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SCALAR-ON-FUNCTION REGRESSION FOR MODELING CLIMATE VARIABLE ASSOCIATIONS

(*Regresi Skalar-Atas-Fungsi untuk Pemodelan Hubungan Pembolehubah Iklim*)

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ABSTRACT

This study aims to investigate the scalar-on-functional relationship through functional regression, focusing on scalar responses, total annual rainfall, and functional predictors represented by daily temperature curves within the context of Malaysia's climate patterns. The distinctiveness of Malaysia's tropical climate, marked by high humidity and consistent temperatures throughout the year, underscores the importance of understanding this relationship for accurate climate modeling and forecasting. A key component of this study is the application of a roughness penalty in constructing Fourier basis functions for temperature regression coefficients, which ensures a smooth and flexible representation of the temperature curves. The study will compare models with a limited number of basis functions against those with a larger number of basis functions supplemented by an additional roughness penalty. The analysis utilises climate data from twelve stations across Peninsular Malaysia, spanning 2010 to 2017. The findings indicate that models incorporating a roughness penalty demonstrate superior performance, as the penalty helps mitigate overfitting by controlling excessive complexity in the estimated functions. Moreover, the results underscore the significant interactions between rainfall and temperature over time, offering critical insights into the dynamics of the Malaysian climate. These insights potentially enhance the region's water resource management, agricultural planning, and climate adaptation strategies.

Keywords: functional regression; scalar-on-function; roughness penalty

ABSTRAK

Kajian ini bertujuan untuk menyiasat hubungan skalar-atas-fungsi melalui regresi fungsi, memfokuskan pada pembolehubah bersandar skalar, seperti jumlah hujan tahunan, dan fungsi pemboleh ubah penerang yang diwakili oleh lengkung suhu harian dalam konteks corak iklim Malaysia. Keistimewaan iklim tropika Malaysia, yang dicirikan dengan kelembapan yang tinggi dan suhu yang konsisten sepanjang tahun, menekankan kepentingan memahami hubungan ini untuk pemodelan dan ramalan iklim yang tepat. Komponen utama kajian ini ialah penggunaan dendaan kasar dalam membina fungsi asas Fourier untuk pekali regresi suhu, bagi memastikan perwakilan licin dan fleksibel bagi lengkung suhu. Kajian ini akan membandingkan model dengan bilangan fungsi asas yang terhad dengan model yang mempunyai bilangan fungsi asas yang lebih besar ditambah dengan dendaan kasar. Analisis menggunakan data iklim daripada dua belas stesen di seluruh Semenanjung Malaysia, merangkumi 2010 hingga 2017. Keputusan kajian menunjukkan bahawa model yang menggabungkan dendaan kasar mempamirkan prestasi yang lebih baik, kerana ia membantu mengurangkan isu terlebih padanan dengan mengawal kerumitan yang berlebihan dalam fungsi yang dianggarkan. Selain itu, keputusan kajian menekankan hubungan yang ketara antara hujan dan suhu dari masa ke masa, memberikan pandangan kritis dalam dinamik iklim Malaysia. Kajian ini berpotensi meningkatkan pengurusan sumber air, perancangan pertanian dan strategi penyesuaian iklim di rantau ini.

Kata kunci: fungsi regresi; regresi scalar atas fungsi; dendaan kasar

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