

Basic graphs. Geospatial Visualization

Lecture 3

732A98

<https://www.ida.liu.se/~732A98/info/3/Lecture3.html#1>

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Density plots and box plots

What should be analysed?

- Density plot, histogram, violin plots
- Mean value or typical value
- Symmetry
- Variation
- Whether reminds some distribution
- Heavy/Light tailed
- One ore more modes
- Skewness

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Density plots and box plots

What should be analysed?

- Box plot
- Median
- Variation
- Outliers
- Symmetry
- Quantiles

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Density plots and box plots

Example: Visualizing miles per gallon depending on transmission type

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Scatter plot

- Y: dependent variable, X: independent variable
- Smoother is a good idea to have

Analysis:

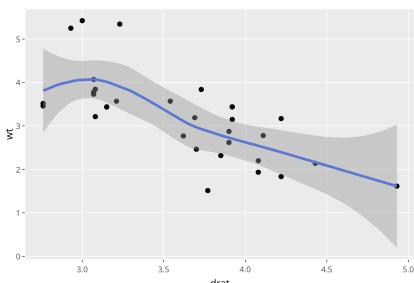
- Shape (data=true+error, true=linear, quadratic, cubic, exponential, ..., empirical)
 - How to find the right model?
 - Fitting the data (regression)
 - Analysis of residuals or model selection methods
- Strength (how close observations to a hypothesized model)
 - If linear, Correlation r or coefficient of determination R²

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Scatter plot

Example: Visualizing weight and rear axle ratio



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Scatter plot

Analysis:

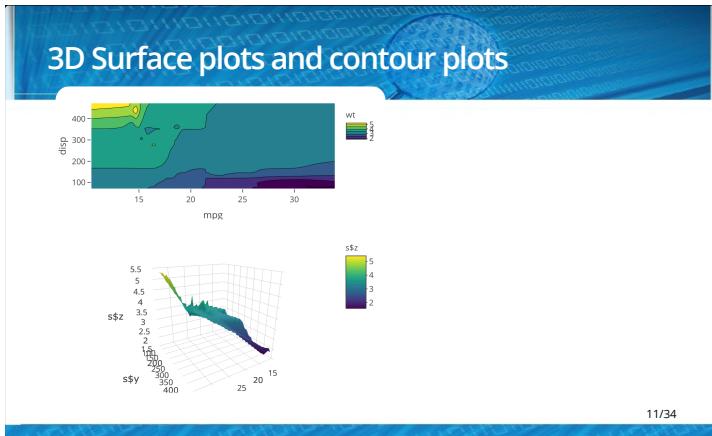
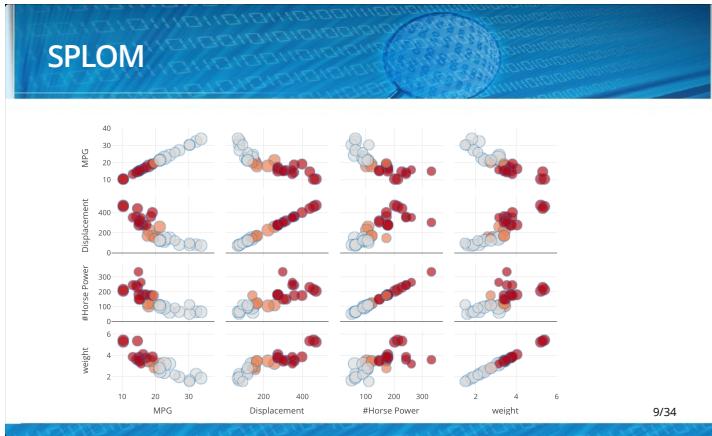
- Direction (if monotonic, decreasing or increasing; if not monotonic, which parts increasing, which decreasing)
- Density (dense areas, sparse areas)
- Outliers
- Clusters

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Scatter plot

- More variables can be mapped
- Mark shape
- Mark size
- Mark color
- Mark orientation
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- Juxtaposed displays or superimposed displays
- If juxtaposed displays used, we get scatterplot matrix

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3D Surface plots and contour plots

- Remember: interpolated data used

Analysis:

- Peaks and draughts
- Trends
- Additivity
- Always check the underlying data after

Geospatial data

- Geographical coordinates are involved
- Used in many applications
 - Climate modeling/analysis
 - Economic/social data analysis
 - Transaction data
 - ...

