Thesis title: **Flexibility, Robustness and Discontinuity in Nonparametric Regression Approaches**

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Abstract:

In this thesis we focus on local polynomial estimation approaches of an unknown regression function while taking into account also some robust issues like a presence of outlying observations or heavy-tailed distributions of random errors as well. We will discuss the most common method used for such settings, so called local polynomial M-smoothers and we will present the main statistical properties and asymptotic inference for this method. The M-smoothers method is especially suitable for such cases because of its natural robust flavour, which can nicely deal with outliers as well as heavy-tailed distributed random errors.

Another important quality we will focus in this thesis on is a discontinuity issue where we allow for sudden changes (discontinuity points) in the unknown regression function or its derivatives respectively.

We will propose a discontinuity model with different variability structures for both independent and dependent random errors while the discontinuity points will be treated in a proper statistical way using one-sided M-smoothers estimates. We will propose a statistical test to decide if an estimated jump and its location are significant for the model they are not. Given the asymptotic distribution for the test statistic under the null hypothesis, which depends on some unknown quantities we will propose some bootstrap algorithms, which can be used to mimic the unknown distribution of interest. The appropriate bootstrap algorithms will be proposed for every considered model scenario and all necessary proofs will be provided.

Finally, the proposed methods and the stated results are tested through out an extensive simulation study presented at the end. Similarly, we also apply the proposed testing and estimating methods to a real data case and the finite sample performance will be compared and discussed at the very end of this thesis.

Keywords:

Local polynomial M-smoothers, flexibility in modelling, robustness, discontinuity in nonparametric regression, Change-points, residual based bootstrap, block-bootstrap, α-mixing dependence.