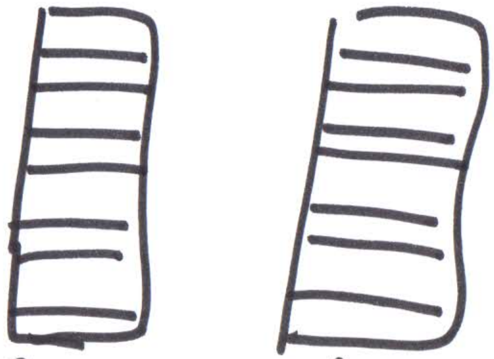
Confounding

If numbers of factors or levels increases, the number of treatment combinations increases rapidly.

2^2 F. E then # of treat combinations = 4.

2^3 . . . . = 8

2^4 ———— 16



Blc. 1 Blc 2

8 + 8 = 16 plots

2^2 F.E. : $\longrightarrow$ 4 treat. combinations

a , b , ab (1)

Each batch of raw material is sufficient enough for 2 treat. combinations to be tested.

a, b

a ab

b ab

a 1 ...

Conduct expt. in RBD in each block

$$A = \frac{1}{2}(a-1)(b+1) = \frac{1}{2}[ab + a - b - (1)]$$

$$B = \frac{1}{2}(a+1)(b-1) = \frac{1}{2}[ab - a + b - (1)]$$

$$AB = \frac{1}{2}(a-1)(b-1) = \frac{1}{2}[ab - a - b + (1)]$$

$$(1) = \frac{1}{2}(a+1)(b+1) = \frac{1}{2}[ab + a + b + (1)]$$

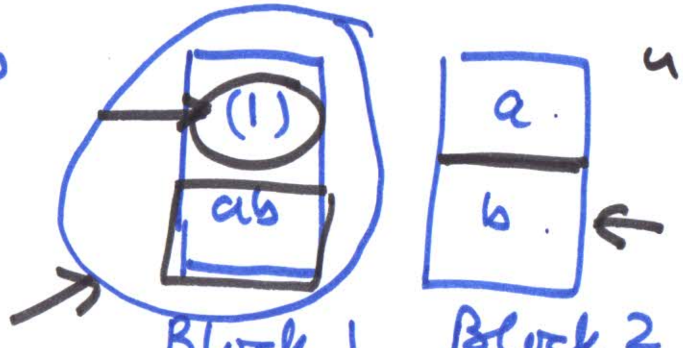
Model: $y_{ij} = \underline{\mu} + \underline{\beta_i} + \underline{\tau_j} + \underline{\varepsilon_{ij}}$, $i = 1, 2, \ldots b$
RBD $j = 1, 2, \ldots, v$

$E(y_{ij}) = \mu + \beta_i + \tau_j$

$i = 1, 2,\quad j = 1, 2, 3, 4.$

(1), a, b, ab

Four treat comb: (1), a, b, ab



Block 1 $\downarrow \beta_1$ Block 2 $\downarrow \beta_2$

$e_1 \; e_2 \; e_3 \; e_4$

$(1) \; a \; b \; ab$

$$E[y_{(1)}] = \mu + \beta_1 + e_{(1)}$$

$$E[y_{ab}] = \mu + \beta_1 + e_{ab}$$

$$E[y_a] = \mu + \beta_2 + e_a$$

$$E[y_b] = \mu + \beta_2 + e_b$$

$$A = \frac{1}{2}(a-1)(b+1) = \frac{1}{2}\left[ab + a - b - (1)\right]$$

$$\hat{A} \equiv y_{ab} + y_a - y_b - y_{(1)}$$ [Ignore $\frac{1}{2}$ for awhile]

$$A = E(y_{ab}) + E(y_a) - E(y_b) - E(y_{(1)})$$

$$= [\cancel{\mu} + \beta_1 + e_{ab}] + [\cancel{\mu} + \boxed{\beta_2} + e_a] - [\cancel{\mu} + \boxed{\beta_2} + e_b] - [\cancel{\mu} + \beta_1 + e_{(1)}]$$

