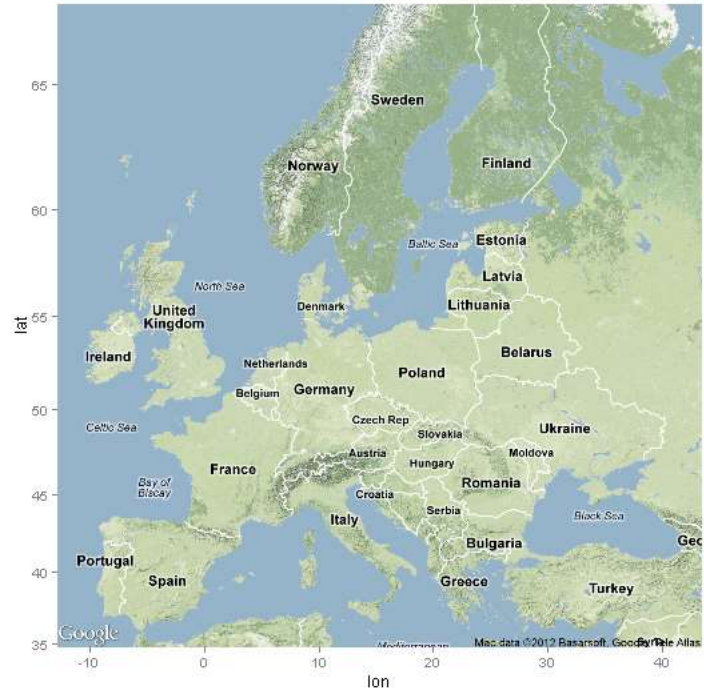


Time-series analysis for ecologists

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ILTER Lake Tovel



<https://lter-tovel.fmach.it/>

This workshop is not a technical introduction to statistics.
The workshop gives hints how time-series data can be analyzed.

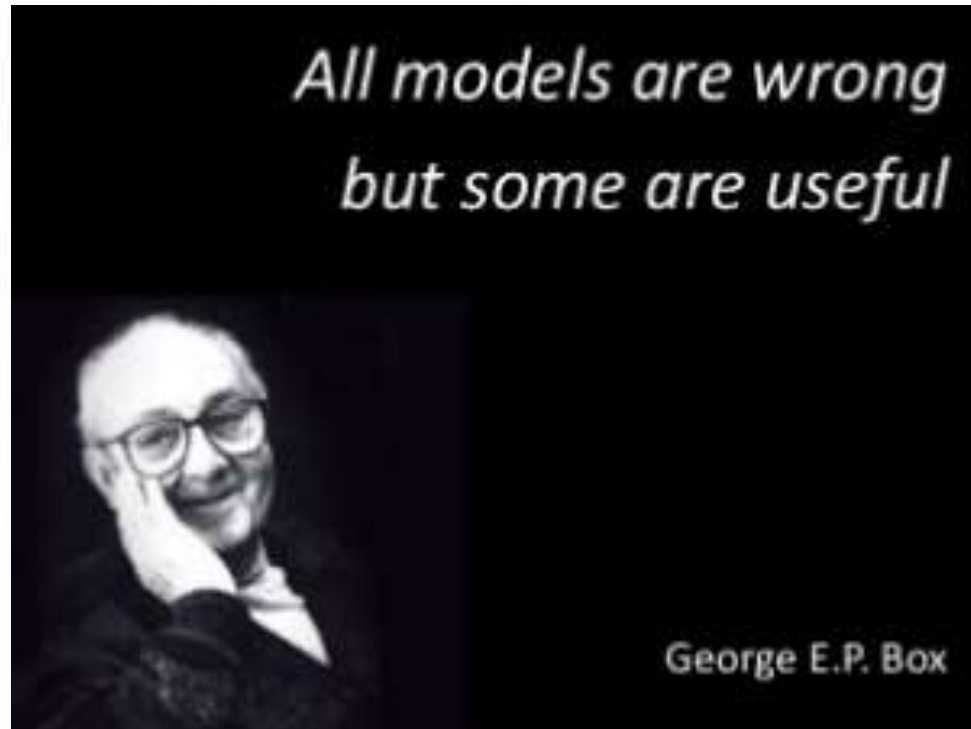


George Edward Pelham BOX

(18 October 1919 – 28 March 2013)

was a British statistician, who worked in the areas of quality control, time-series analysis, design of experiments, and Bayesian inference.

He has been called "*one of the great statistical minds of the 20th century*".



