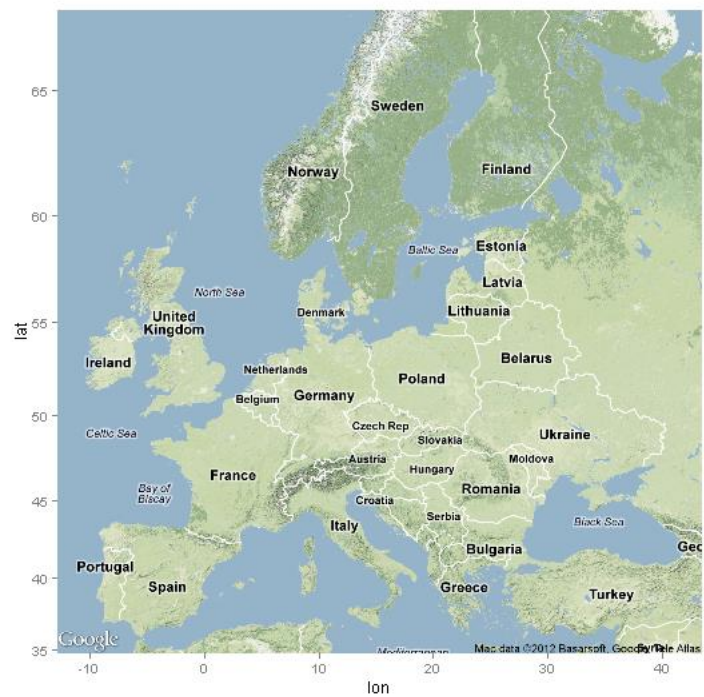


Time-series analysis for ecologists

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LTER 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.

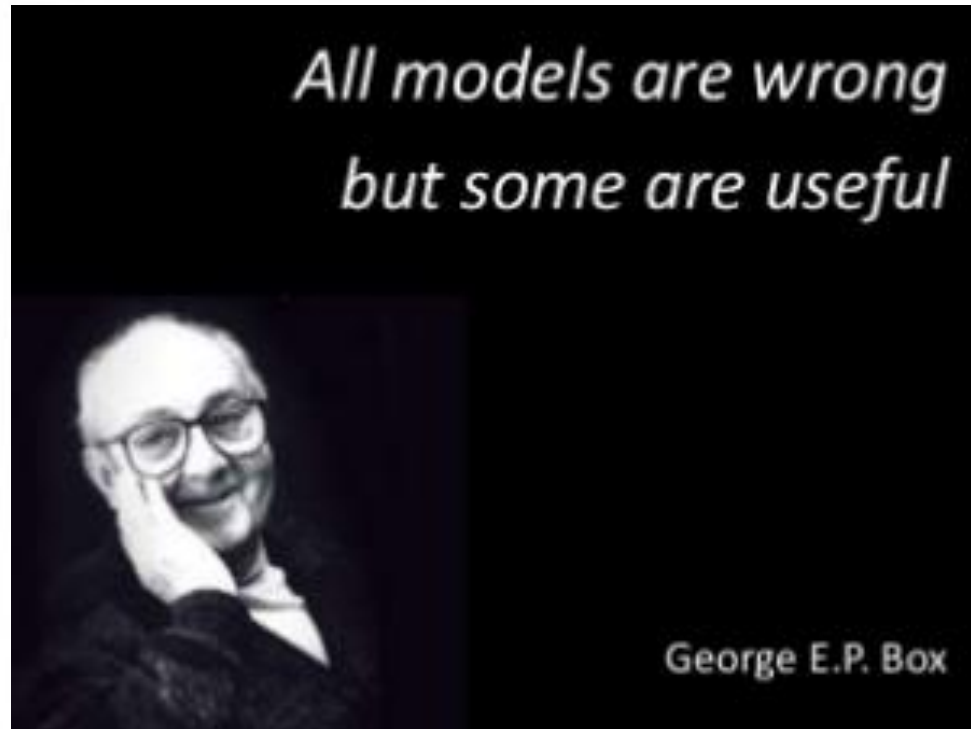


George Edward Pelham BOX

(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"*.

