Local analogue prediction method

- To make a prediction from $\boldsymbol{y}_t$:
- First define a local neighbourhood $B(\boldsymbol{y}_t)$ around $\boldsymbol{y}_t$
  - select k nearest neighbours from the learning data, or
  - select all nearest neighbours within distance r of $\boldsymbol{y}_t$, or
  - select a fraction of nearest neighbours from the learning data
- Local analogue: use the future of the nearest neighbour as the prediction,

$$\hat{y}_{t+1} = y_{j+1}, \text{ where } j \text{ minimizes } ||\boldsymbol{y}_t - \boldsymbol{y}_j||$$

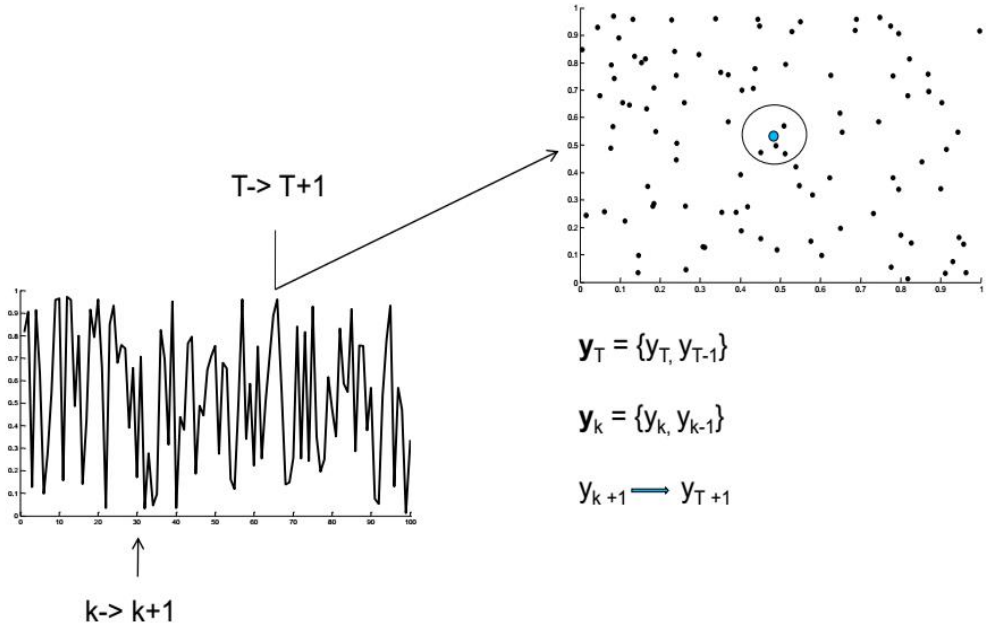
- Local average: use the average of the future of all neighbours found in the neighbourhood

$$\hat{y}_{t+1} = \frac{1}{|B(\boldsymbol{y}_t)|} \sum_{j \in B(\boldsymbol{y}_t)} y_{j+1}$$

where $|B(\boldsymbol{y}_t)|$ denotes the number of state vectors in $B(\boldsymbol{y}_t)$

- Any advantage of defining neighbourhood size in terms of k as opposed to r?

Random Analogue Prediction Model



Local analogue prediction method

- Note that as the number of neighbours tends to the total number of points in the training data set, the local average forecast becomes the unconditional mean
- Use cross-validation to estimate the optimal neighbourhood size by evaluating the model on out-of-sample data as a function of number of states (k) or radii (r) or fraction of states (f)
- Dynamically adaptive and can be used with data streams (easily updated)
- Random Analogue Prediction (RAP): Choose near neighbour at random and use its future as a prediction (stochastic prediction), proposed by Paparella et al. (1997)
- Weighted RAP (WRAP): Allot more weight to more recent and more similar states and estimate parameters using in-sample density forecast performance (Arora et al. 2013)

Local analogue prediction methods

- Once the analogues have been identified, one can either use the mean, median to issue a point forecast, or build a local linear model

- Underlying assumption: the dynamics underlying the time series follows a pattern, such that the trajectory of the time series from the current state would be quite similar to the trajectories of similar past states, given that a similar situation has been witnessed before

- Advantage: requires the estimation of very few parameters, generalizes well, and provides a nonlinear and nonparametric modelling framework

Applications of analogue prediction methods

Forecasting applications:

- Toth (1989) – weather
- Viboud et al. (2003) – spread of influenza epidemics
- Langmack et al. (2012) – cyclone tracks
- Arora et al. (2013) – US GNP
- Zubov et al. (2015) – temperature extremes