- Statistics is driving a car

Topics covered – outline

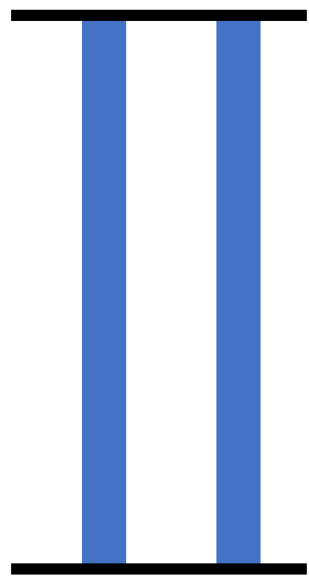
- Introduction on basic terminology
- Classic time-series analyses. Mann Kendall, Sen Theil trend estimation
- Change point analysis
- Modeling time-series with cosine trends
- GAM
- Clustering of time-series with DTW

Three centuries ago, Bishop Berkeley's 1710 classic “A treatise on the nature of human knowledge,” first spelled out the “correlation vs. causation” dilemma.

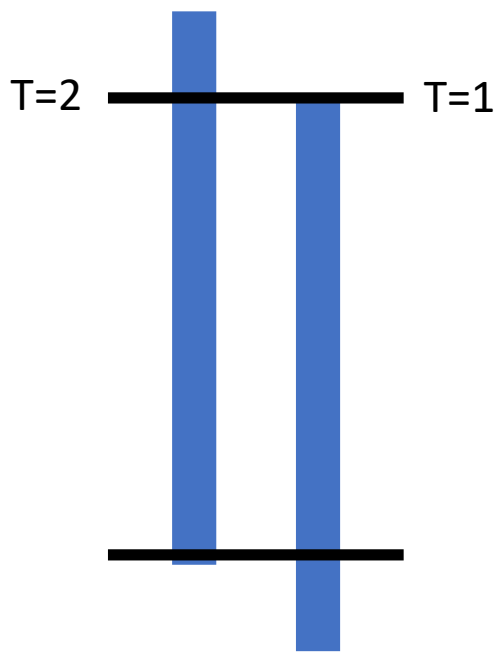
Residuals are your friends but neglecting them leads
to bad models

Every person has an own coding style

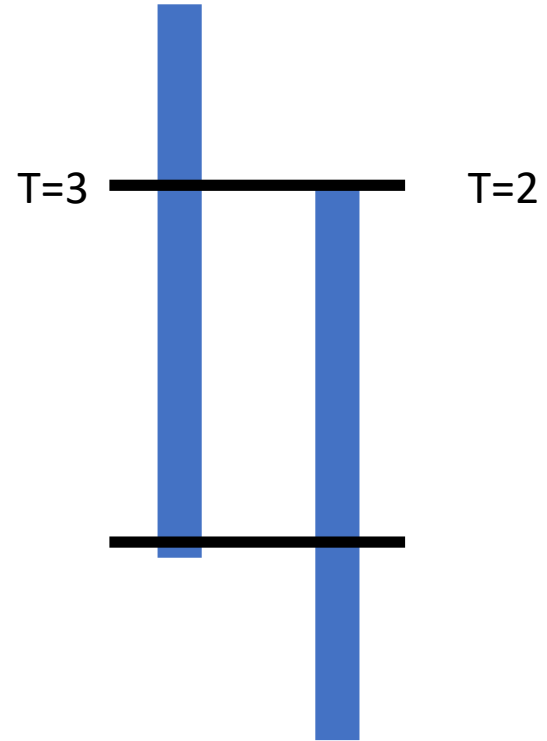
Autocorrelation



Lag=0



lag=1



lag=2

Correlation for the overlapping window

GAM is a non-parametric regression technique

$$y = \beta_0 + x_1\beta_1 + \varepsilon, \quad \varepsilon \sim N(0, \sigma^2)$$

