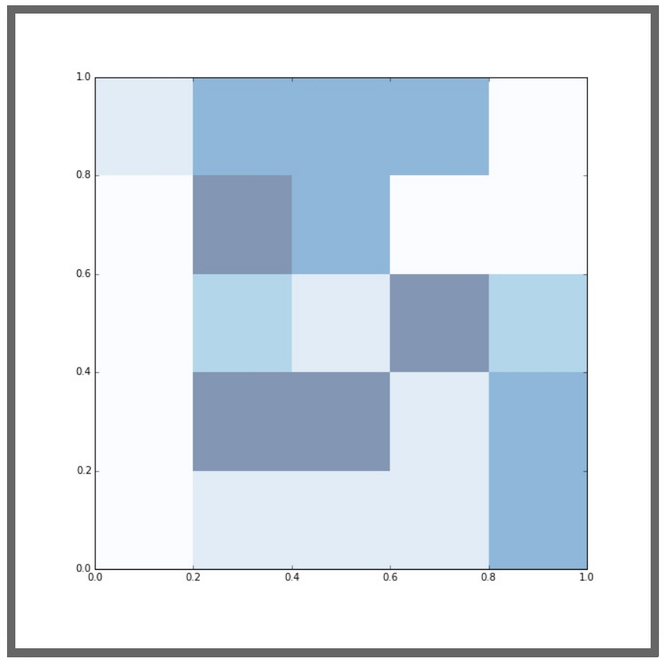
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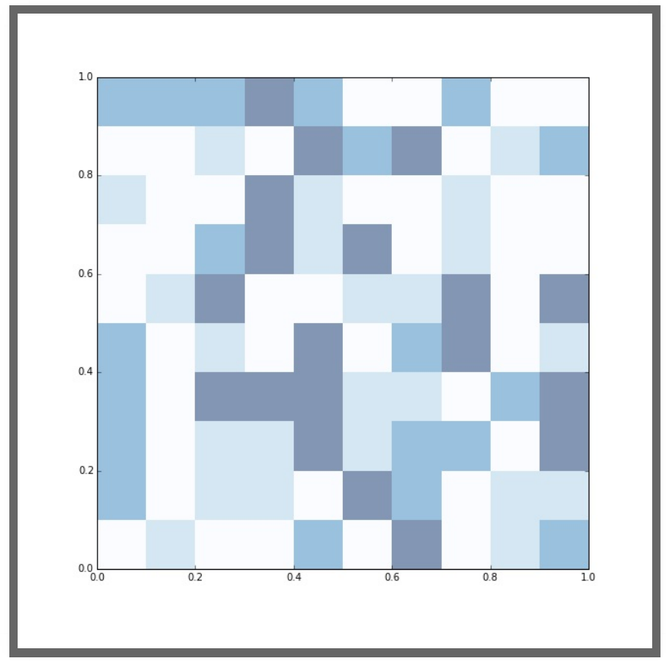
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MAUP

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

MAUP

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- 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

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
- Bins
- Algorithm:

Classification choices

- Colors --> in alignment with the goal of the map
- Bins
- Algorithm:

Classification choices

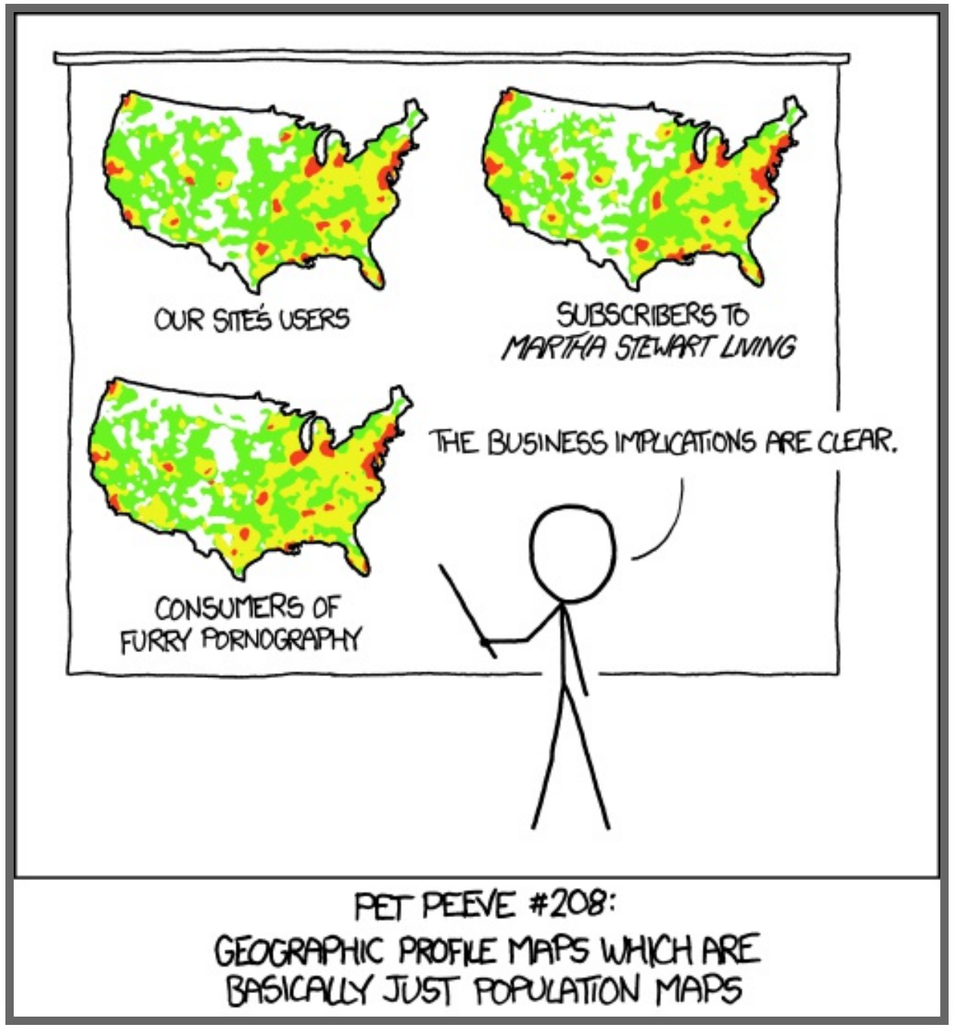
- Colors --> in alignment with the goal of the map
- Bins --> How many?
- Algorithm:

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
  - ...

