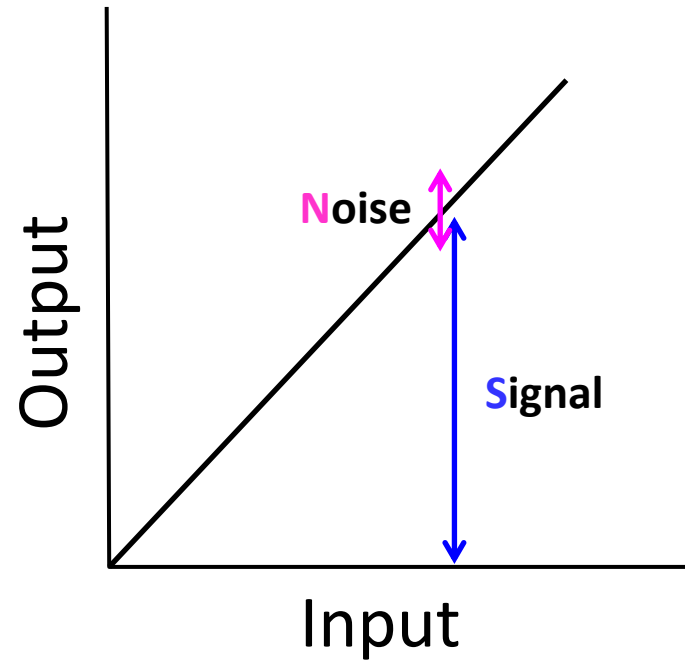


The SN ratio η formula

$$\eta = \frac{\text{Signal}}{\text{Noise}} = \frac{\beta^2}{\sigma^2}$$



We use below formula for quality engineering(QE)



$$\eta = 10 \log \frac{1}{nr} (\mathbf{S}_\beta - \mathbf{V}_e) \text{ or } \mathbf{V}_N$$

