

Extended Abstract | Proceedings of the 1st International Conference on Sustainable Economies and Inclusive Growth

Optimization of Depopulation Prediction in Castilla-La Mancha Using Neural Networks and Geostatistics

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KEYWORDS

Deep Kriging Covariance, Geostatistics, Neural Network, Depopulation, Semivariogram, Radial Basis Functions

ARTICLE HISTORY

Published: 11 July 2026

Depopulation in rural areas of Castilla-La Mancha is a complex phenomenon characterized by strong spatial dependence and nonlinear dynamics that traditional statistical models often fail to capture accurately. This paper proposes the implementation of a deep learning architecture that integrates fundamental principles of classical geostatistics within the framework of neural networks. Unlike linear interpolation methods such as traditional Kriging, this approach uses radial basis functions based on the empirical semivariogram of the data, adjusted using theoretical covariance models, to transform geographic coordinates into a high-dimensional feature space. This integration allows the neural network to explicitly process the spatial correlation structure of the municipalities, simultaneously capturing local heterogeneities and global trends in population loss. Using municipal data from the region, the model incorporates parameters derived from a previous empirical fit to guide the network's learning. The results demonstrate that combining the flexibility of neural networks with the structural rigor of geostatistics improves predictive and mapping capabilities, providing a robust tool for identifying critical clusters of demographic vulnerability and supporting the design of public policies aimed at territorial cohesion in rural Spain.

Funding Statement

This work has been partially funded by the research group Applied Economics & Quantitative Methods (University of Castilla-La Mancha)

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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Cite as

Hidalgo-Arellano, I., Fernández-Avilés, G., & Montero, J. M. (2026). Optimization of Depopulation Prediction in Castilla-La Mancha Using Neural Networks and Geostatistics. In *Proceedings of the 1st International Conference on Sustainable Economies* (pp. 1–2). Business Research Proceedings. 10.51300/BRP-2026-15