

How BlueBEAR helps Business School Research? From the Perspective of Econometrics

Machine Learning and AI Session for Business School and Economics

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Introduce Myself

- Binzhi Chen PhD in Economics (3rd year)
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- Research Interests:
 - Theoretical and Applied Econometrics
 - Panel Data
 - Group Patterns and Factor Models



Figure: Personal Website QR Code

My Research

Basic Grouped Fixed Effects Model:

$$y_{it} = \beta_1 x_{it-1} + \beta_2 x_{it-1}^2 + \beta_3 y_{it-1} + \mathbf{z}'_{it-1} \boldsymbol{\theta} + \alpha_{g_{it}} + v_{it} \quad (1)$$

g_i treats each unit as group membership and assigns them into the total number of G groups, as $g_i \in \{G_1, G_2, \dots, G_n\}$ and it is fixed over time. The number of groups is decided by an algorithm which is similar as the machine learning K-means algorithm.

GFE Extensions: with Heterogeneous Coefficient:

$$y_{it} = \beta_{g_i 1} x_{it-1} + \beta_{g_i 2} x_{it-1}^2 + \beta_3 y_{it-1} + \mathbf{z}'_{it-1} \boldsymbol{\theta} + \alpha_{g_{it}} + \eta_i + v_{it} \quad (2)$$

Algorithm GFE K-means Algorithm

- 1: Loop for $r = 1 : R$.
- 2: Let $(\theta^{(0)}, \alpha^{(0)})$ be some starting value. Set $s = 0$. (Initialization: Randomly assign each unit into the G groups and set up the starting value/simulations for θ and α .)
- 3: Compute for all $i \in \{1, \dots, N\}$: (We update the optimal group memberships)

$$g_i^{(s+1)} = \operatorname{argmin}_{g \in \{1, \dots, G\}} \sum_{t=1}^T \left(y_{it} - x'_{it} \theta^{(s)} - \alpha_{gt}^{(s)} \right)^2$$

- 4: Compute: (Then we use least squares to update the latest parameters.)

$$\left(\theta^{(s+1)}, \alpha^{(s+1)} \right) = \operatorname{argmin}_{(\theta, \alpha) \in \Theta \times \mathcal{A}^{GT}} \sum_{i=1}^N \sum_{t=1}^T \left(y_{it} - x'_{it} \theta - \alpha_{g_i^{(s+1)} t} \right)^2$$

- 5: Set $s = s + 1$ and go to Step 2 (Till it is numerical convergence in $L2$).
- 6: Set $r = r + 1$.

How BlueBEAR Helps Econometrician?

- Leave it to BlueBEAR and set your own computer free!
- No matter what kind of programming language you use
- Machine Learning with Parallel Computing
- Monte Carlo Simulation with Parallel Computing
 - Check the statistical properties (e.g., consistency and bias) of the estimator.
 - 1000 or more simulation under different large N and large T scenario.
 - 1000 or more bootstrap standard errors.

What if...

What if I am a student in Management? Marketing? Accounting?

What if I am currently using qualitative research method?

What if I am currently using basic quantitative research method?

How BlueBEAR Helps Business School?

- Mixed methods are popular.
- Traditional data → Big data.
- Maybe start by BlueBEAR Training?
- The Research Data Store, fast and secure.
- Treat it as an investment for your potential future research.



Figure: BEAR Training QR Code

Thanks for listening