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# MULTIVARIATE CALIBRATION IN LINEAR REGRESSION AND ITS APPLICATION

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**Abstract**

Classical, inverse and conditional multivariate calibration techniques are studied using application data obtained from experiments and artificial data for the case in which the independent variable is fixed. The aim is to obtain the best model for the prediction of the independent variable(s) and the confidence regions of this prediction. In addition, the outliers in the observed data and in the predicted data set are also examined in this study.

**Keywords:** Calibration, Inverse regression, Prediction, Conditional calibration.

## 1. Introduction

Calibration is the use of data available through the experimental method to find information about the unknown $X$ from measurements of $Y$ using mathematical transformation methods. Calibration is defined as the replacement of expensive measurement methods that require much effort and time but give accurate results, by measurement methods which are swift and cheap but give less accurate results. Statistically, calibration is the estimation of $X$, the independent variable corresponding to the observed value of the dependent variable $Y$. The simple regression model between the independent variable $X$ and the dependent variable $Y$ with $n$ observations is defined as follows:

$$y_i = f(\beta, x_i) + \epsilon_i, \tag{1.1}$$

where $\boldsymbol{\beta}$ is the vector of unknown parameters and $\epsilon_i$ is an error term with mean 0 and variance $\sigma^2$. There are two stages in the statistical calibration process:

1) The values of $X$ are obtained using a standard method which gives accurate but generally slow and expensive results. The same measurements are then made using a second method or an instrument which gives faster, cheaper but generally less accurate results than the first method. The second measurements are the values of $Y$. Then the "calibration relationship" between $X$ and $Y$ is estimated from (1.1).

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