

## Advancing Urban Sustainability through Data-Driven Machine Learning Solutions

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**Abstract :** With the ongoing urbanization, cities face increasing environmental challenges impacting human well-being. To tackle these issues, data-driven approaches in urban analysis have gained prominence, leveraging urban data to promote sustainability. Integrating Machine Learning techniques enables researchers to analyze and predict complex environmental phenomena like Urban Heat Island occurrences in urban areas. This paper demonstrates the implementation of data-driven approach and interpretable Machine Learning algorithms with interpretability techniques to conduct comprehensive data analyses for sustainable urban design. The developed framework and algorithms are demonstrated for Tallinn, Estonia to develop sustainable urban strategies to mitigate urban heat waves. Geospatial data, preprocessed and labeled with UHI levels, are used to train various ML models, with Logistic Regression emerging as the best-performing model based on evaluation metrics to derive a mathematical equation representing the area with UHI or without UHI effects, providing insights into UHI occurrences based on buildings and urban features. The derived formula highlights the importance of building volume, height, area, and shape length to create an urban environment with UHI impact. The data-driven approach and derived equation inform mitigation strategies and sustainable urban development in Tallinn and offer valuable guidance for other locations with varying climates.

**Keywords :** data-driven approach, machine learning transparent models, interpretable machine learning models, urban heat island effect

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