# Statistical modelling of space-time series of counts

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AutoRegressive and Moving Average (ARMA) models are fundamental tools in time series analysis, designed to capture the dynamics of time-dependent real-valued data. The ARMA models extend into the Spatial Temporal ARMA (STARMA) models, to handle data exhibiting both spatial and temporal dependencies. For non-negative integer-valued data, the INARMA counterpart mimics the ARMA structure while keeping the integer nature of the data. This is achieved by replacing the multiplication with a discrete operator (such as the binomial thinning) and using a discrete distribution for the innovation process.

This research introduces a new class of statistical models for space-time series of counts. The novel class is addressed as STINARMA and connects with existing ARMA-based classes. On one hand, it is an integer counterpart of the STARMA based on the binomial thinning operator and, on the other hand, it is a STARMA-type extension of the INARMA class. The work established the theoretical properties of the new models, including first- and second-order moments, and defined estimation approaches (like moment-based and conditional maximum likelihood) with evaluation in finite samples. The STINARMA models are broadly applicable to fields using space-time count data. One ongoing application focuses on analysing the daily number of hospital admissions across Portugal. These models integrate meteorological and environmental covariates to assess their impact on admissions, shedding light on the distributive (environmental) justice within our country.

This work has been disseminated in several scientific conferences (2023 European Meeting of Statisticians, 2023 European Young Statisticians Meetings, 2023 Congresso da Sociedade Portuguesa de Estatística, 2024 Workshop on Stochastic Models, Statistics and Their Applications and 2024 Bernoulli-IMS World Congress in Probability and Statistics) and journal publications (Electronic Journal of Statistics, DOI: 10.1214/23-EJS2183).

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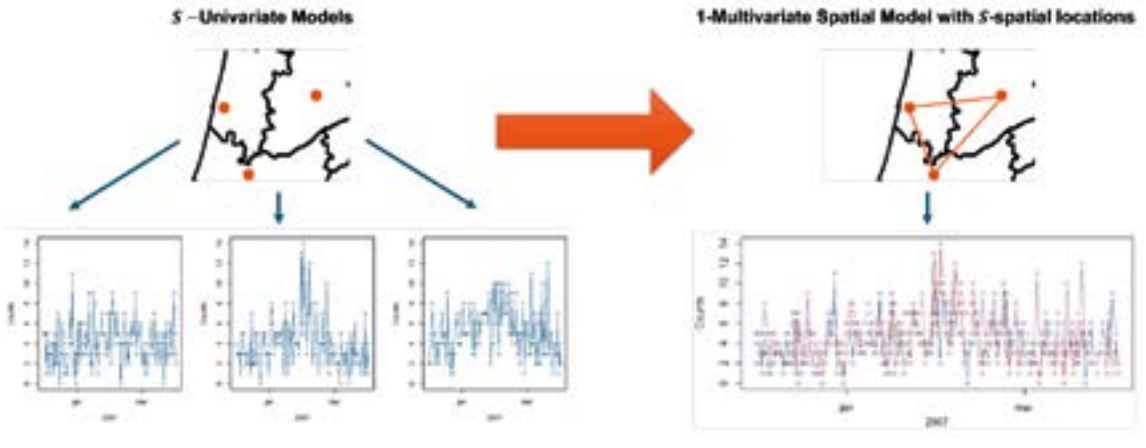


FIGURE 1
Scheme representing the univariate (left) and the multivariate spatial (right) modelling approaches.