敬請張貼

淡 江 大 學 統 計 學 系

學 術 演 講

講　題：Adaptive Calibrations of Spatially Misaligned IoT Data

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地　點：B302A（淡水校園商管大樓）

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摘 要

We address the challenging problem of calibrating geo-referenced data affected by spatial misalignment due to the use of multiple instruments for measuring the same variables. High-precision instruments are costly, while low-cost ones, though less accurate, are more widespread. Data fusion techniques are employed to combine these sources and extract more information, but spatial misalignment complicates direct application. To enable effective data fusion, it is essential to calibrate unreliable observations carefully, as uncalibrated data can introduce bias and noise.

Our proposed strategy focuses on calibrating fine particulate matter (PM2.5) data in Taiwan. We utilize two data sources: precise but sparse traditional monitoring stations, and low-cost, widely deployed IoT devices called AirBoxes, which are less reliable. A uniform calibration procedure for all AirBoxes is inadequate due to spatial variability and numerous outliers. Therefore, we develop a fast, robust method to model PM2.5

processes, accounting for data heterogeneity. We employ a spatially varying coefficient regression framework to calibrate AirBox measurements without requiring collocated data.

Our method provides spatially adaptive calibrations for AirBoxes, produces accurate PM2.5 concentration estimates at any location, and offers calibration formulas for new AirBoxes added to the network. Using hourly PM2.5 data from 2020, our calibration approach improves PM2.5 predictions by approximately 38% – 68% in root-mean-squared prediction error. This work offers a practical and reliable solution to the problem of spatial misalignment, enhancing the utility of data from multiple sources.

Keywords: Geostatistics; Robust estimation; Spatially varying coefficient model; Heterogeneous variance; Misalignment.