

**(One-Way ANOVA)**

two sample t-Test

. ANOVA 2



	( )	(BLOCK)	
Completely Randomized Design (CRD)	1	0	1
Randomized Block Design (RBD)	1	1	1
Latin Square Design (LSD)	1	2	1
Factorial Design (FD)	2	0	1

**1. CRD**

가 가 ,  
 가 가 ,  
 가 가 random order

**2. RBD**

block CRD ( )

CRD

RBD

RBD 가 RBD , CRD  
 F 가 F RBD

### 3.LSD

### 4.FD

가 Factorial CRD, Factorial RBD, Factorial LSD . FD




#### 1. ( fixed effects models )

, 가

:

#### 2. ( random effects model )

가

:

가

### 3. ( mixed effects models )

가 2



( )

가

2 t  
가

가

가

가

95%

Levene

가

: Bonferroni, Sidak, Tukey

, Hochberg GT2, Gabriel, Dunnett, Ryan-Einot-Gabriel-Welsch F (R-E-G-W F),

Ryan-Einot-Gabriel-Welsch (R-E-G-W Q), Tamhane T2, Dunnett T3, Games-Howell,

Dunnett C, Duncan , Student-Newman-Keuls (S-N-K), Tukey b, Waller-

Duncan, Scheffe

가

1	$y_{11}, y_{12}, \dots, y_{1n_1}$	$\bar{y}_1$	$\sum_{j=1}^{n_1} (y_{1j} - \bar{y}_1)^2$
2	$y_{21}, y_{22}, \dots, y_{2n_2}$	$\bar{y}_2$	$\sum_{j=1}^{n_2} (y_{2j} - \bar{y}_2)^2$
$\vdots$	$\vdots$	$\vdots$	$\vdots$
k	$y_{k1}, y_{k2}, \dots, y_{kn_k}$	$\bar{y}_k$	$\sum_{j=1}^{n_k} (y_{kj} - \bar{y}_k)^2$

$\bar{m}, \bar{m}_2, \dots, \bar{m}_k$

Model:  $Y_{ij} = \bar{m} + e_{ij} = \bar{m} + a_i + e_{ij}$

$\bar{m}$ : Gross Mean; 가 ( ,  $a_i=0$  )

$a_i$ : i

$e_{ij}$ :

“0” , (Constant Variance)

$a_i = 0$

$a_i$



$$\sum_{i=1}^k \sum_{j=1}^{n_i} (y_{ij} - \bar{y})^2 = \sum_{i=1}^k \sum_{j=1}^{n_i} (y_{ij} - \bar{y}_i)^2 + \sum_{i=1}^k n_i (\bar{y}_i - \bar{y})^2$$

$$\text{SST} = \text{SSE} + \text{SSt}$$

SST: Total Sum of Squares

SSt: Treatment Sum of Squares

SSE: Error Sum of Squares

SST , SSt  
 , SSE

가 SSt 가

- **Testing Hypotheses**

$H_0: \mathbf{m}_1 = \mathbf{m}_2 = \dots = \mathbf{m}_k$  or  $H_0: \mathbf{a}_1 = \mathbf{a}_2 = \dots = \mathbf{a}_k = 0$ ,  $H_1: \text{Not } H_0$  가

$$F = \frac{\text{SSt} / k - 1}{\text{SSE} / N - k} = \frac{\text{MS}_t}{\text{MSE}} \underset{\text{under } H_0}{\sim} F(k - 1, N - k)$$

$$, E(\text{MS}_t) = \mathbf{s}^2 + \frac{n}{k-1} \sum_{i=1}^k \mathbf{a}_i^2, \quad E(\text{MSE}) = \mathbf{s}^2$$

$$\frac{E(\text{MS}_t)}{E(\text{MSE})} = 1 + \frac{\frac{n}{k-1} \sum_{i=1}^k \mathbf{a}_i^2}{\mathbf{s}^2}, \quad \text{가}$$

( 가 )  $F = 1$  , 가

$F > 1$  가 ,  $F > F(k - 1, N - k; \mathbf{a})$

가  $\mathbf{a}$  가

- ANOVA Table

Source	D.F	SS	MS	F	p-value
Treatment	k-1	SSt	MSt	MSt/MSE	p
Error	N-k	SSE	MSE		
Total	N-1	SST			

value < **a** 가 .

- (Multiple Comparison)

가 ,  
 가 가 .  
 . **a** t  
**a** , 10  
 0.05 t-test  $\frac{10(10-1)}{2} = 45$  t-test  
 $1 - (1 - 0.05)^{45} = 0.9$ 가 . ,

가 가

가 , Tukey, Duncan,

Scheffe



(Multivariate Analysis of Variance :MANOVA)

가 2

)

Pillai

.F 가

Wilks

U . 0 1 0

가

1 가

(1 )

Hotelling