

Factorial Repeated Measures Analysis

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One Repeated Factor Linear Model (Population Model)

$$Y_{ij} = \mu_{..} + \rho_i + \tau_j + \varepsilon_{ij}$$

Score on Y of the *i*th individual in the *j*th treatment = Grand Mean + Overall offset for Individual *i* + Treatment offset for level *j* + Error

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Two Repeated Factors Linear Model (Population Model)

$$Y_{ijk} = \mu_{...} + \rho_i + \alpha_j + \beta_k + (\alpha\beta)_{jk} + (\rho\alpha)_{ij} + (\rho\beta)_{ik} + \varepsilon_{ijk}$$

Model Effects

Main Effects	2-Way Interactions	Subject Effects
A B	A x B	S S x A S x B

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WineRatings(4x2 within).jmp

Ratings of Wine By Wine (4-levels), Label (2-levels), and Judge (15-levels)

Judge	Wine	Label	Rating
1	1 Wine 1	Cheap	51
2	1 Wine 2	Cheap	52
3	1 Wine 3	Cheap	62
4	1 Wine 4	Cheap	55
5	1 Wine 1	Expensive	55
6	1 Wine 2	Expensive	72
7	1 Wine 3	Expensive	72
8	1 Wine 4	Expensive	73
9	2 Wine 1	Cheap	38
10	2 Wine 2	Cheap	46
11	2 Wine 3	Cheap	49
12	2 Wine 4	Cheap	38
13	2 Wine 1	Expensive	57
14	2 Wine 2	Expensive	46

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WineRatings(2x2x2 within).jmp

Ratings of Wine
By Type (2-levels), Closure (2-levels), Label (2-levels), and Judge (15-levels)

Judge	Type	Closure	Label	Rating
1	White	Cork	Cheap	59
2	White	Screw-top	Cheap	52
3	Red	Cork	Cheap	62
4	Red	Screw-top	Cheap	50
5	White	Cork	Expensive	69
6	White	Screw-top	Expensive	72
7	Red	Cork	Expensive	72
8	Red	Screw-top	Expensive	73
9	White	Cork	Cheap	48
10	White	Screw-top	Cheap	46
11	Red	Cork	Cheap	62
12	Red	Screw-top	Cheap	38
13	White	Cork	Expensive	57
14	White	Screw-top	Expensive	59
15	Red	Cork	Expensive	68
16	Red	Screw-top	Expensive	81
17	White	Cork	Cheap	94
18	White	Screw-top	Cheap	86

Repeated Measures Analysis with Between Subject Factors

Factorial Design

Factorial Designs are multifactor designs in which two or more factors are completely crossed; measurements are taken for every combination of factor levels

Nested Designs

Factors A and B are "nested" if particular levels of B occur only with one level of A;
B "nested inside" A

Teaching Efficacy Study

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Teaching Efficacy Study

School (factor A)

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Teaching Efficacy Study

School (factor A)

Atlanta

Chicago

San Francisco

•

• 15

Teaching Efficacy Study

School (factor A)

Instructor (factor B)

1

2

3

4

5

6

Atlanta

Chicago

San Francisco

•

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Teaching Efficacy Study
Instructors Crossed with Schools

School (factor A)	Instructor (factor B)					
	1	2	3	4	5	6
Atlanta	$\bar{Y}_{.11}$	$\bar{Y}_{.12}$	$\bar{Y}_{.13}$	$\bar{Y}_{.14}$	$\bar{Y}_{.15}$	$\bar{Y}_{.16}$
Chicago	$\bar{Y}_{.21}$	$\bar{Y}_{.22}$	$\bar{Y}_{.23}$	$\bar{Y}_{.24}$	$\bar{Y}_{.25}$	$\bar{Y}_{.26}$
San Francisco	$\bar{Y}_{.31}$	$\bar{Y}_{.32}$	$\bar{Y}_{.33}$	$\bar{Y}_{.34}$	$\bar{Y}_{.35}$	$\bar{Y}_{.36}$

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Teaching Efficacy Study
Instructors Nested Inside Schools

School (factor A)	Instructor (factor B)					
	1	2	3	4	5	6
Atlanta	$\bar{Y}_{.11}$	$\bar{Y}_{.12}$				
Chicago			$\bar{Y}_{.23}$	$\bar{Y}_{.24}$		
San Francisco					$\bar{Y}_{.35}$	$\bar{Y}_{.36}$

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Nested Designs

Factors A and B are "nested" if particular levels of B occur only with one level of A;
B "nested inside" A

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Nested Designs

Factors A and B are "nested" if particular levels of B occur only with one level of A;
B "nested inside" A

When Subjects are treated as a factor, and Factor A is a between-subjects factor, Subjects are said to be "nested inside" Factor A

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Expertise α	Subject β_{ij}	Endorser β	
		Celebrity $k = 1$	Unknown $k = 2$
Expert $j = 1$	$i = 1$	Y_{111}	Y_{112}
	$i = 2$	Y_{211}	Y_{212}
	$i = 3$	Y_{311}	Y_{312}
Novice $j = 2$	$i = 4$	Y_{421}	Y_{422}
	$i = 5$	Y_{521}	Y_{522}
	$i = 6$	Y_{621}	Y_{622}

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Ads(2b x 2w).jmp

Ratings of Advertisements
By Expertise (2-levels between), Endorser (2-levels within), and Subject (60-levels)

Subject Number	Expertise (B)	Endorser (W)	Rating
1	Expert	Celebrity	44
2	Expert	Unknown	49
3	Novice	Celebrity	64
4	Novice	Unknown	57
5	Expert	Celebrity	53
6	Expert	Unknown	49
7	Novice	Celebrity	62
8	Novice	Unknown	51
9	Expert	Celebrity	61
10	Expert	Unknown	67
11	Novice	Celebrity	43
12	Novice	Unknown	37
13	Expert	Celebrity	52
14	Expert	Unknown	54
15	Novice	Celebrity	44
16	Novice	Unknown	43
17	Expert	Celebrity	41
18	Expert	Unknown	42
19	Novice	Celebrity	48

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WineRatings(4x2[2x2]).jmp

Ratings of Wine
By Expertise (2-levels between), Gender (2-levels between)
Wine (4-levels within), Label (2-levels within) and Subject (15-levels)

Judge	Wine	Label	Gender	Expertise	Rating
1	Wine 1	Cheap	Male	Expert	51
2	Wine 2	Cheap	Male	Expert	52
3	Wine 3	Cheap	Male	Expert	62
4	Wine 4	Cheap	Male	Expert	55
5	Wine 1	Expensive	Male	Expert	55
6	Wine 2	Expensive	Male	Expert	72
7	Wine 3	Expensive	Male	Expert	72
8	Wine 4	Expensive	Male	Expert	73
9	Wine 1	Cheap	Male	Expert	38
10	Wine 2	Cheap	Male	Expert	46
11	Wine 3	Cheap	Male	Expert	49
12	Wine 4	Cheap	Male	Expert	38
13	Wine 1	Expensive	Male	Expert	57
14	Wine 2	Expensive	Male	Expert	46
15	Wine 3	Expensive	Male	Expert	59
16	Wine 4	Expensive	Male	Expert	61
17	Wine 1	Cheap	Male	Expert	94
18	Wine 2	Cheap	Male	Expert	86
19	Wine 3	Cheap	Male	Expert	85
20	Wine 4	Cheap	Male	Expert	79

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