Beyond the Average: Random Slope Models for Revealing Territorial and Gender Inequalities

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Socioeconomic indicators based on regional averages often conceal important territorial and gender inequalities. This work shows how incorporating random slopes into Small Area Estimation models uncovers heterogeneous relationships between poverty, income, and their socioeconomic determinants across territories and population groups.

Using Spanish official data, the analyses reveal that the protective effect of higher education against poverty varies substantially across provinces and between men and women. Likewise, the impact of unemployment and demographic factors differs across income groups, reflecting distinct socioeconomic dynamics. A longitudinal analysis of disposable income further highlights regional convergence alongside persistent gender disparities in economic growth.

These findings demonstrate that random slope models provide more than improved statistical fit: they reveal meaningful socioeconomic heterogeneity that can support more effective, place-based, and gender-sensitive public policies.

Randomization Inference on Policy Assignments

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Placebo randomization tests are becoming a widely used statistical approach in empirical economics.

Common examples include difference-in-differences designs, where researchers randomize the labels of treatment and control groups, as well as regression discontinuity and bunching designs, where researchers randomize the discontinuity point. It is understood that this testing procedure has exact size control in finite samples under the sharp null hypothesis. However, size control requires researchers to know the distribution of the policy assignment, that is, the data generating process that assigns individuals intro treatment and control groups. This paper proposes a new placebo randomization test that relaxes this requirement. Our test controls size in large samples under arbitrary misspecification of the policy distribution, while it controls size exactly in finite samples when the policy distribution is correctly specified. The paper makes two additional contributions. First, we demonstrate that in designs prone to biased test statistics --- such as regression discontinuity and bunching --- the size distortion of our test does not necessarily increase with the bias. Second, we address settings where statistics evaluated at all placebos are perfectly collinear and thus not exchangeable, a problem that arises in difference-in-differences. We show how to implement our test in these cases while maintaining its size control features.

Simulations show desirable finite sample.

Becker's models for mixture experiments: An A-optimal approach

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In this article, we have investigated the derivation of weight expressions for the A-optimal designs for Becker's models using the weighted simplex-centroid design approach and established a comprehensive generalized form for these weights. Employing the equivalence theorem, we have validated the derived allocations as A-optimal designs. Furthermore, we have conducted a comparative efficiency analysis against the D-optimal design, shedding light on the performance disparities between the two methodologies.

Inference for GMANOVA model for Volatile Data

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The Generalized Multivariate Analysis of Variance (GMANOVA) model is widely used for analyzing longitudinal and growth curve data with structured mean profiles, where both the between (groups) and within individual (across time) design matrices areincorporated in a bilinear set up.The classical inference for the GMANOVA model is developed under the distributional assumption of matrix-variate normality which makes it sensitive to skewed and volatile data.The objective of the study is to propose a robust inference for the GMANOVA model for data exhibiting volatility such as financial data, assuming the error matrix follows a matrix variate t. The Maximum Likelihood estimation of the unknown regression coefficient matrix B and unknown variance covariance matrix sigma is developed. Since the equations do not admit closed formed solutions, an iterative approach like Newton Raphson is carried out.To achieve this, the model is formulated via a hierarchical (latent variable structure) representation of the matrix variate t distribution. Three distinct iterative architectures are implemented and evaluated: the standard Newton Raphson method, the Expectation Maximization (EM) algorithm and the Expectation- Conditional Maximization Either (ECME) algorithm.the simulation performance of the proposed t-based iterative estimators demonstrates strong robust alternatives with significantly lower MSE and numerical stability.Future work includes developing hypothesis testing procedures.