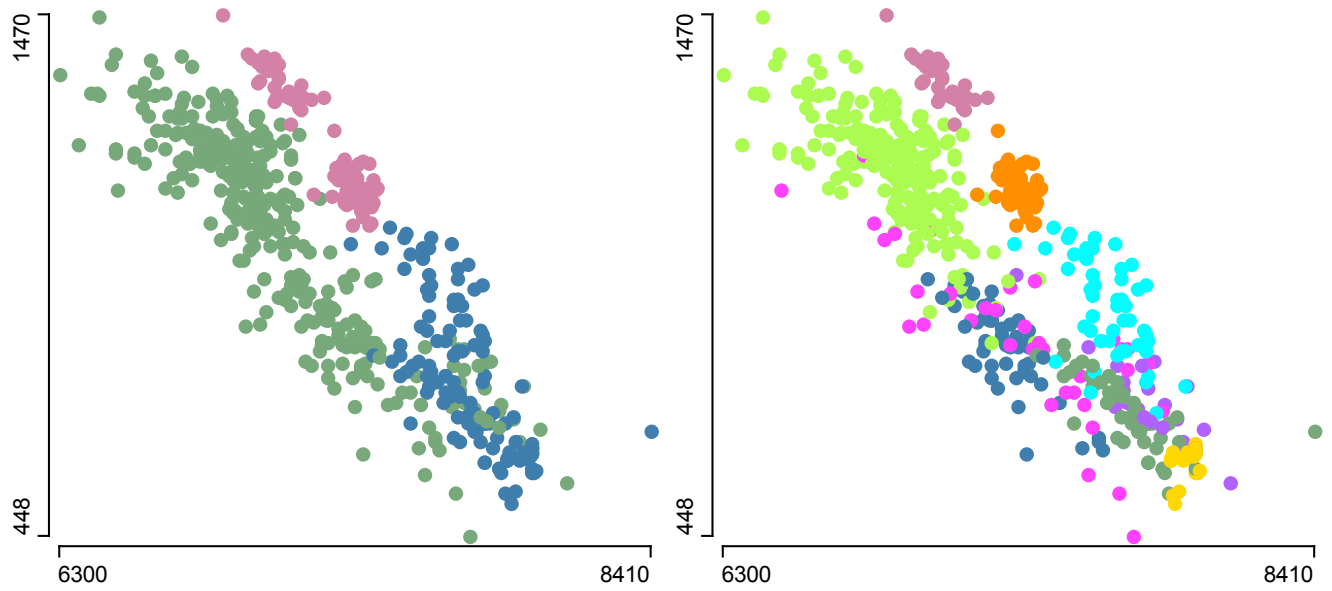
Selection vs. Brushing vs. Painting

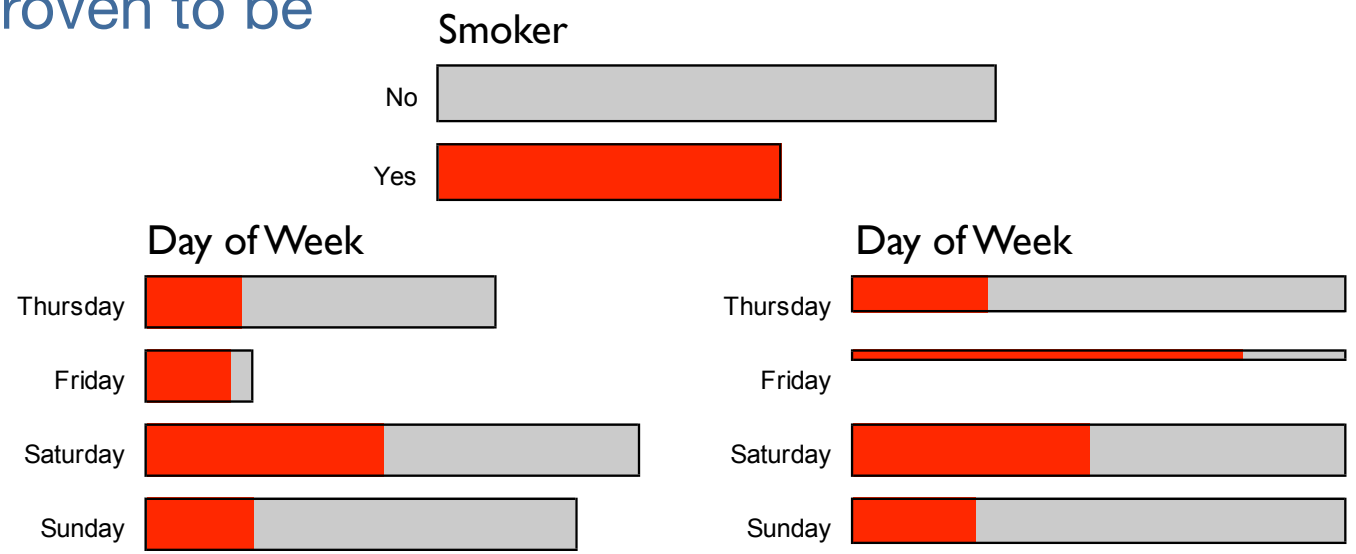
- It is important to clarify some of the terms that are often used as synonyms, although their meaning differs:
  - **Selections**
    Are transient and define one static subgroup
  - **Brushing**
    Is a selection performed dynamically we speak of brushing
  - **Painting**
    If the brushing action results in a persistent change of state (usually color), we speak of painting.