← the expected value of β^2

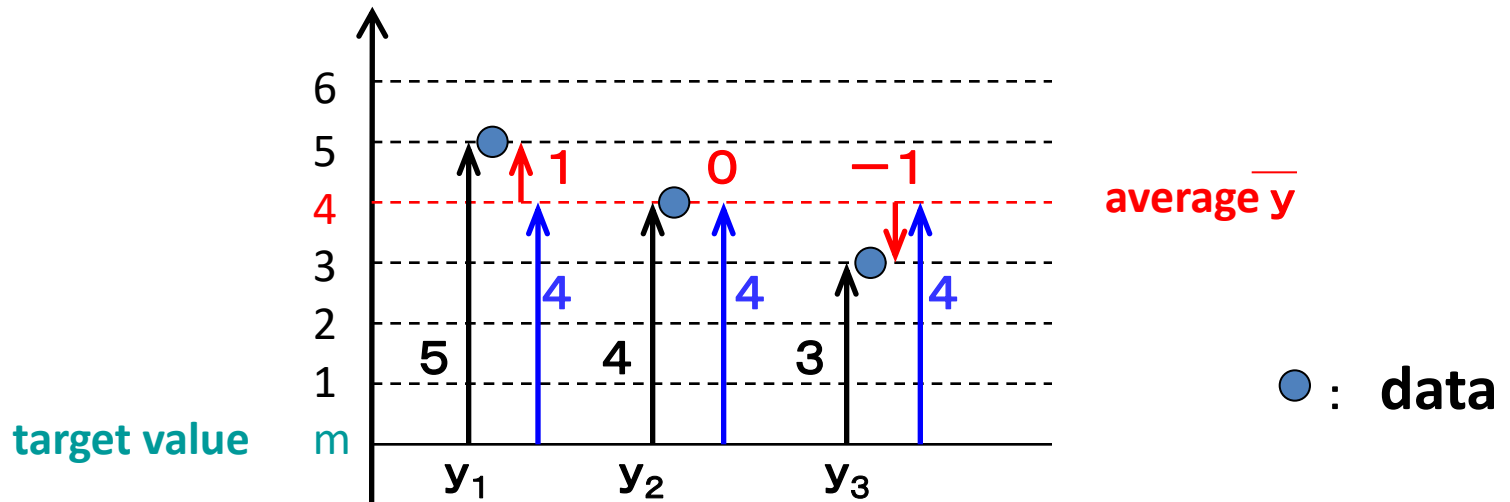
← the expected value of σ^2 **db**

$$S_T = S_m + S_e$$

total variation = deviation + error fluctuation

degree
of freedom

n 1 n-1

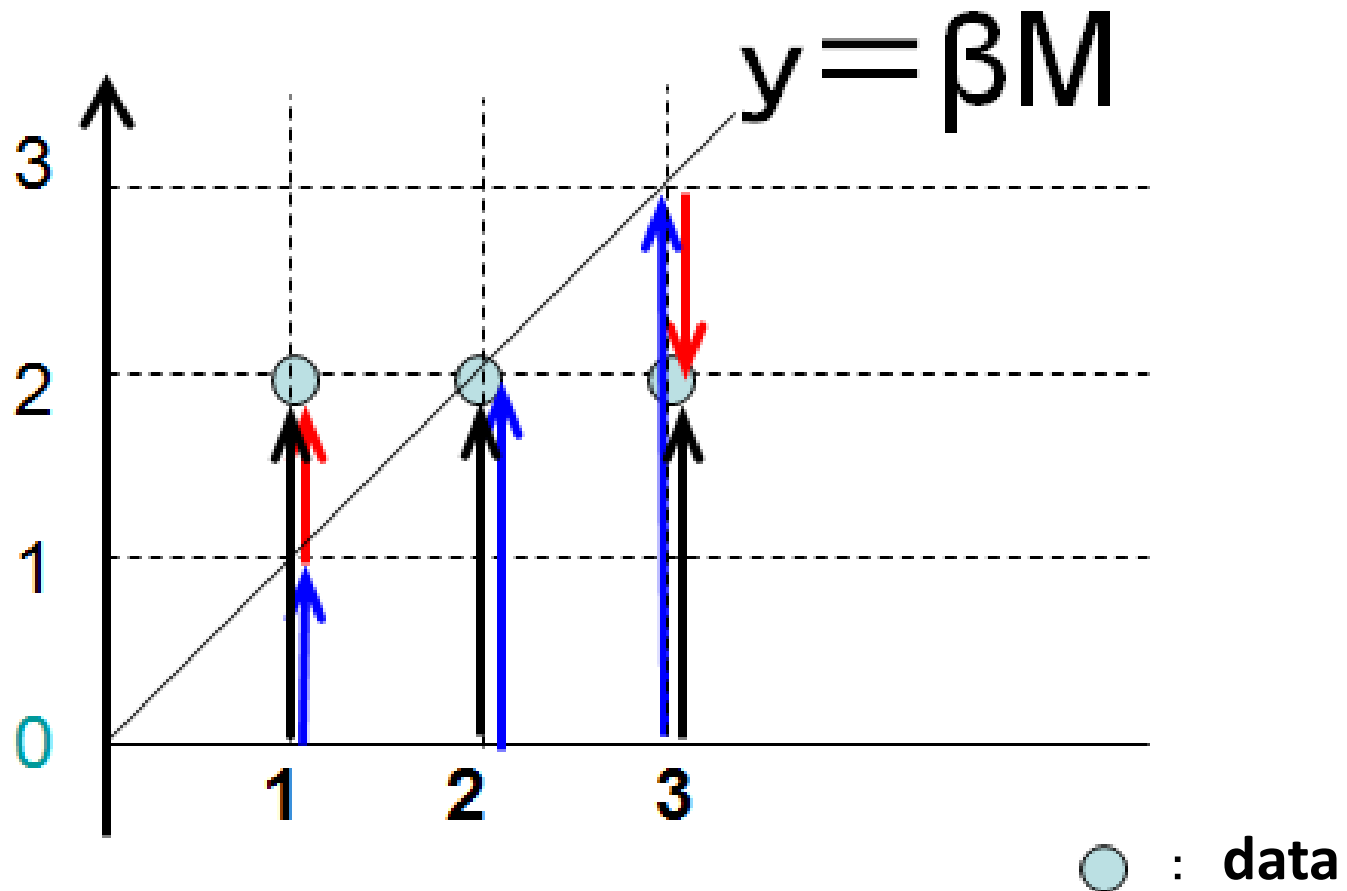


	y_1	y_2	y_3	sum of squares	f
$(y_i - m)^2$	25	16	9	$S_T = 50$	3
$(\bar{y} - m)^2$	16	16	16	$S_m = 48$	1
$(\bar{y} - y_i)^2$	1	0	1	$S_e = 2$	2

$$S_T = S_\beta + Se$$

total variation = deviation + error fluctuation

$$2^2 + 2^2 + 2^2 = 12 \quad \frac{(1 \times 2 + 2 \times 2 + 3 \times 2)^2}{1^2 + 2^2 + 3^2} = 10 \quad 1^2 + (-1)^2 = 2$$



formula

data	M_1	M_3	M_5	linear equation
N_1	y_{11}	y_{31}	y_{51}	L_1
N_2	y_{12}	y_{32}	y_{52}	L_2

$$S_T = y_{11}^2 + y_{31}^2 + y_{51}^2 + y_{12}^2 + y_{32}^2 + y_{52}^2 \quad (f = 6)$$

$$L_1 = M_1 \times y_{11} + M_3 \times y_{31} + M_5 \times y_{51}$$

$$L_2 = M_1 \times y_{12} + M_3 \times y_{32} + M_5 \times y_{52}$$

$$r = M_1^2 + M_3^2 + M_5^2$$

$$S_\beta = \frac{(L_1 + L_2)^2}{2r} \quad S_{N \times \beta} = \frac{(L_1 - L_2)^2}{2r} \quad (f = 1)$$