Beware standarization!!!

[Source]



Color schemes

Align with your purpose

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

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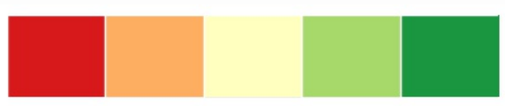
- Graduated, **divergent** 

Daniel

ColorBrewer: Color A ×

colorbrewer2.org

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sequential ○ diverging ○ qualitative

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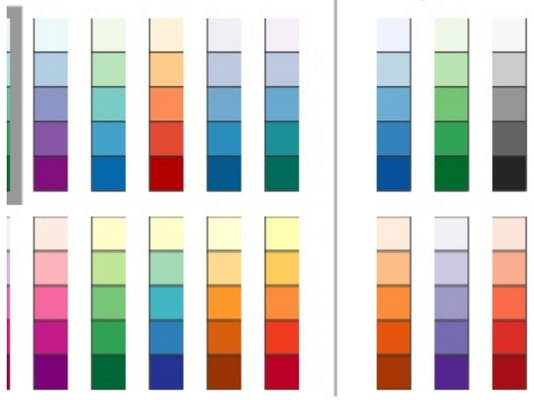

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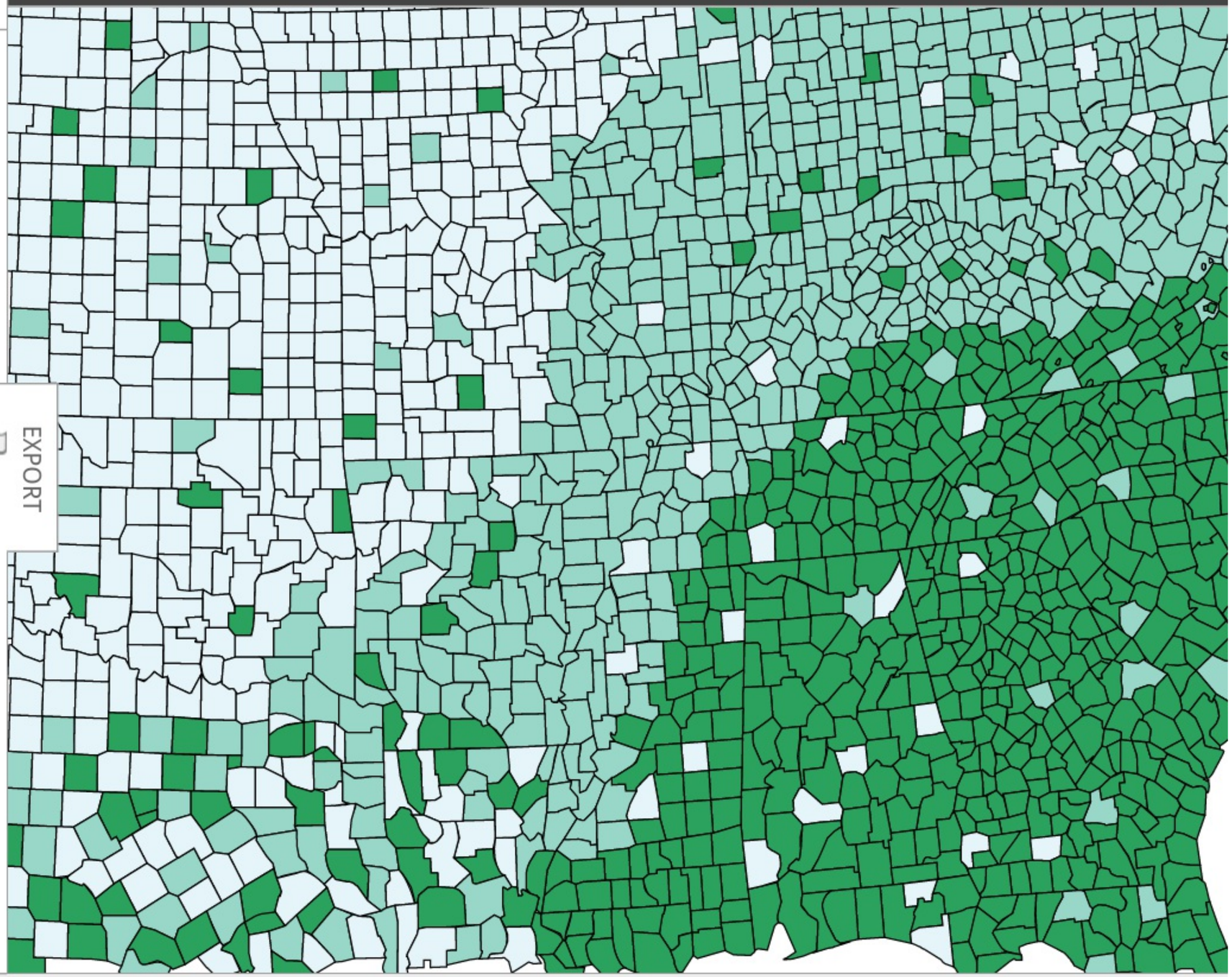
COLORBREWER 2.

