# Semiparametric Time Series Regression – Mixed Additive Spline Fourier (STSR MASF): An Innovative Framework for PM2.5 and PM10 Analysis in Jakarta, Indonesia toward SDG Targets

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## Abstract

Particulate Matter (PM) is a critical issue in environmental quality and public health. Two common particulate indicators are PM2.5 and PM10, as both reflect the level of air pollution resulting from human activities as well as natural processes. This study aims to understand the dynamics of PM2.5 and PM10 variations using the STSR–MASF. The STSR–MASF model represents an innovative development in time series modeling that combines the flexibility of semiparametric regression, balancing parametric and nonparametric components, with a mixed spline–Fourier estimator capable of capturing nonlinear patterns and periodic fluctuations. Daily PM2.5 and PM10 data from the Jagakarsa Station, Jakarta, covering the period from January to August 2025, were used, with 90% for training and 10% for testing. Model evaluation was conducted using Generalized Cross-Validation (GCV). The results indicate that the STSR–MASF model achieves accurate estimations and exhibits good predictive ability, effectively capturing the dynamics of particulate concentration. Based on the minimum GCV value, the optimal combination of knot points and oscillations was identified, reflecting the model's ability to effectively balance complexity and estimation error. These findings contribute to SDG 3 and SDG 11 by providing scientific insights to support policies aimed at controlling air pollution.