Highlighting

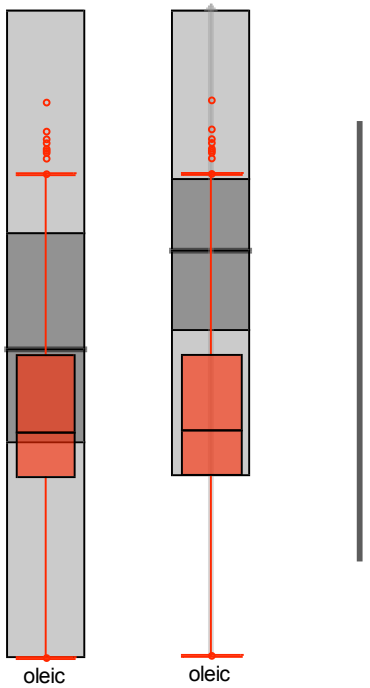
- Once a selection is defined, it needs to be propagated to all other plots
- All plots need to know how to highlight a subgroup
- Highlighting may be
  - **transient** (only changes when a new selection is performed)
  - **persistent** (a new state explicitly must be assigned to the involved cases)
- A clear rule how highlighting is performed is desirable, but exceptions have proven to be very powerful

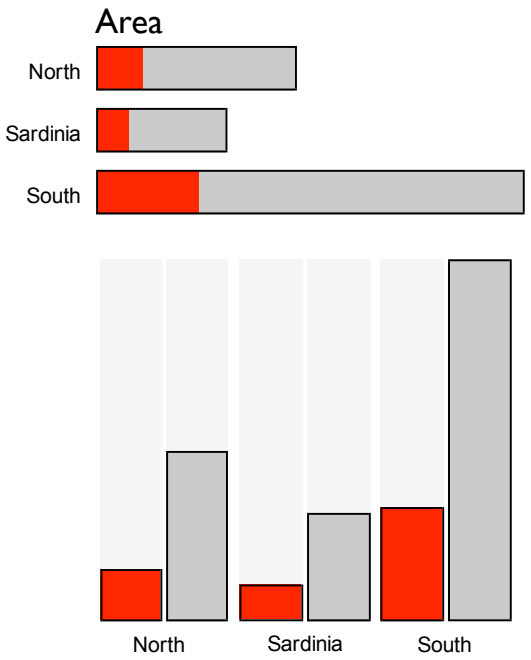
Example:
Barchart/Spineplot

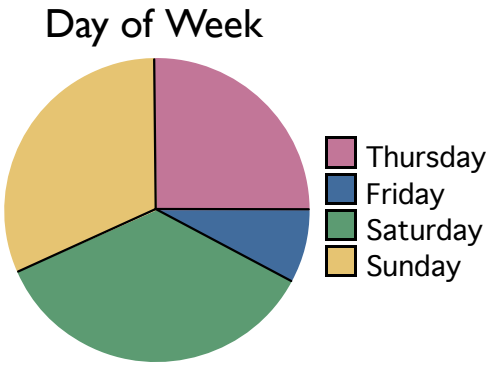


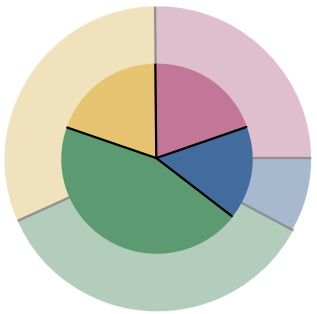
Highlighting: Generalizations and Limits

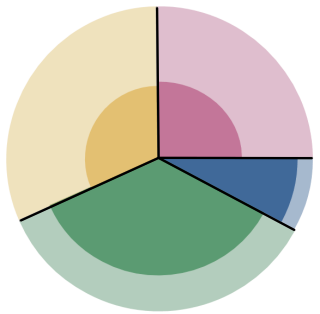
- Two major questions need to be clarified
  - Is the highlighting of the same kind as the plot itself?
  - To what should the selected subset be compared?
    (a) the complete sample or
    (b) the complement of the selection
    For many plots it does not matter, e.g. scatter plots, pcp …
  - Some plots are different, e.g. box-plot