Spatial phenomena

- Point phenomena (ex: building location, city location)
- Line phenomena (paths, roads)
- Area phenomena (counties)
- Surface phenomenon (mountains)

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What is map?

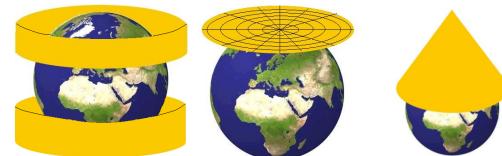
- Map coordinates:
 - longitude $\lambda = [-180, 180]$, negative=west
 - latitude $\phi = [-90, 90]$, negative= south
- Challenge: $[\lambda, \phi] \rightarrow [x, y]$
- Different map projections
 - Conformal projection: retains angles (shapes) but not area
 - Equal area: retains areas but not angles (shapes)
 - ...

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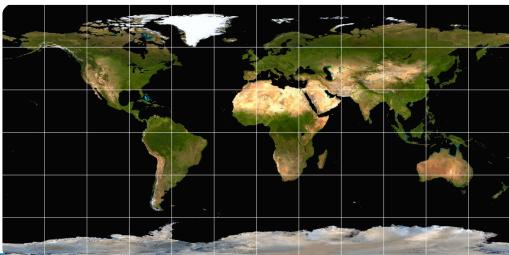
What is map?

- Cylindrical projection, plane projection and cone projection
- Cylindrical projection used by Google, standard now



Cylindrical projection

- Conformal projection: far northern/far southern areas inflated
- Defined by $x = \lambda, y = \phi$



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Cone projection

- Albers Equal-area projection
 - Preserves areas
 - Shapes or distances are not correct



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Visual variables for spatial data

	Size	Shape	Brightness	Color	Orientation	Spacing	Perspective height	Arrangement
Point	[dots]	[+/-]	[E/F]	[color swatches]	[diagonal lines]	[grid]	[3D arrows]	[overlaid patterns]
Linear	[wavy lines]	[dots]	[dashed/dotted]	[color swatches]	[diagonal lines]	[grid]	[3D arrows]	[overlaid patterns]
Areal	[cross-hatch]	[solid]	[diagonal]	[color swatches]	[diagonal]	[grid]	[3D arrows]	[overlaid patterns]

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Symbol/Dot maps

- Data= Latitude, Longitude+ Other variables
- Latt, Long->Coord, Other variables->Visual aesthetics
 - Amount is limited! (perception problems)
- Another approach: multiple parameters on multiple maps



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- Analysis:**

- Density in geogr areas and between geogr areas
- Spatial pattern of density (north, south)
- Clusters, outliers

- Problems:**

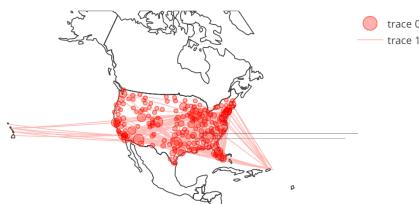
- Overplotting in highly populated areas
- If several observations have the same coordinate
- Size aesthetics used-> perception problem
- Perceived size depends on local neighborhood (Ebbinghaus illusion)

- Color used: color perception problems**

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- Observation: set of (Latt, Long) pairs+ other variables
- Often: start, end point



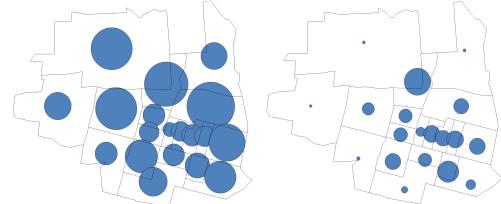
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Symbol/dot maps

- Problems:**

- Absolute vs relative mapping (proportional to population)

Absolute Population Density for Administrative Areas: Area-Relative Population Density:



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Line diagrams:

- Same as in network analysis plus geographical relationships between links and their density (size)
 - Where dense links located?
 - How links are directed?
- Problems:**
 - Overplotting
 - If line length analysed -> length perception problem
 - If width analysed -> volume perception problem
 - Colors analysed ->color perception problem

