Implementation of Geographical and Temporal Weighted Regression(GTWR)

Author : jimmg35

(1) Data structure abstract

$$\boldsymbol{S_t} = \{b_{St}, b_{S(t-1)}, \dots, b_{S(t-q)}, b_{Tt}\}$$

(2) Objective function

$$\underset{S_t}{\mathbf{argmin}}\ \boldsymbol{CV}(S_t)$$

(3) Kernel function

$$\boldsymbol{\omega}^{\boldsymbol{t}}_{ijS,T} = \boldsymbol{exp}\left(-\frac{d^2_{S_{ij}}}{b^2_{St}}\right) * \boldsymbol{exp}\left(-\frac{d^2_{t_{ij}}}{b^2_{Tt}}\right)$$

(4) Bandwidth optimization algorithm

Algorithm 1 spatiotemporal weighted matrix optimization

Input: ***Lags***, time searching constraint. [0, 1, 2, 3, 4]
Input: **Set_{bt}**, temporal bandwidth set. [1, 2, 3, 4, 5]
for *t* in (start_year+1, end year) **do**
  for b_T in Set_{bt} **do**
    for *q* in *Lags* **do**
      while $CV_{S(t-q)}$ not converge **do**
        optimize $\boldsymbol{b_{S(t-q)}}$ using data points from time *t* <= *q* and fixed previous $\boldsymbol{b_{S(t-q)}}$.
      end while store best $\boldsymbol{b_{S(t-q)}}$ for time *t-q*.
    end for
    optimize CV of b_T.
  end for store best b_T and $[b_{St}, b_{S(t-1)}, \dots, b_{S(t-q)}]$ for *t*.
store constant of ***weight matrix for t***, using bandwidth set obtained above.
end for

(5) Fitting algorithm

Algorithm 2 GTWR fitting routine

Input: ***Lags,*** temporal bandwidth searching constraint.
Input: ***Opt,*** optimal spatial and temporal bandwidth.
for *t* in (start_year+1, end year) **do**
  retrive bandwidth in ***Opt*** → *t*.
  data chunk = *{t, t-1,…,t-Lags}*.
  for i(***data chunk***) **in** t **do**
    compute spatiotemporal weighted matrix with respect to i.
    compute MLE coefficients with respect to i.
  end for
end for