

# COMPUTING COLLOQUIUM

## Balancing Flexibility and Interpretability: A Conditional Linear Model Estimation via Random Forests

Friday, November 15

10:30 a.m.

City Center Plaza 259

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Traditional parametric econometric models often rely on rigid functional forms, while nonparametric techniques, despite their flexibility, often lack interpretability. This paper proposes a parsimonious alternative by modeling the outcome  $Y$  as a linear function of a vector of variables of interest  $X$ , conditional on additional covariates  $Z$ . Specifically, the conditional expectation is expressed as  $[Y | X, Z] = X \beta(Z)$ , where  $\beta(\cdot)$  is an unknown Lipschitz-continuous function. We introduce an adaptation of the Random Forest (RF) algorithm to estimate this model, striking a balance between machine learning methods' flexibility and traditional linear models' interpretability. This approach addresses a key challenge in applied econometrics by accommodating heterogeneity in the relationship between covariates and outcomes. Furthermore, the heterogeneous partial effects of  $X$  on  $Y$  is given by  $\beta(\cdot)$  and can be directly estimated by our proposed method. Our framework unifies well-established parametric and nonparametric models, such as varying-coefficient, switching regression, and additive models. We provide theoretical guarantees, including pointwise and  $L_p$ -norm rates of convergence for the estimator, and establish a pointwise central limit theorem through subsampling, facilitating inference on the function  $\beta(\cdot)$ . We provide Monte Carlo simulation results to evaluate the finite-sample performance of the method.

**Marcelo C. Medeiros is a Professor of Economics at the University of Illinois at Urbana-Champaign, holding the Jorge Paulo Lemann Endowed Chair. Marcelo has a BA, MSc. and PhD in Electrical Engineering from PUC-Rio, with an emphasis on Statistics, Optimization, and Control Theory. His area of research is econometrics and data science, and he is particularly interested in the intersection between econometric/statistical theory and cutting-edge machine learning tools. He focuses his research on both theoretical developments and empirical applications in finance, macroeconomics, forecasting, and the evaluation of public policies, among other areas. Marcelo was elected Fellow of the Society of Financial Econometrics (SoFIE) in 2022 and serves as Associate Editor for the Journal of the American Statistical Association (Theory and Methods), the Journal of Business and Economic Statistics, the Journal of Financial Econometrics, and the Quarterly Review of Economics and Finance. Marcelo has published more than 50 papers in international peer-reviewed journals such as, for example, the Annals of Statistics, the Journal of the American Statistical Association, the Journal of Econometrics, the Journal of Business and Economic Statistics, Econometric Theory, the International Journal of Forecasting, and the Journal of Banking and Finance. Finally, Marcelo also serves as an external consultant for firms in Brazil and abroad.**



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