$$S_e = S_T - S_\beta - S_{N \times \beta} \quad (f = 4)$$

$$S_N = S_T - S_\beta = S_{N \times \beta} + S_e$$

$$V_e = \frac{S_e}{f(=4)} \quad V_N = \frac{S_N}{f(=5)}$$

$$\text{SN ratio } \eta = 10 \log \frac{S_\beta - V_e}{V_N}$$

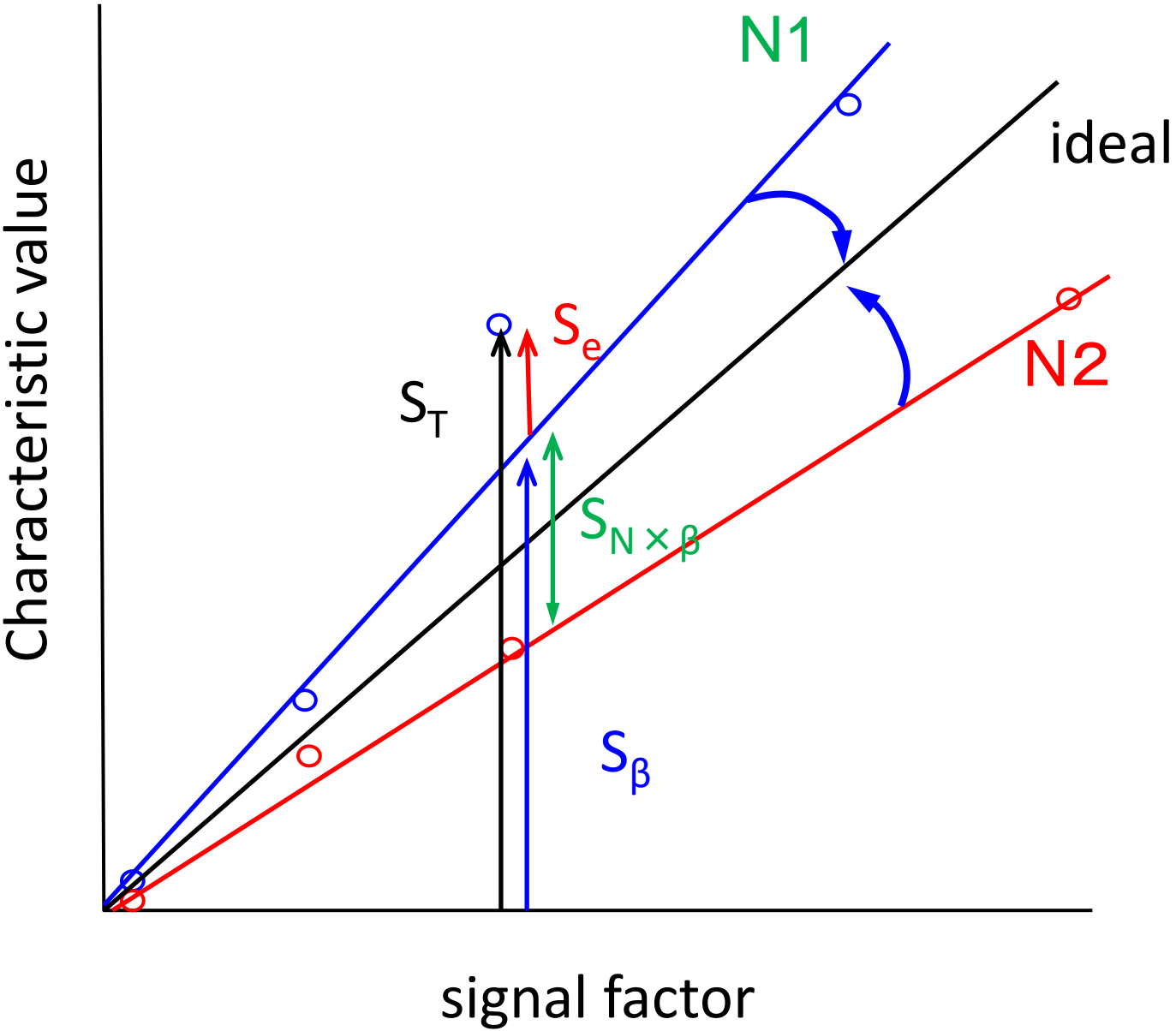
←in the case of
"the standard SN ratio method"

Normal case

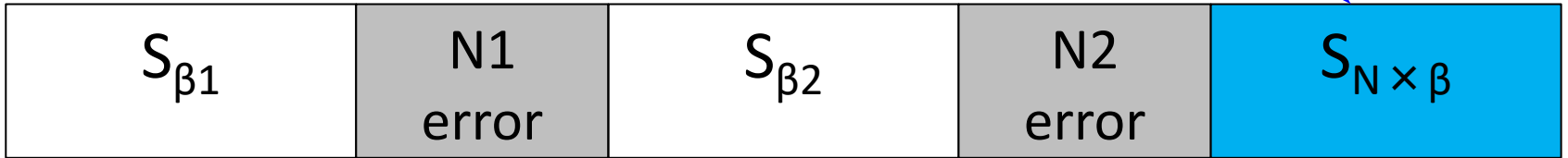


$$\text{SN ratio } \eta = 10 \log \frac{\frac{1}{2r}(S_\beta - V_e)}{V_N}$$

$$\text{sensitivity } S = 10 \log \frac{1}{2r}(S_\beta - V_e)$$



difference variation of two straight line



S_T