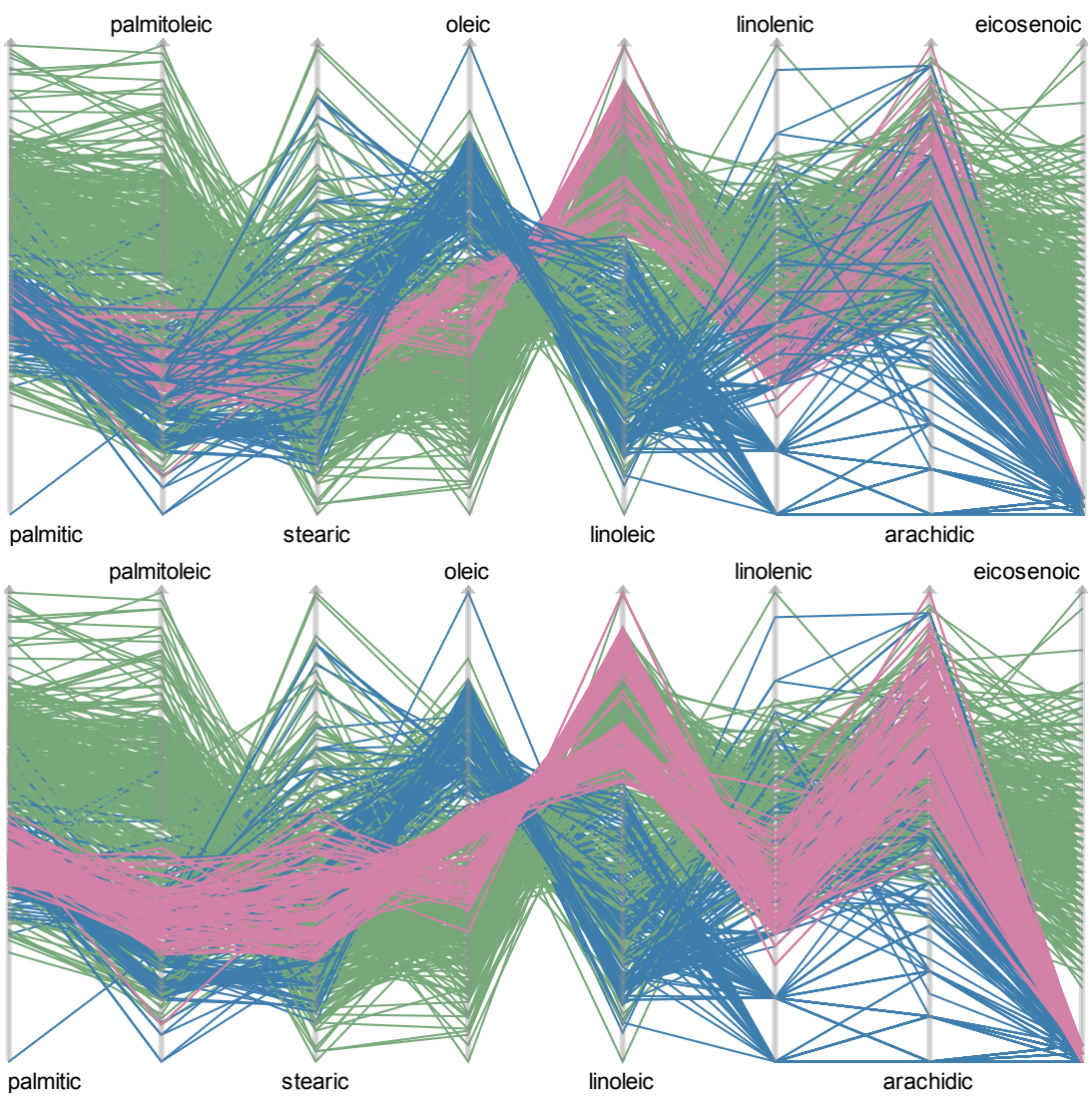


Highlighting vs. Color Brushing

- Selection and Highlighting essentially divide the data into two groups, i.e. a virtual binary variable is introduced
- In settings where we want to compare more than two groups simultaneously color brushing can be used
- Combining the two ways to mark groups has its problems …

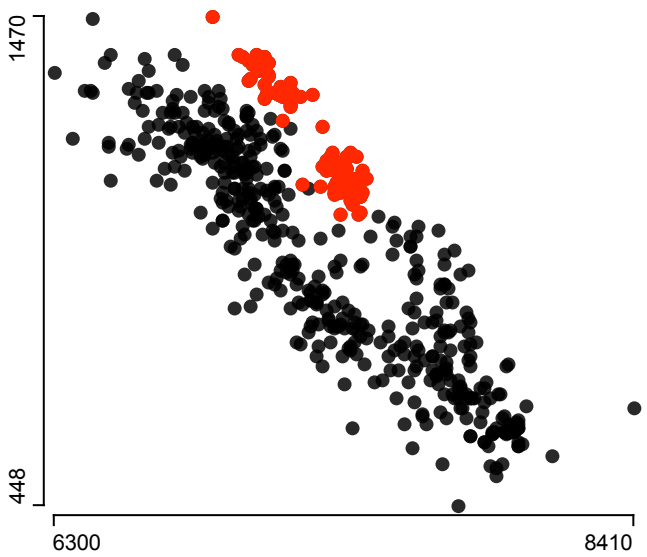