color advice for cartography



nthia Brewer, Mark Harrower and The Pennsylvania State University

ort

to Flash version

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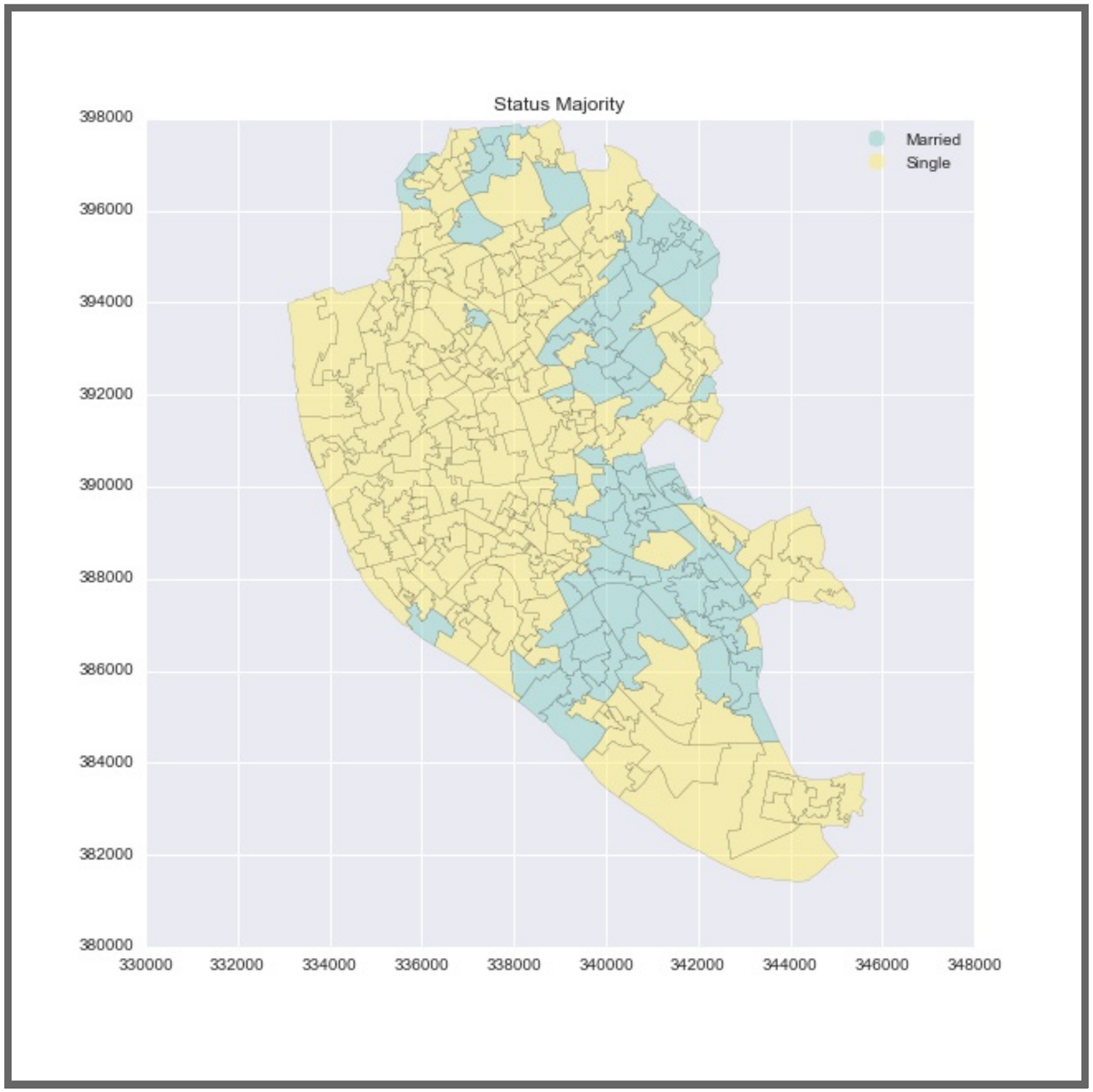
axismo

