

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \gamma_{12} X_1 X_2 + \varepsilon$$

X_1 、 X_2 、 X_3 及び X_1 と X_2 の交互作用の水準を1と-1とする実験計画の組合わせを X のベクトルで表す

$$Y = \begin{bmatrix} Y_1 \\ Y_2 \\ Y_3 \\ Y_4 \\ Y_5 \\ Y_6 \\ Y_7 \\ Y_8 \end{bmatrix} \quad X = \begin{bmatrix} 1 & -1 & -1 & -1 & 1 \\ 1 & -1 & -1 & 1 & 1 \\ 1 & -1 & 1 & -1 & -1 \\ 1 & -1 & 1 & 1 & -1 \\ 1 & 1 & -1 & -1 & -1 \\ 1 & 1 & -1 & 1 & -1 \\ 1 & 1 & 1 & -1 & 1 \\ 1 & 1 & 1 & 1 & 1 \end{bmatrix} \quad \beta = \begin{bmatrix} \alpha \\ \beta_1 \\ \beta_2 \\ \beta_3 \\ \gamma_{12} \end{bmatrix} \quad \varepsilon = \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \\ \varepsilon_4 \\ \varepsilon_5 \\ \varepsilon_6 \\ \varepsilon_7 \\ \varepsilon_8 \end{bmatrix}$$

$$Y = X\beta + \varepsilon$$

$$\begin{bmatrix} Y_1 \\ Y_2 \\ Y_3 \\ Y_4 \\ Y_5 \\ Y_6 \\ Y_7 \\ Y_8 \end{bmatrix} = \begin{bmatrix} 1 & -1 & -1 & -1 & 1 \\ 1 & -1 & -1 & 1 & 1 \\ 1 & -1 & 1 & -1 & -1 \\ 1 & -1 & 1 & 1 & -1 \\ 1 & 1 & -1 & -1 & -1 \\ 1 & 1 & -1 & 1 & -1 \\ 1 & 1 & 1 & -1 & 1 \\ 1 & 1 & 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} \alpha \\ \beta_1 \\ \beta_2 \\ \beta_3 \\ \gamma_{12} \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \\ \varepsilon_4 \\ \varepsilon_5 \\ \varepsilon_6 \\ \varepsilon_7 \\ \varepsilon_8 \end{bmatrix}$$

$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \gamma_{12} X_1 X_2 + \varepsilon$ の直交表実験の特性値 $Y_1 \sim Y_8$ より係数を求める

$$Y_1 = \alpha - \beta_1 - \beta_2 - \beta_3 + \gamma_{12} + \varepsilon_1$$

$$Y_2 = \alpha - \beta_1 - \beta_2 + \beta_3 + \gamma_{12} + \varepsilon_2$$

$$Y_3 = \alpha - \beta_1 + \beta_2 - \beta_3 - \gamma_{12} + \varepsilon_3$$

$$Y_4 = \alpha - \beta_1 + \beta_2 + \beta_3 - \gamma_{12} + \varepsilon_4$$

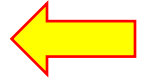
$$Y_5 = \alpha + \beta_1 - \beta_2 - \beta_3 - \gamma_{12} + \varepsilon_5$$

$$Y_6 = \alpha + \beta_1 - \beta_2 + \beta_3 - \gamma_{12} + \varepsilon_6$$

$$Y_7 = \alpha + \beta_1 + \beta_2 - \beta_3 + \gamma_{12} + \varepsilon_7$$

$$Y_8 = \alpha + \beta_1 + \beta_2 + \beta_3 + \gamma_{12} + \varepsilon_8$$

$$\begin{bmatrix} Y_1 \\ Y_2 \\ Y_3 \\ Y_4 \\ Y_5 \\ Y_6 \\ Y_7 \\ Y_8 \end{bmatrix} = \begin{bmatrix} 1 & -1 & -1 & -1 & 1 \\ 1 & -1 & -1 & 1 & 1 \\ 1 & -1 & 1 & -1 & -1 \\ 1 & -1 & 1 & 1 & -1 \\ 1 & 1 & -1 & -1 & -1 \\ 1 & 1 & -1 & 1 & -1 \\ 1 & 1 & 1 & -1 & 1 \\ 1 & 1 & 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} \alpha \\ \beta_1 \\ \beta_2 \\ \beta_3 \\ \gamma_{12} \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \\ \varepsilon_4 \\ \varepsilon_5 \\ \varepsilon_6 \\ \varepsilon_7 \\ \varepsilon_8 \end{bmatrix}$$