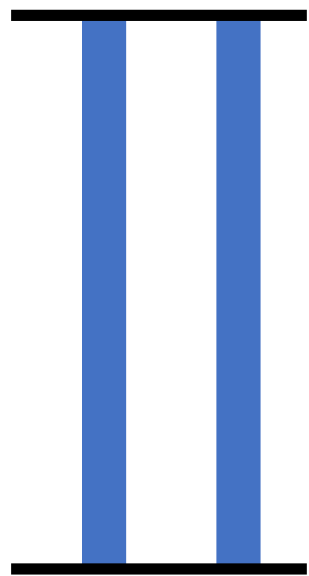


- Statistics is driving a car

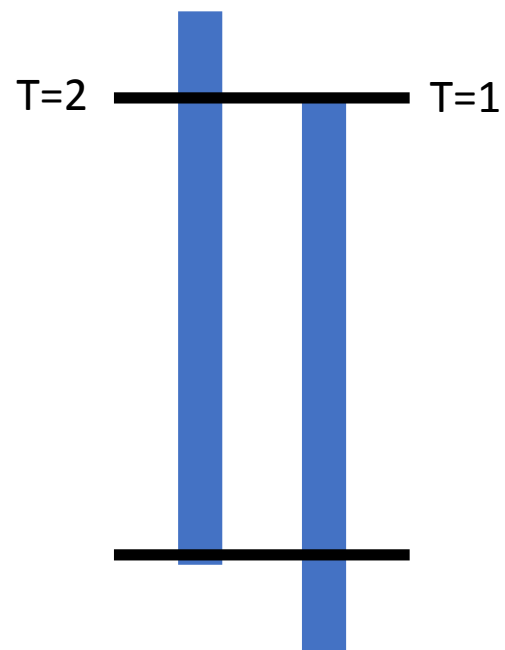
Topics covered – outline

- 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

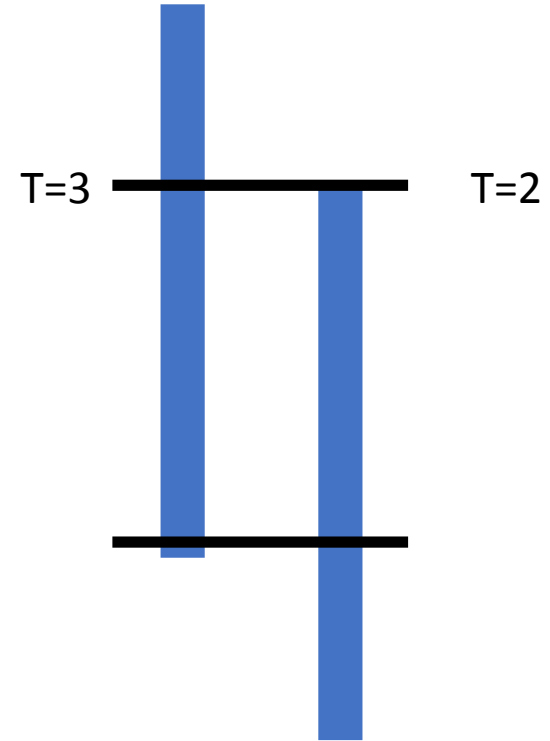
Autocorrelation



Lag=0



lag=1



lag=2

Correlation for the overlapping window

GAM is a non-parametric regression technique

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