Unique values

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

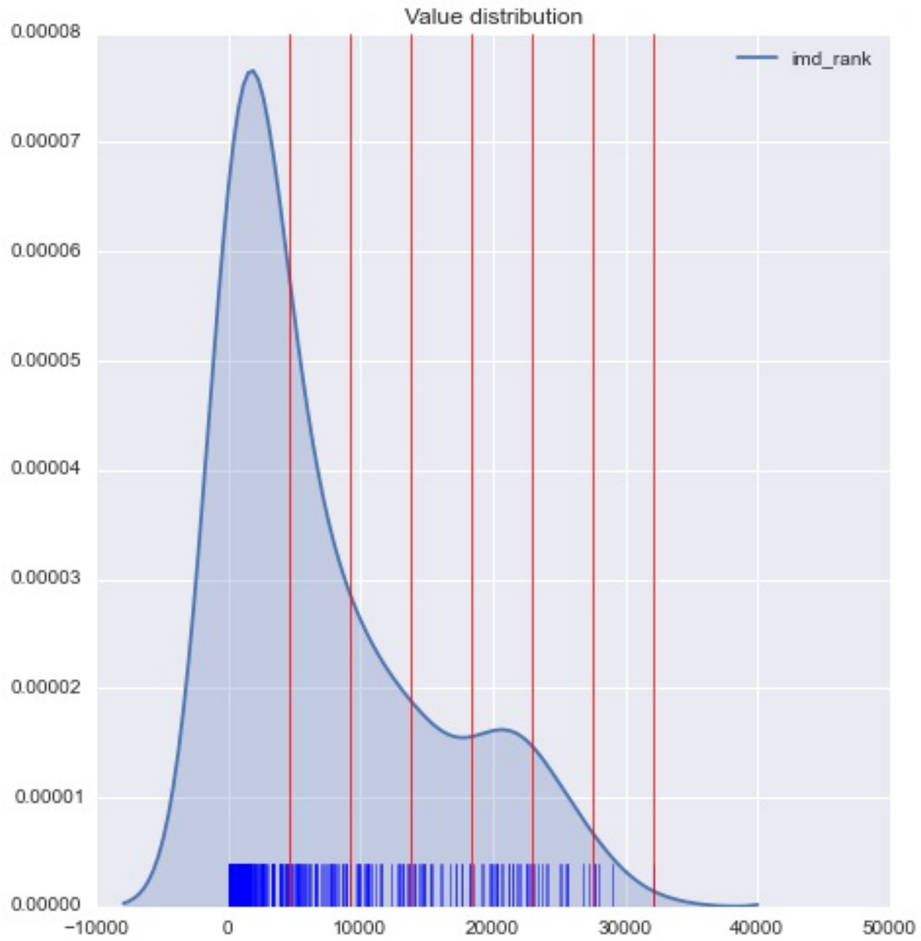
Unique values

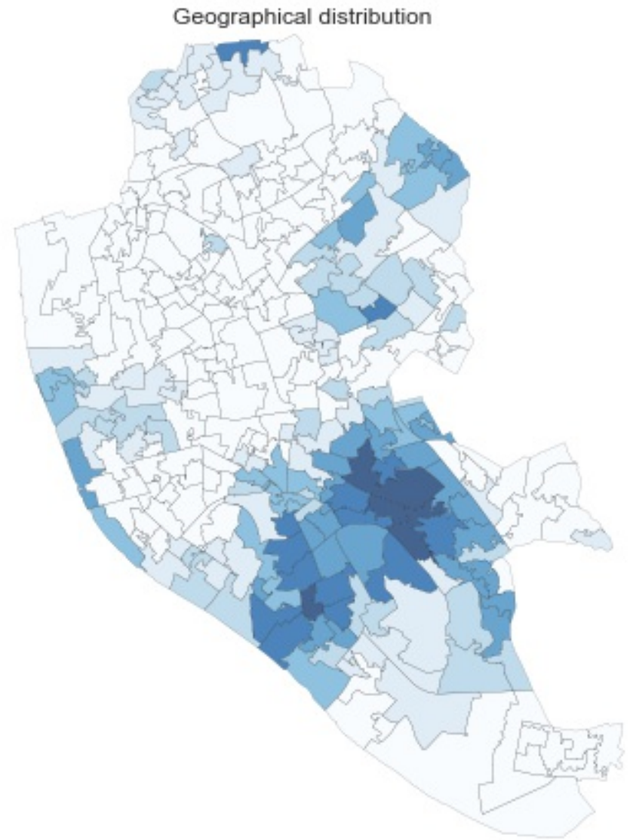


Equal interval

- 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

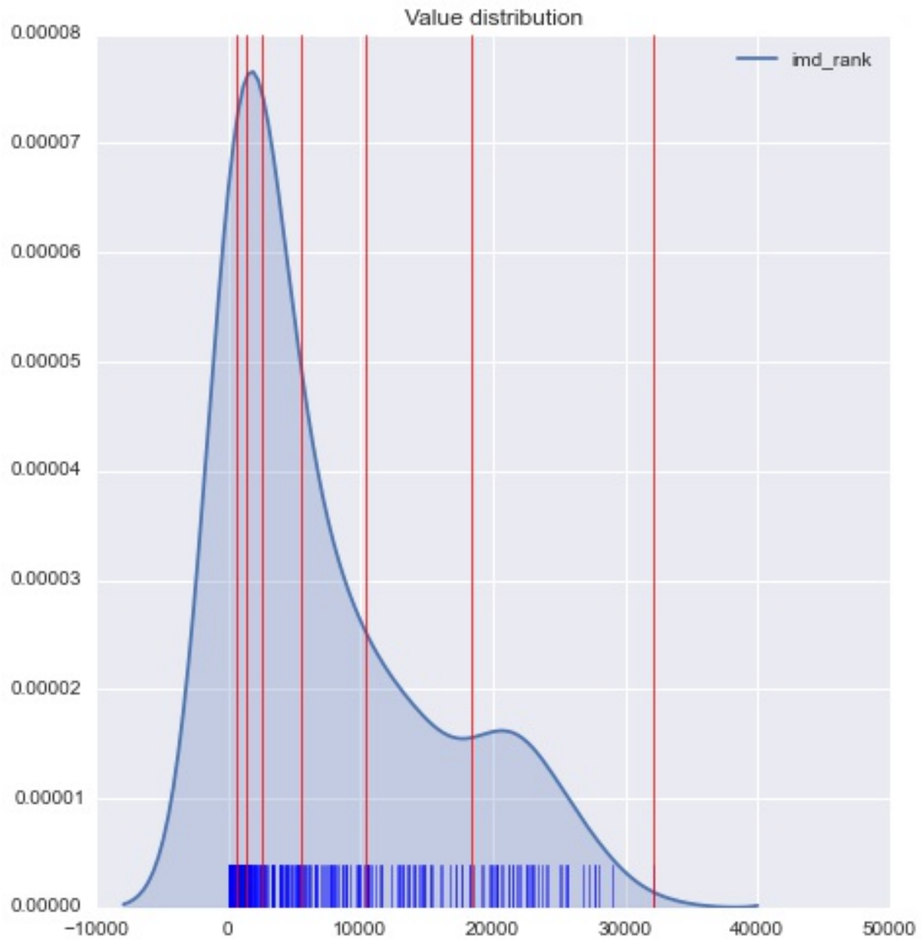




Quantiles

- 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


Value distribution
