

ABSTRACT

Central Java Province consists of 35 regencies/cities with highly diverse budget expenditures and macroeconomic indicators, necessitating regional *clustering* as a foundation for formulating targeted development policies. This study applies a two-stage *clustering* approach based on Self-Organizing Map (SOM) and K-Medoids using variables of regional expenditure realization, GRDP per capita, Open Unemployment Rate (TPT), percentage of poor population, and Human Development Index (HDI) in 2024. Multivariate outlier detection was conducted using Robust Mahalanobis Distance based on Minimum Covariance Determinant (MCD), hyperparameter optimization was performed via Grid Search, and the optimal number of clusters was determined using an aggregate score approach from the Silhouette Coefficient, Davies-Bouldin Index, DUNN, and *Balance Ratio*. The analysis identified Semarang City as an extreme outlier with a robust Mahalanobis distance value of 2,228.039, thereby designating it as a standalone exclusive cluster. Meanwhile, the optimal SOM configuration was obtained on a 3×4 grid with 6,000 iterations and a Quantization Error of 1.0498. *Clustering* of the remaining 34 regencies/cities yielded the best aggregate score at K=2 for the optimal cluster. Cluster 1 consists of 28 regencies/cities with an average HDI of 75.2 and TPT of 3.94%. Conversely, Cluster 2 encompasses 6 regencies in the western region of Central Java (Banyumas, Batang, Brebes, Cilacap, Pemalang, and Tegal) which, despite having higher budget expenditures and GRDP per capita, recorded a TPT of 7.03%, a poverty rate of 11.4%, and a lower HDI of 70.9. This indicates that the scale of the budget has not yet fully impacted the improvement of public welfare.

Keywords: Macroeconomic indicators, Self-Organizing Map, K-Medoids, *Robust Mahalanobis Distance*, regional expenditure realization.