

Special structures

Time series

- Sequences of values over time
 - regular or irregular
 - discrete or continuous times
 - discrete or continuous values
 - univariate or multivariate
- Unemployment rates
- Share prices, share indices, consumer price indices
- Weather (temperature, wind, rain, ...), air pollution, tree rings
- Individual medical data (temperature, blood pressure, ...)

Examples

- Ngrams
 - books.google.com/ngrams/
- Share prices
 - uk.finance.yahoo.com/q?s=BMW.DE or [VOW.DE](http://uk.finance.yahoo.com/q?s=VOW.DE)
- Climate
 - google “hockey stick graph” and click on images

Time series — possible features

- Outliers (single or in groups, local v. global)
- Trend (longterm steady changes)
- Level changes (mean or variability)
- Sudden jumps
- Seasonality
- Cycles
- Stationarity
- ...

Time series — data

- Is the time series directly observable?
 - historical weather patterns, price indices
- Missing values
 - sometimes data do not exist (share prices at the weekend)
 - sometimes data can be constructed in retrospect (price indices), sometimes not (person's temperature)
- Arregation
 - rain per hour, per day
 - accidents per month, per week, per day, per hour
- Time scales
 - when during the day/month/year

Time series — dates

- Year/Month/Day/Hour/Minute/Second
- Formats for dates
 - cf. Excel
 - days since a specific date (useful for calculations)
 - Unix (1st January, 1970)
 - Office PC (31st December, 1899)
 - Office Mac (1st January, 1904)
 - SPSS (14th October, 1582, start of the Gregorian calendar)
 - SAS (1st January, 1960)
- Converting times to minutes or seconds

Time series plots

- Start, finish, scale
- Points, lines
- Aspect ratio
- Scaled to starting point, average, ...
- Plots of levels v. plots of rates
- Smoothers, models
 - detrended
 - deseasonalised
- Forecasts
- Multiple plots (cf. sparklines)

R classes and packages

- *Classes*
 - *ts*
 - *POSIXct*
 - *timeDate*
 - *timeSeries*
- *chron*
- *timeDate*
- *zoo*

Spatial data examples

- Election maps
 - polygons
 - cartograms
- Disease atlases
 - US cancer mortality (www3.cancer.gov/atlasplus/)
- Incident location maps
 - www.crimemapping.com
 - www.zeit.de/gesellschaft/zeitgeschehen/todesopfer-rechter-gewalt
 - www.citybeast.com/londoncyclists.html

Spatial data

- Points
- Lines (roads, flows, communications)
- Areas
- Neighbours
 - adjacent
 - by distance of centres
- Layers
- Storing geographic data — GIS
- R and spatial data:
 - cran.r-project.org/web/views/Spatial.html