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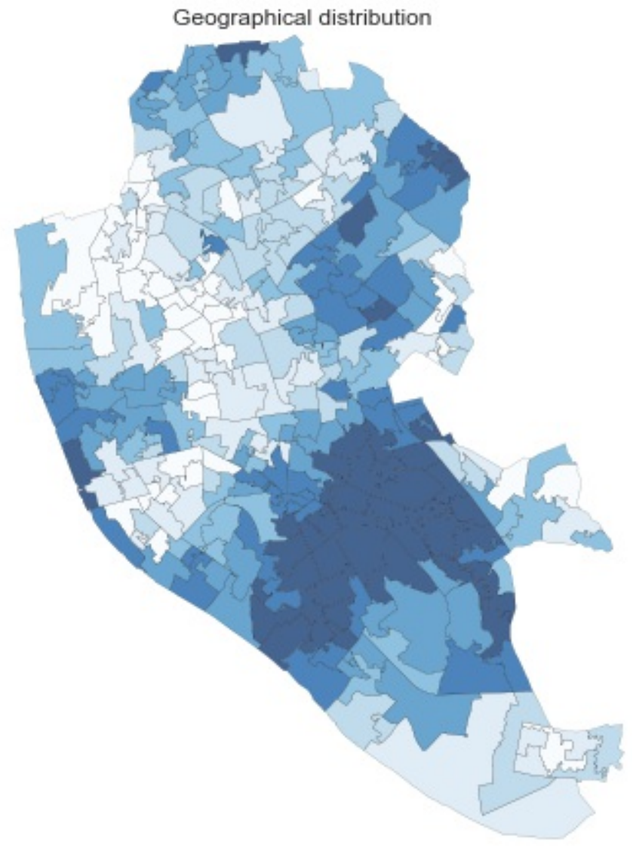

Geographical distribution

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

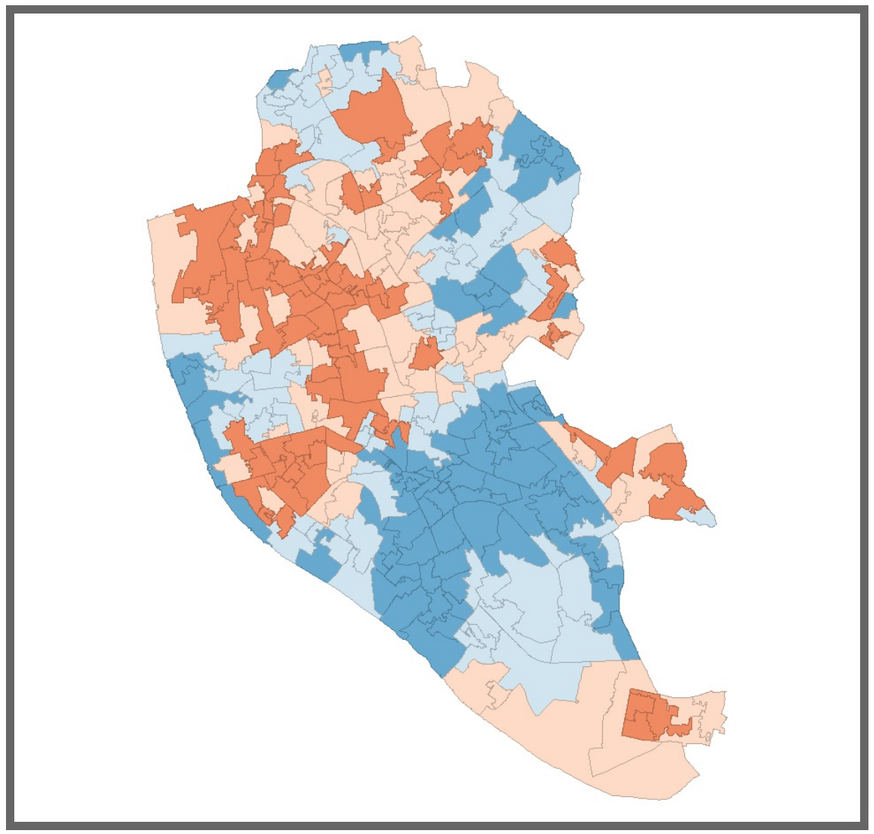
*"**Data maps** where the variable is encoded, not by a color gradient, but by **distorting the shape/size** of the geographical objects"*

