## 0.1 Estimating the Variance ratio

$$x_i = \mu + \beta_0 + \epsilon_{xi}$$
$$y_i = \mu + \beta_1 + \epsilon_{yi}$$

The inter-method bias is the difference of these biases. In order to determine an estimate for the residual variances, one of the method biases must be assumed to be zero, i.e. $\beta_0 = 0$. The inter-method bias is now represented by $\beta_1$.

$$\begin{aligned} x_i &= \mu + \epsilon_{xi} \\ y_i &= \mu + \beta_1 + \epsilon_{yi} \end{aligned}$$

The residuals can be expressed as

$$\begin{aligned} \epsilon_{xi} &= x_i - \mu \\ \epsilon_{yi} &= y_i - (\mu + \beta_1) \end{aligned}$$

The variance of the residuals are equivalent to the variance of the corresponding observations, $\sigma^2_{\epsilon x} = \sigma^2_x$ and $\sigma^2_{\epsilon y} = \sigma^2_y$.

$$\lambda = \frac{\sigma^2_{yx}}{\sigma^2_y}. \tag{1}$$

## 0.2 Using LMEs to estimate the ratio

$$y_{mi} = \mu + \beta_m + b_i + \epsilon_{mi}$$

with $\beta_m$ is a fixed effect for the method $m$ and $b_i$ is a random effect associated with patient $i$, and $\epsilon_{mi}$ as the measurement error.

This is a simple single level LME model. **?** provides for the implementation of fitting a model.

The variance ratio of the residual variances is immediately determinable from the output. This variance ratio can be use to fit a Deming regression, as described in chapter 1.

## 0.3 Estimating the variance ratio

Using duplicate measurements, one can estimate the analytical standard deviations and compute their ratio. This ratio is then used for computing the slope by the Deming method.[Linnet]

### 0.3.1 RMSE

The root mean square error, RMSE, is given by

$$\text{RMSE} = \sqrt{\sum (b-1)^2/nruns} = \sqrt{(\text{Bias})^2 + (\text{SE})^2}$$

where ‘nruns’ is the number of runs.

## 0.4 determining lambda

assuming constant standard deviations, and given duplicate measurements, the analytical standard deviations are given by

$$SD_{ax}^2 = \frac{1}{2n}\sum(x_{2i} - x_{1i})^2$$
$$SD_{ay}^2 = \frac{1}{2n}\sum(y_{2i} - y_{1i})^2$$

## 0.5 performance in the presence of oultiers

All least square estimation methods are sensitive to outliers.

### 0.5.1 Rejection Rule

Rejection rule for outliers.

## 0.6 Ordinary Linear regression

## 0.7 weighted least square regression

The constancy of variance is a necessary assumption for ordinary linear regression.

$$\mathrm{SD}_{ay} = ch(x_i) \tag{2}$$