Color Brushing and Overplotting

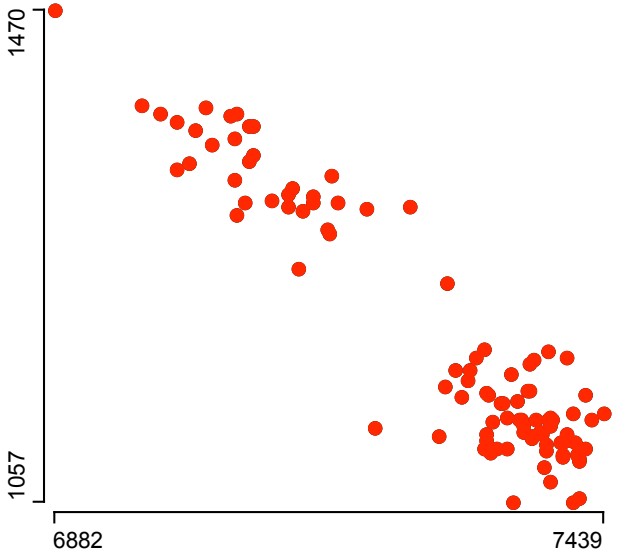
- When we work with more than just tiny datasets, we face overplotting problems
- Highlighting has the advantage that the highlighting group can always be plotted on top of the rest
- With more than one color the order in which the different groups are plotted is important and may result in very different views

