## EMPIRICAL LIKELIHOOD RATIO TESTS FOR VARYING COEFFICIENT GEO MODELS

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Abstract: In this study, we investigate varying-coefficient models for spatial data distributed over two-dimensional domains. First, we approximate the univariate components and the geographical component in the model using univariate polynomial splines and bivariate penalized splines over triangulation, respectively. The spline estimators of the univariate and bivariate functions are consistent, and their convergence rates are also established. Second, we propose empirical likelihood-based test procedures to conduct both pointwise and simultaneous inferences for the varying-coefficient functions. We derive the asymptotic distributions of the test statistics under the null and local alternative hypotheses. The proposed methods perform favorably in finite-sample applications, as we show in simulations and an application to adult obesity prevalence data in the United States.

*Key words and phrases:* B-spline, bivariate spline, empirical likelihood, Geo data, non-parametric hypothesis testing

## 1. Introduction

Varying-coefficient models (VCMs)'s introduced by Hastie and Tibshirani (1993), are regression models commonly applied to examine the interactive associations between a response and predictors. These models are appealing because the regression coefficients are allowed to vary as a smooth function of some variables of interest to detect nonlinear interactions. Because of their flexibility, VCMs have been widely applied in many scientific areas. See Fan and Zhang (2008) for a selective overview of the major methodological and theoretical developments on VCMs. This study focuses on VCMs for spatial data randomly distributed over an arbitrary geographical region.

Our work is motivated by inference problems examining the effects of the county-level food retail environment on obesity rates in United States, with the effect varying over median household income. County food retail environments

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