$$\alpha = \frac{1}{8} (Y_1 + Y_2 + Y_3 + Y_4 + Y_5 + Y_6 + Y_7 + Y_8)$$

$$\beta_1 = \frac{1}{8} (-Y_1 - Y_2 - Y_3 - Y_4 + Y_5 + Y_6 + Y_7 + Y_8)$$

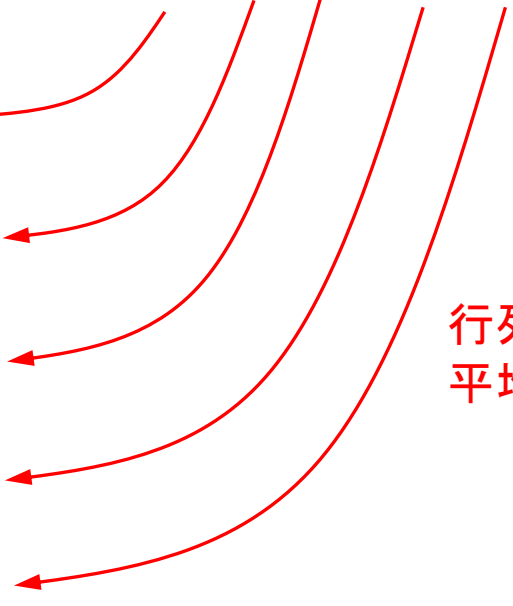
$$\beta_2 = \frac{1}{8} (-Y_1 - Y_2 + Y_3 + Y_4 - Y_5 - Y_6 + Y_7 + Y_8)$$

$$\beta_3 = \frac{1}{8} (-Y_1 + Y_2 - Y_3 + Y_4 - Y_5 + Y_6 - Y_7 + Y_8)$$

$$\gamma_{12} = \frac{1}{8} (Y_1 + Y_2 - Y_3 - Y_4 - Y_5 - Y_6 + Y_7 + Y_8)$$

$$\varepsilon_1 + \varepsilon_2 + \varepsilon_3 + \varepsilon_4 + \varepsilon_5 + \varepsilon_6 + \varepsilon_7 + \varepsilon_8 = 0$$

行列の符号をYに掛けて合計して
平均値を求める



$$X = \begin{bmatrix} 1 & -1 & -1 & -1 & 1 \\ 1 & -1 & -1 & 1 & 1 \\ 1 & -1 & 1 & -1 & -1 \\ 1 & -1 & 1 & 1 & -1 \\ 1 & 1 & -1 & -1 & -1 \\ 1 & 1 & -1 & 1 & -1 \\ 1 & 1 & 1 & -1 & 1 \\ 1 & 1 & 1 & 1 & 1 \end{bmatrix}$$

Xの転置行列

$${}^tXX = \begin{bmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ -1 & -1 & -1 & -1 & 1 & 1 & 1 & 1 \\ -1 & -1 & 1 & 1 & -1 & -1 & 1 & 1 \\ -1 & 1 & -1 & 1 & -1 & 1 & -1 & 1 \\ 1 & 1 & -1 & -1 & -1 & -1 & 1 & 1 \end{bmatrix}$$

$$= \frac{1}{8} \begin{bmatrix} 1 & -1 & -1 & -1 & 1 \\ 1 & -1 & -1 & 1 & 1 \\ 1 & -1 & 1 & -1 & -1 \\ 1 & -1 & 1 & 1 & -1 \\ 1 & 1 & -1 & -1 & -1 \\ 1 & 1 & -1 & 1 & -1 \\ 1 & 1 & 1 & -1 & 1 \\ 1 & 1 & 1 & 1 & 1 \end{bmatrix}$$

直交

$$= \frac{1}{8} \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

=TRANSPOSE(J2:N9)

=MMULT(A2#,J2:N9)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	
1																							
2	1	1	1	1	1	1	1	1	1	1	-1	-1	-1	1		8	0	0	0	0			
3	-1	-1	-1	-1	1	1	1	1		1	-1	-1	1	1		0	8	0	0	0			
4	-1	-1	1	1	-1	-1	1	1		1	-1	1	-1	-1		0	0	8	0	0			
5	-1	1	-1	1	-1	1	-1	1		1	-1	1	1	-1		0	0	0	8	0			
6	1	1	-1	-1	-1	-1	1	1		1	1	-1	-1	-1		0	0	0	0	8			
7										1	1	-1	1	-1									
8										1	1	1	-1	1									
9										1	1	1	1	1									
10																							

Xの転置行列