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Line diagrams

- Overplotting - possible solution:
 - Using curved lines, minimize edge crossing



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Choropleth maps

- Analysis:
 - Find clusters of regions that are similar
 - Find unusual regions (compared to neighbor regions)
 - Find patterns on the map
- Problems affecting perception:
 - Color/grayscale mapping
 - Choice of regions (county, state,...)
 - Larger region with the same color looks dominating
 - Patterns in small/densely populated areas hard to see

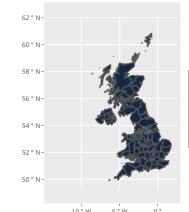
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Visualizing area data

- Data: Name/Coordinates of geographic area+ other variables
- Choropleth maps: variables=color or shaded region on map

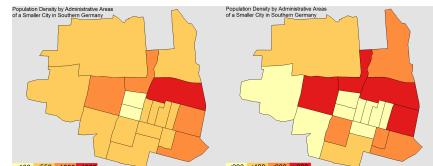


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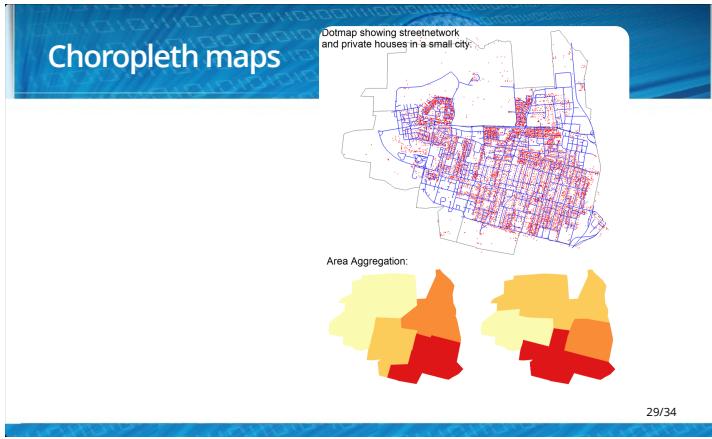
Choropleth maps



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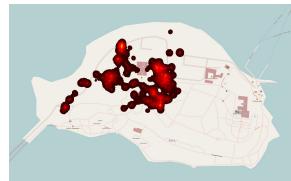
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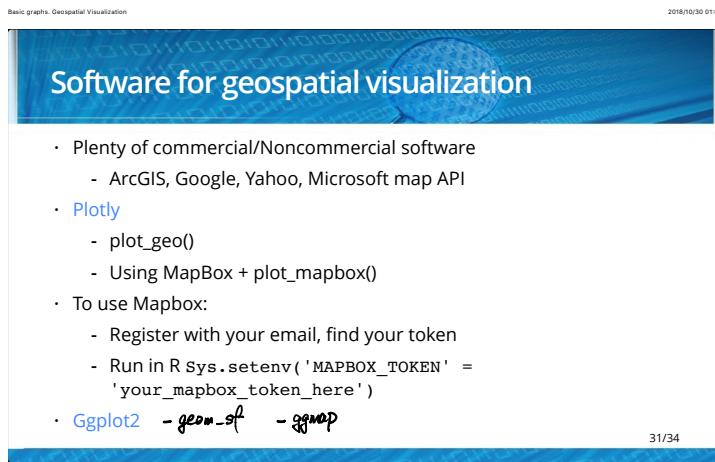


Visualizing area data

- Isarithmic maps: show areas of phenomenon on the map (density)
 - Contour map
 - Topographic map



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Using maps

- A few countries available through `plotly`
- Downloading map of a country:
 - Finding a country map <http://gadm.org/>
 - Decide what level of detailization is needed (region, county,...)
 - Download R(sf) file.
 - Load the file to R using `readRDS` function
 - e.g. `rds <- readRDS('filename.rds')`
 - Use with `ggplot() + geom_sf(data=rds)`
 - Use with Plotly: `plot_ly() + add_sf(data=rds)`

Finding locations

- Given addresses/city/county-> coordinates?
- Go to <http://www.gpsvisualizer.com/geocoder/>
- Create MapQuest Open Key
- Paste locations in separate rows

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Read home

- Chapter 6
- Plotly book, ch 2.2, 2.4 and 2.5

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