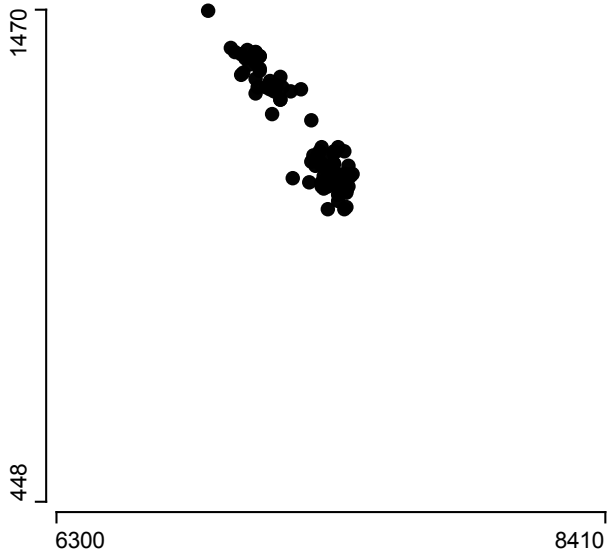


Hot-Selection and Shadowing

- **Hot-selection** mode is a property of a single plot and simply means that only currently selected cases are shown in a plot
- Hot-selection comes in two flavors:
  - fixed (respectively frozen) scale,
  - automatic scale, i.e., the scale is updated whenever the selection changes
- Shadowing (sometimes also referred to as ghosting) hides points in order to focus on the rest of the sample

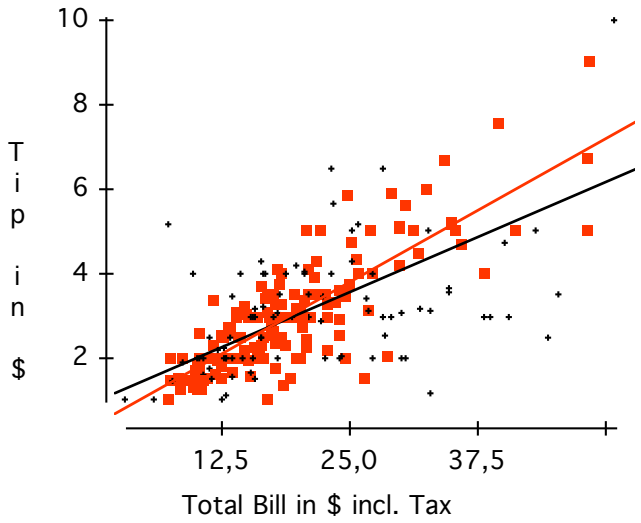






Linking beyond Graphics

- Linking is not limited to graphics, but can also be applied to statistical summaries, tests or even models
- Highlighting in data tables
- Fit models to the selected subset
- Link to model diagnostics
- Link variable properties
  - permutation of categories
  - scales



Dependent variable is: **Tip in $**
cases selected according to **Selected ClipBoard**
244 total cases of which 93 are missing
R squared = 67,6% R squared (adjusted) = 67,4%
s = 0,7866 with 151 - 2 = 149 degrees of freedom

Source	Sum of Squares	df	Mean Square	F-ratio
Regression	192,316	1	192,316	311
Residual	92,1818	149	0,618670	

Variable	Coefficient	s.e. of Coeff	t-ratio	prob
Constant	0,360069	0,1624	2,22	0,0281
Total Bill i...	0,137156	0,0078	17,6	≤ 0,0001

Interacting with Graphics: Direct Manipulation

- To explore "what-if scenarios", we need to be able to change selection states and plot parameters instantaneously
- We can roughly divide the possible interactions into

general interactions

  - Creating, and manipulating selections
  - Changing the order of objects
  - Changing scales (zooming)

plot specific interactions

  - Setting the anchor point and bin width of a histogram (bandwidth of a density estimate)
  - Changing the point size in a scatterplot
  - Flipping the axes in a scatterplot
  - Setting the smoothness of a scatterplot smoother
  - Switching the representation (relative or absolute) of a barchart/spineplot or histogram/spinogram
  - Changing the amount of α-blending applied to a glyph based plot

Interacting with Graphics: GUI

- The user interface must support an exploratory working style
- Modern GUIs offer many components that can be used to manipulate graphics