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Estimation of Conditional Distributions with Factor Model of Mixtures

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This paper estimates distribution of a response variable conditioned on observing factors (features). We estimate the conditional quantile of the distribution as a mixture (weighted sum) of basis quantile functions with weights depending on factors. The suggested factor model has a closed-form expression. The calibration problem is reduced to conducting quantile regressions for all confidence levels simultaneously. However, the model does not suffer from "quantile crossing" by design. The calibration is equivalent to minimization of Continuous Probability Ranked Score (CRPS). We prove asymptotic normality of the estimator. The approach allows for application of neural networks for calibration of the model. Numerical experiments demonstrated high efficiency of the approach. In particular, we have used factor model of mixtures for predicting horse-racing outcomes.

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