Comparison of performances of three methods of inverse prediction

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Abstract
The object of inverse prediction is to infer the value of a condition $x^*$ that caused an observed response $y^*$ (univariate or multivariate), based on a linear model (fixed or mixed) relating responses to conditions fit to training data. Three methods of inverse prediction are investigated here. Their performances are compared in terms of the rates at which they reject potential values $x_0$ of the true condition $x^*$. The three methods are (1) inverse regression (IR), based on a point estimate of $x^*$ from $y^*$, along with a delta-method approximation to its variance to find an interval estimate; (2) reverse regression (RR), in which $x$ is modeled in terms of $y$ to get a prediction interval estimate of $x^*$ at $y^*$; and (3) inverse prediction (IP), which produces a confidence set on $x^*$ as the values of $x_0$ for which $y^*$ is not rejected as an outlier. All three are well-known in the voluminous literature on inverse prediction and calibration. In practice, it appears that RR is the consensus choice, because of its simplicity. Under ideal conditions (normality and the right model) the IP confidence set is exact, while the other two are approximate. RR and IR have not been extended to mixed models, where variances are not constant; IP has (LaMotte and Wells 2016).

We compare performances of the three methods in terms of the rates at which they reject potential values (the complement of coverage rates) via simulated data from fixed-effects models with constant variance and from mixed-effects models.

Keywords
Calibration methods, Rejection rates, Confidence sets.

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References