# AN EFFICIENT NONPARAMETRIC MULTIVARIATE FUNCTIONAL REGRESSION WITH CONDITIONAL EXPECTATION

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SUMMARY

This paper introduces an innovative approach to nonparametric functional regression with a focus on conditional expectation. The method is designed to handle cases where the covariate follows a functional form, while the output consists of a multivariate variable. The proposed technique builds upon the Nadaraya-Watson estimator, also referred to as the Knearest neighbors (KNN) estimator, which leverages two distinct semi-metrics for estimation. By efficiently combining these metrics, the approach significantly reduces the computational time and resources required. The primary advantage of this approach lies in its ability to simultaneously estimate the components of random variables, a task that typically demands substantial time and cost. The efficacy of the method is rigorously evaluated by quantifying mean square estimation errors and establishing their relationship with the independent output variable. To validate its performance, the technique is applied to both simulated data and two distinct real-world datasets. Through comprehensive simulations and practical case studies, this study showcases the effectiveness and versatility of the proposed nonparametric functional regression technique. By addressing the challenges posed by functional covariates and multivariate outputs, this approach offers a promising avenue for accurate and efficient estimation in a wide range of applications.

*Keywords and phrases:* Nonparametric regression; Functional data analysis; Multivariate response; Functional covariates; KNN estimator; Semi-metrics.

*2020 Mathematics Subject Classification:* Primary 62H10, secondary 62J12.