

To obtain the lowess estimates lowess \pm SD:

Notation: To distinguish estimates from parameters or true values, we'll use a "hat" (^) over estimates whenever possible. However, arc can't write the "hat," so just writes "lowess \pm SD"

1. Smooth to get the lowess estimate $\hat{E}(Y|x)$ of $E(Y|x)$.

2. Let

$$\hat{e} = Y - \hat{E}(Y|x) \text{ -- the "lowess residual"}$$

It estimates the "error" (deviation from the conditional mean) $e = Y - E(Y|x)$

The definition of Variance says $\text{Var}(Y|x) = E(e^2)$. Thus we can consider

$$E(\hat{e}^2|x)$$

as an estimate of $\text{Var}(Y|x)$.

3. Use smoothing (lowess) to get an estimate $\hat{E}(\hat{e}^2|x)$ of $E(\hat{e}^2|x)$

$$4. \widehat{SD} = \sqrt{\hat{E}(\hat{e}^2|x)}$$