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



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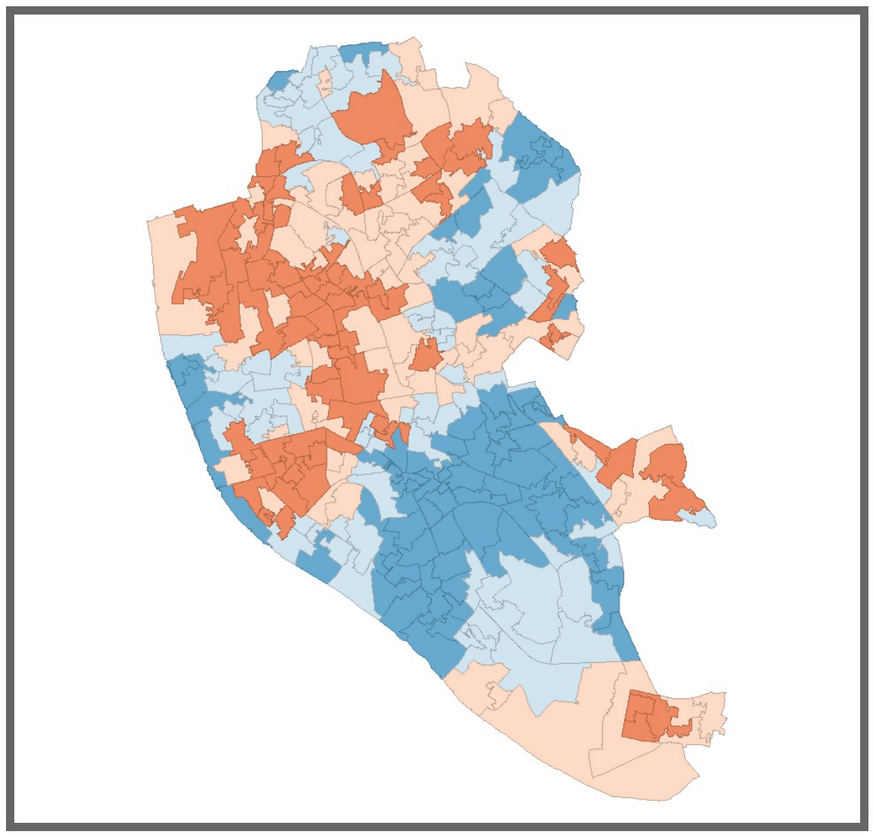
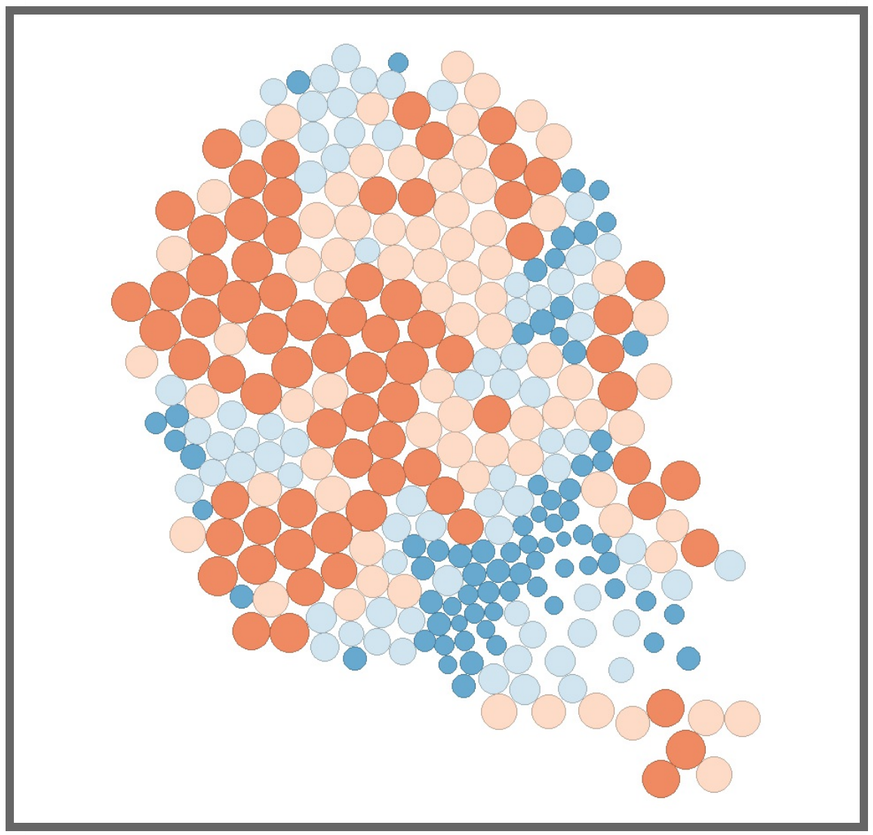
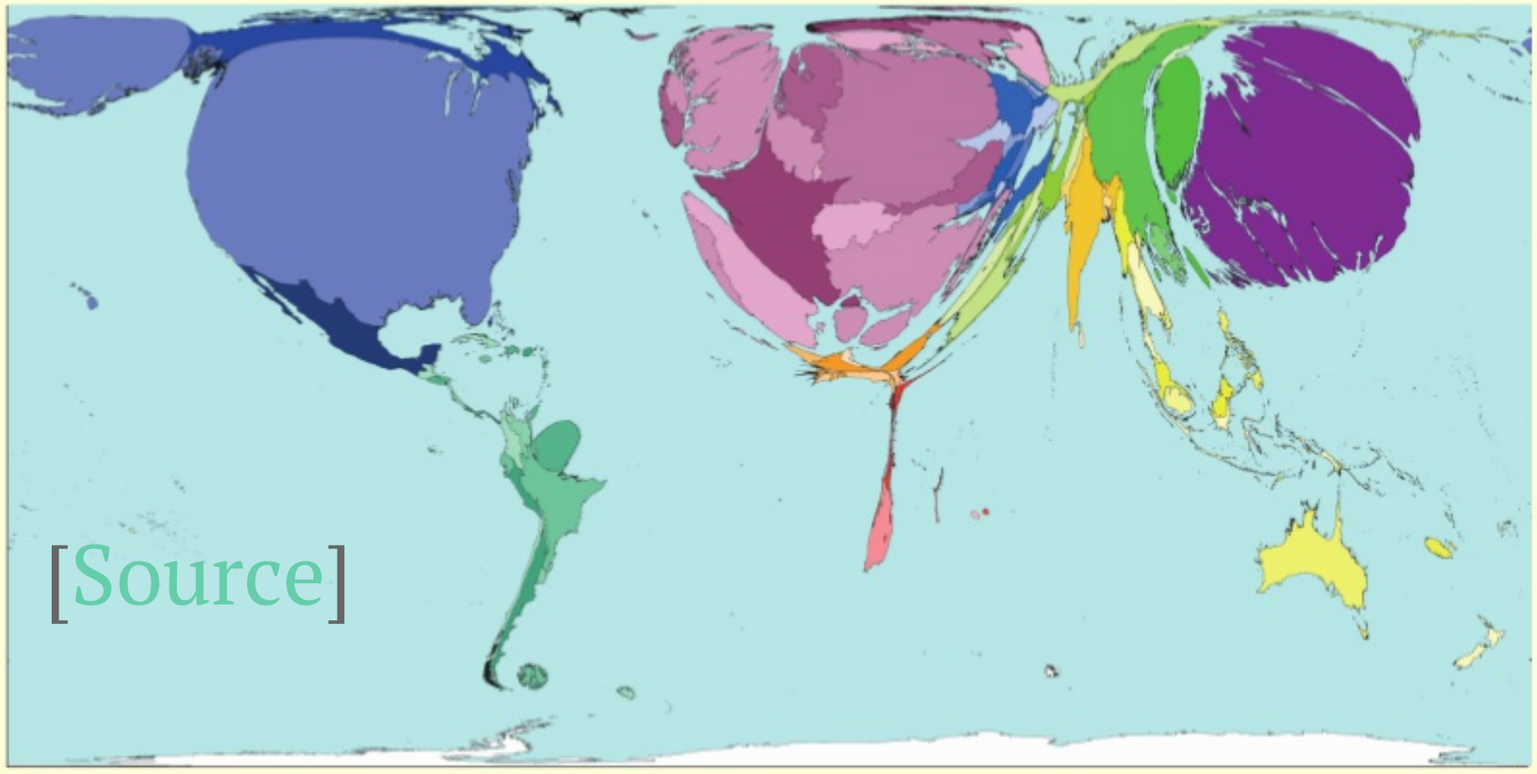




