

Bayesian Conditional Transformation Models

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Abstract

Recent developments in statistical regression methodology shift away from pure mean regression toward distributional regression models. One important strand thereof is that of conditional transformation models (CTMs). CTMs infer the entire conditional distribution directly by applying a transformation function to the response conditionally on a set of covariates toward a simple log-concave reference distribution. Thereby, CTMs allow not only variance, kurtosis or skewness but the complete conditional distribution to depend on the explanatory variables. We propose a Bayesian notion of conditional transformation models (BCTMs) focusing on exactly observed continuous responses, but also incorporating extensions to randomly censored and discrete responses. Rather than relying on Bernstein polynomials that have been considered in likelihood-based CTMs, we implement a spline-based parameterization for monotonic effects that are supplemented with smoothness priors. Furthermore, we are able to benefit from the Bayesian paradigm via easily obtainable credible intervals and other quantities without relying on large sample approximations. A simulation study demonstrates the competitiveness of our approach against its likelihood-based counterpart but also Bayesian additive models of location, scale and shape and Bayesian quantile regression.