Threshold boundary logistic regression with spatial and spatio-temporal covariates

Presenter: Chih-Hao Chang

Department of Statistics, National Chengchi University

This talk introduces the Threshold Boundary Logistic Regression (TBLR) model for binary data analysis, which flexibly incorporates spatial and spatio-temporal covariates into both logistic and threshold components. The threshold function, linear or nonlinear, defines a decision boundary that partitions the domain into regions governed by distinct logistic models. To estimate TBLR, we propose an iterative two-stage algorithm that reformulates the non-differentiable likelihood into an optimization framework. A weighted classification error guides threshold estimation, while logistic parameters are updated via maximum likelihood. For linear thresholds, we use Mixed-Integer Programming (MIP) with warm starts from Weighted Support Vector Machines (WSVM); WSVM also provides a practical alternative for nonlinear cases. Simulation and real-data examples demonstrate that incorporating spatial structure improves classification accuracy and reveals region-specific effects, making TBLR suitable for spatial applications such as environmental risk mapping and spatial epidemiology.Renewable energy has significant potential for future energy portfolios without negative environmental impacts. We analyze climate variables, such as wind vectors and wave height, around the Korean Peninsula from the fifth-generation ECMWF atmospheric reanalysis (ERA5). To model the spatio-temporal dynamics of these variables, we explore several modeling approaches, including trans-Gaussian processes, Fixed Rank Kriging, and/or deep learning models. The results provide practical insights into the optimal site selection for power generation and highlight the feasibility of renewable energy sources in South Korea.