Capital Consumption

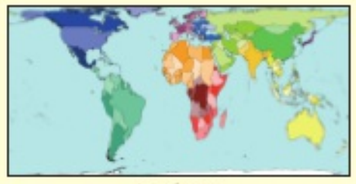
The University Of Sheffield. The Leverhulme Trust Geographical Association
Produced by the SASI group (Sheffield) and Mark Newman (Michigan)



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

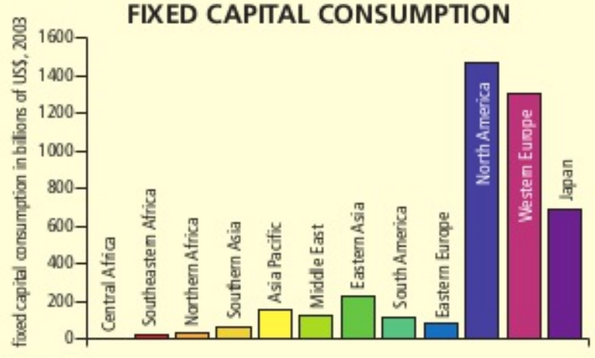
Technical notes
- Data are from the World Bank's 2005 World Development Indicators.
- See website for further information.

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

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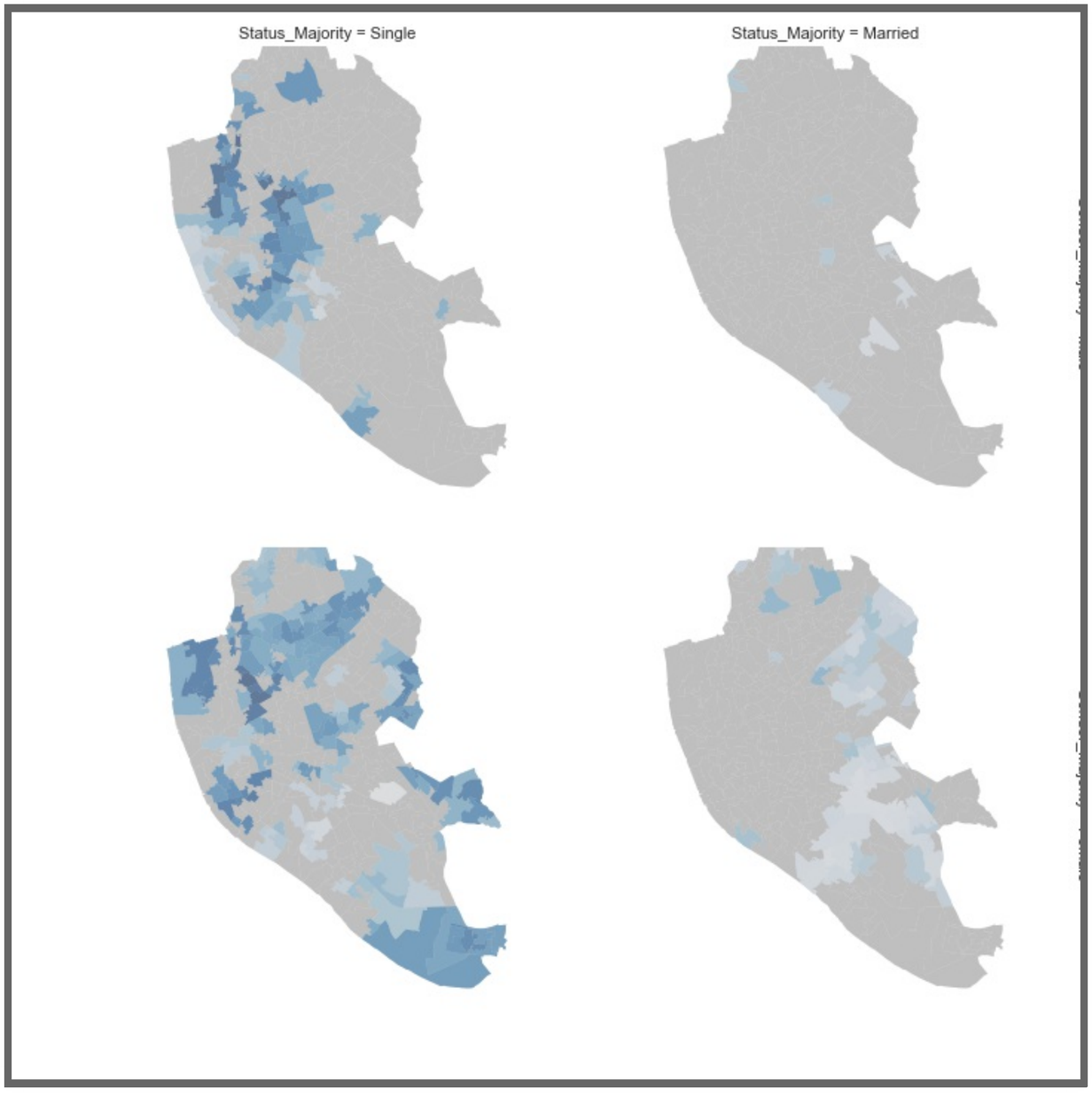
Conditional maps