$$= e_{ab} + e_a - e_b - e_{(1)} = (e_{ab} - e_{(1)}) + (e_a - e_b)$$

Block 1	Block 2
(1)	a
ab	b
β_1	β_2

$$B = \frac{1}{2}\left[ab - a + b - (1)\right]$$

$$\hat{B} \equiv y_{ab} - y_a + y_b - y_{(1)}$$

$$B = E(y_{ab}) - E(y_a) + E(y_b) - E(y_{(1)})$$

$$= [\cancel{\mu} + \beta_1 + e_{ab}] - [\cancel{\mu} + \boxed{\beta_2} + e_a] + [\cancel{\mu} + \beta_2 + e_b] - [\cancel{\mu} + \beta_1 + e_{(1)}]$$

$$= e_{ab} - e_a + e_b - e_{(1)}$$

$$AB = \frac{1}{2}\left[ab - a - b + (1)\right]$$

$$\hat{AB} = y_{ab} - y_a - y_b + y_{(1)}$$

$$E\,AB = E(y_{ab}) - E(y_a) - E(y_b) + E(y_{(1)})$$

$$= [\cancel{\mu} + \beta_1 + e_{ab}] - [\cancel{\mu} + \beta_2 + e_a] - [\cancel{\mu} + \beta_2 + e_b] + [\cancel{\mu} + \beta_1 + e_{(1)}]$$

$$= 2(\beta_1 - \beta_2) + (e_{ab} - e_a - e_b + e_{(1)}]$$

only e's are present

$A = (e_{ab} - e_{(1)}) + (e_a - e_b)$

Bl 1
(1)
ab

Bl 2
a
b.

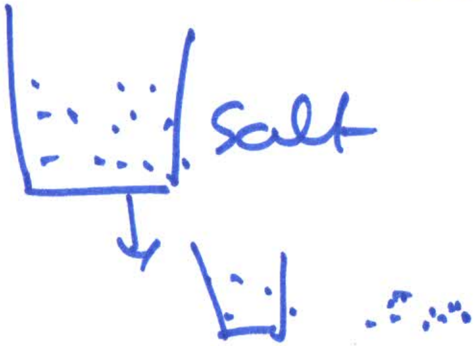
$B = e_{ab} - e_a + e_b - e_1$

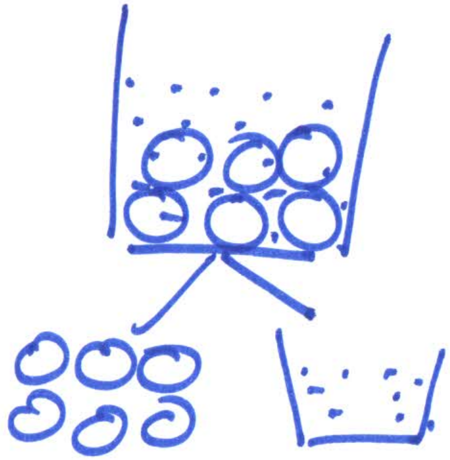
$\boxed{AB} = \boxed{2(\beta_1 - \beta_2)} + \boxed{(e_{ab} - e_a - e_b + e_{(1)})}$

block effects
treat. effects
MIXED together

$AB = 100 < \begin{matrix} \beta_i\text{'s} \\ e\text{'s} \end{matrix}$

confounded





If we choose then A is confounded

Block 1	Block 2
(1)	a
b	ab
β_1	β_2

Who decides the effects to be confounded.

Block effects and treat. effects are mixed together.

$AB = (ab + (1)) - (a + b)$

confounded

Bl. 1	Bl 2
(1)	a
ab	b.
+	−

AB is not a linear contrast.

$\Rightarrow$ This is not estimable

→ Non estimable l.p.f. are called confounded.

Bl 1	Bl 2
(1)	a
ab	b.

AB is confounded

$AB = \boxed{ab + (1)} \; \boxed{- a - b}$

$A = (ab - (1)) + (a - b)$

$B = \boxed{ab - (1)} + (b - a.)$

AB : + sign → assigned to Bl. 1.
− " → " " " 2.

$A = (ab - (1)) + (a - b)$

$B = (ab - (1) + (b - a)$
linear contrast

$AB = [ab + (1)] - (a + b)$
Bl. 1.

(1)	a
b	ab

A is confounded

$A = ab - (1) + a - b$ → Bl. 1

Bl 2