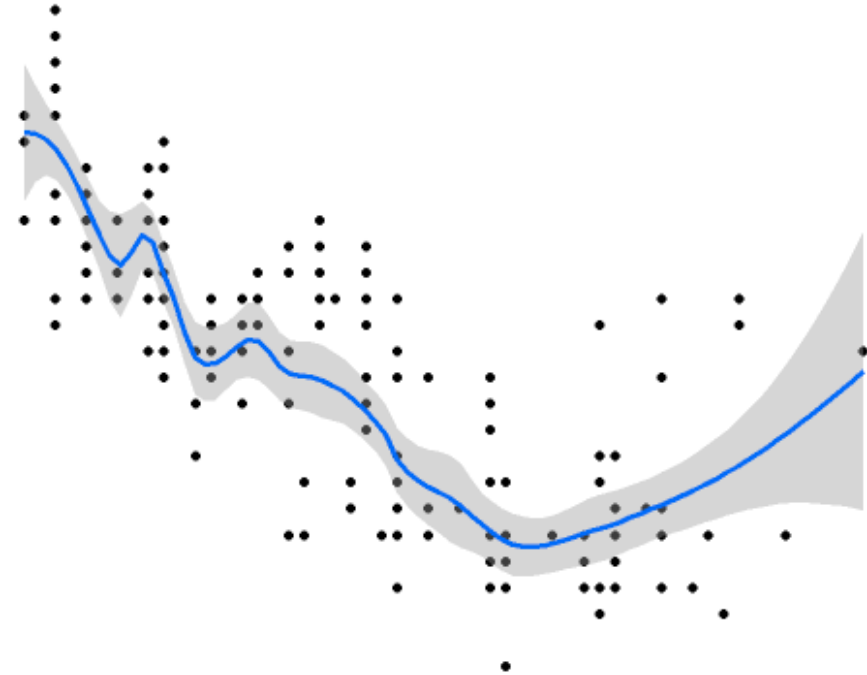
$$y = \beta_0 + f(x_1) + \varepsilon, \quad \varepsilon \sim N(0, \sigma^2)$$

thin plate regression spline

Cyclical cubic regression splines

the model is trying to balance two competing goals

- maximize the fit to the data
 - minimize wiggleness (overfitting).
- > penalized smoothing splines



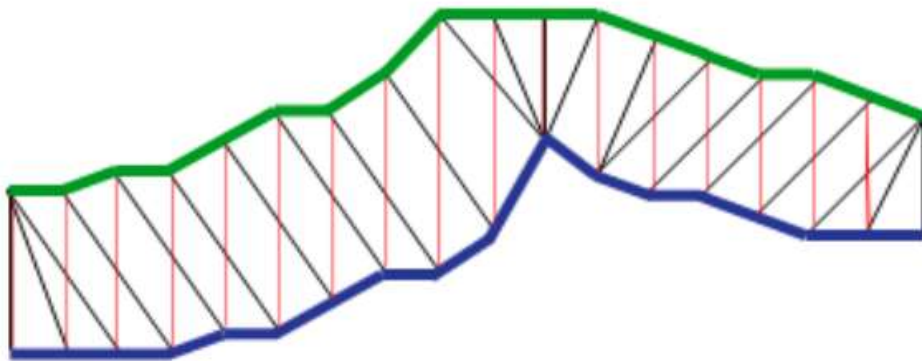
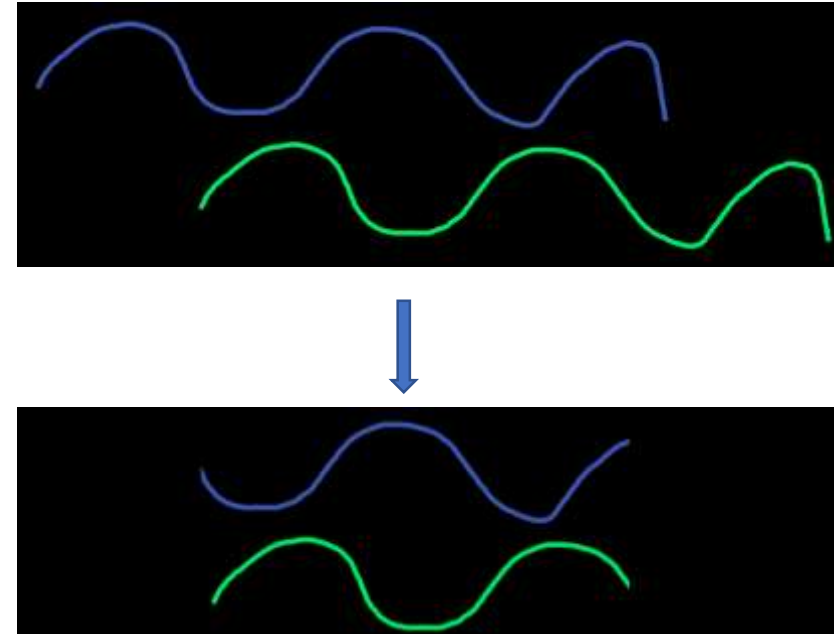


Fig. 1: Visual comparison of matched points based on DTW (black) and Euclidean (red) distance



In dtwclust, the native R function hclust is used; in hclust, each object is assigned to its own cluster and then the algorithm proceeds iteratively, at each stage joining the two most similar clusters, continuing until there is just a single cluster.

More advanced topics:
Wavelet analysis
Machine learning techniques
.....

Thanks for your attention
&
successful time-series analysis with R
&
stay healthy



western jackdaw (*Coloeus monedula*)