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
- More recently

Space-Time mapping

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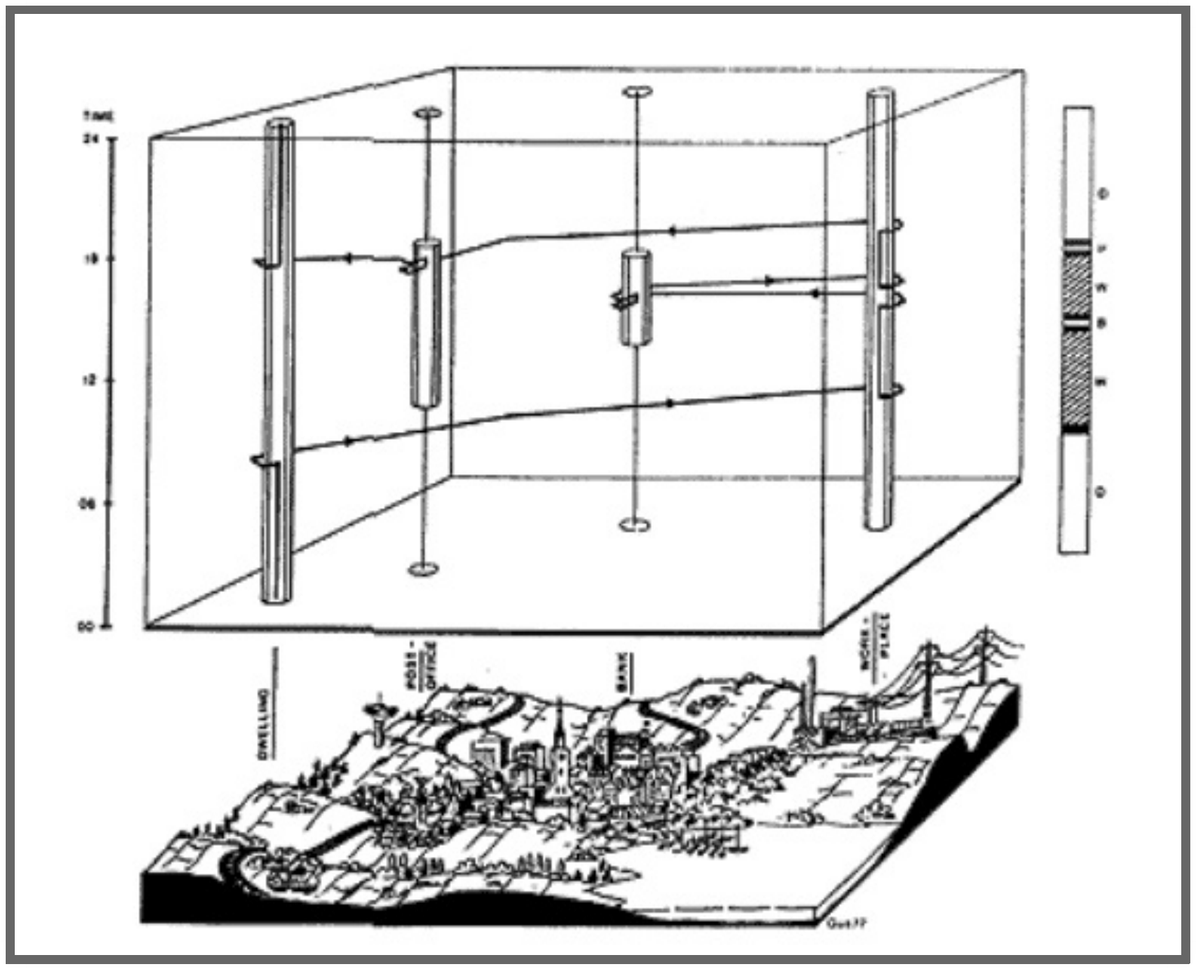
- Traditionally --> sequence of time periods, 3D plots
- More recently

Space-Time mapping

- Bringing time into a spatial 2D context is "tricky" (it's really 3D!)
- Traditionally --> sequence of time periods, 3D plots
- More recently --> animation and interactivity

[Source]



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Greenland
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Norway
Finland
Sweden
Estonia
Latvia
Lithuania
Belarus
United Kingdom
Poland
Germany
Czech Rep.
Ukraine
Kazakhstan
France
Austria
Croatia
Romania
Italy
Bulgaria
Georgia
Azerbaijan
Uzbekistan
Kyrgyzstan
Turkmenistan
Tajikistan
Spain
Greece
Turkey
[Source]
Syria
Iraq
Iran
Afghanistan
Pakistan
Nepal
India
Bangladesh
United Arab Emirates
Oman
Morocco
Algeria
Libya
Egypt
W. Sahara
Mauritania
Mali
Niger
Chad
Sudan
Eritrea
Yemen
Senegal
Burkina Faso
Guinea
Nigeria
Côte d'Ivoire
Ethiopia
S. Sudan
Cameroon
Somalia
Kenya
Congo
Dem. Rep. Congo
Tanzania
Angola
Zambia
Mozambique
Zimbabwe
Madagascar
Botswana
South Africa
Cuba
Honduras
Panama
Venezuela
Guyana
Colombia
Ecuador
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Leaflet | CartoDB

LA Metro Movement

Rapid Bus Lines

[Source]

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