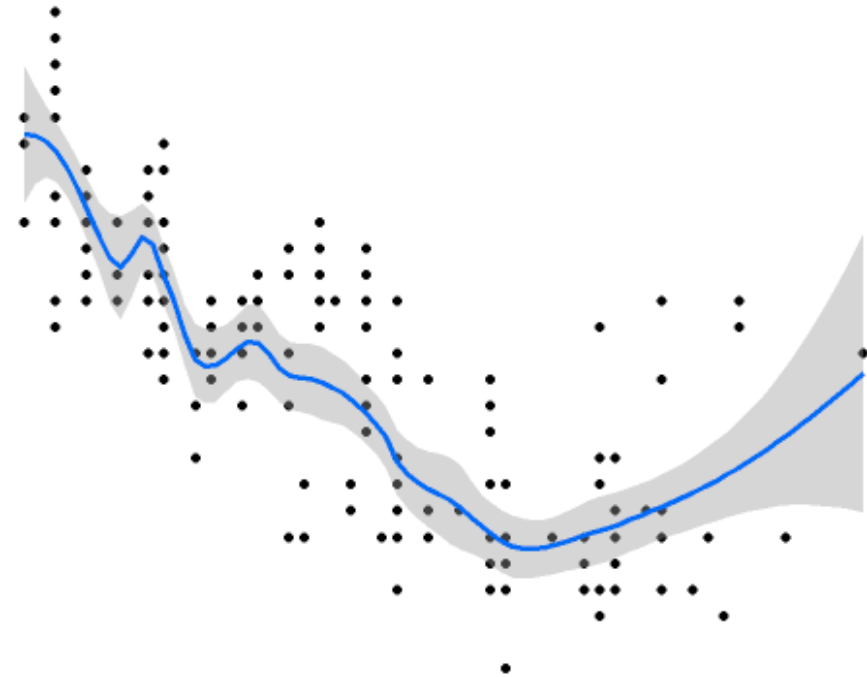
$$y = \beta_0 + f(x_1) + \varepsilon, \quad \varepsilon \sim N(0, \sigma^2)$$

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



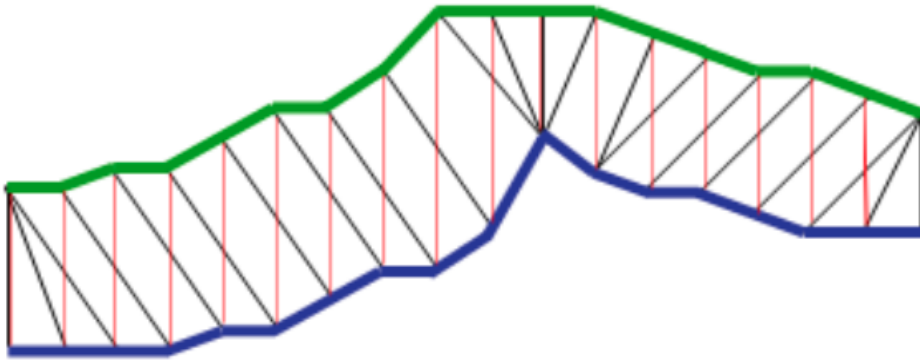
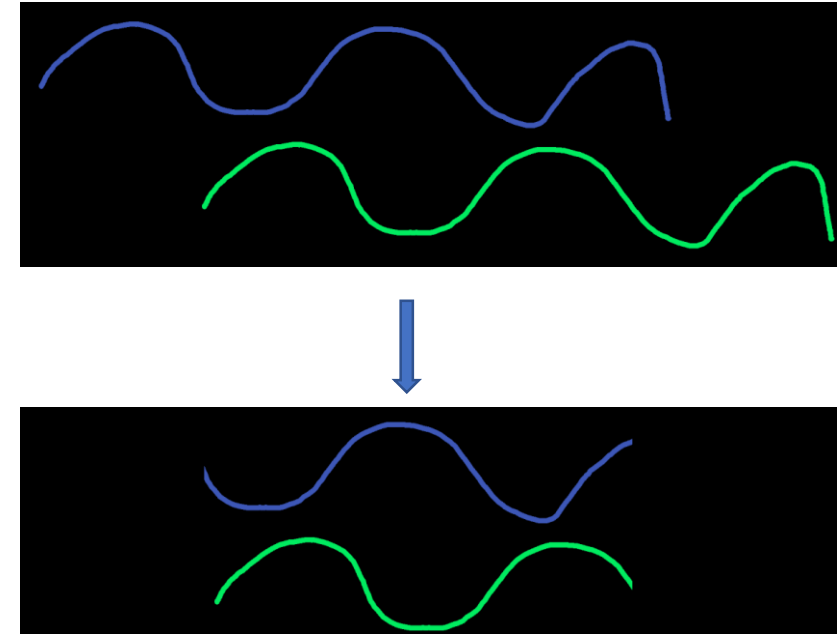


Fig. 1: Visual comparison of matched points based on DTW (black) and Euclidean (red) distance



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*)