Statistics One

Lecture 17

Mixed factorial ANOVA

Two segments

- Mixed factorial ANOVA : What's new?
- Mixed factorial ANOVA : Example in R

Lecture 17
Segment 1

Mixed factorial ANOVA:

What's new?

Mixed factorial designs

- One IV is manipulated between groups
- One IV is manipulated within groups
  - Repeated measures

Data structure (3x3: Ax(BxS))

Subject	A	B1	B2	B3
1	1			
2	1			
3	2			
4	2			
5	3			
6	3			
…				

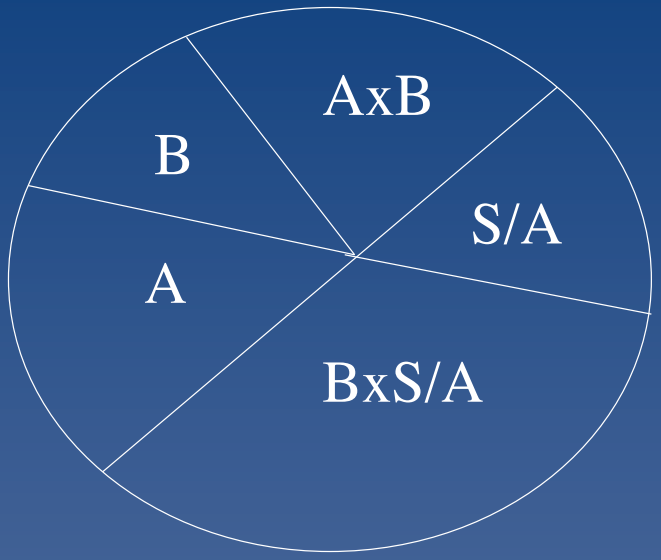
Data structure in R (3x3: Ax(BxS))

Subject	A	DV
1	1	B1
1	1	B2
1	1	B3
…	…	
3	2	B1
3	2	B2
3	2	B3

Mixed factorial designs

- What's new?
  - Partitioning SS
  - Formulae for F_A, F_B, F_{AxB}
  - Error term for post-hoc tests
  - Approach to simple effects analyses
  - Assumptions

Partitioning SS



df

- $df_A = a - 1$
- $df_B = b - 1$
- $df_{AxB} = (a - 1)(b - 1)$
- $df_{S/A} = a(n - 1)$
- $df_{BxS/A} = a(b - 1)(n - 1)$
- $df_{Total} = (a)(b)(n) - 1$

MS

- $MS_A = SS_A / df_A$
- $MS_B = SS_B / df_B$
- $MS_{AxB} = SS_{AxB} / df_{AxB}$
- $MS_{S/A} = SS_{S/A} / df_{S/A}$
- $MS_{BxS/A} = SS_{BxS/A} / df_{BxS/A}$

F

- $F_A = MS_A / MS_{S/A}$
- $F_B = MS_B / MS_{BxS/A}$
- $F_{AxB} = MS_{AxB} / MS_{BxS/A}$

Post-hoc tests on main effects

- Post-hoc tests on the between-groups IV are performed in the same way as with a one-way ANOVA
  - TukeyHSD

Post-hoc tests on main effects

- Post-hoc tests on the repeated measures IV are performed in the same way as with a one-way repeated measures ANOVA
  - Pairwise comparisons with Bonferroni correction

Simple effects analyses

- Must choose one approach or the other
  - To report both is redundant
- (a) Simple effects of the between groups IV
- (b) Simple effects of the repeated IV

Data structure in R (3x4: Ax(BxS))

Subject	A	DV
1	1	B1
1	1	B2
1	1	B3
…	…	
3	2	B1
3	2	B2
3	2	B3

Simple effects analyses

- Simple effects of the between groups IV
  - Simple effect of A at each level of B
    - $F_{A.at.b1} = MS_{A.at.b1} / MS_{S/A.at.b1}$

Simple effects analyses

- Simple effects on the between groups IV
  - Simple comparisons use the same error term
    - $MS_{S/A.at.b1}$

Simple effects analyses

- Simple effect on the repeated measures IV
  - Simple effect of B at each level of A
    - $F_{B.at.a1} = MS_{B.at.a1} / MS_{BxS/A.at.a1}$

Assumptions

- Each subject provides b scores
- Therefore, there are
  - b variances
  - (b*(b+1) / 2) - b covariances (correlations)
  - e.g., if b = 3 then 3 covariances
  - e.g., if b = 4 then 6 covariances

Assumptions

- Between-groups assumptions
  - The variances do not depend upon the group
    - Levene's test
      - If violated then calculate a new restricted error term
  - The covariances do not depend upon the group
    - Box's test of equality of covariance matrices

Box's test (a = 3, b = 3)

$$
\begin{array}{c}
\text{a1} \\
\begin{array}{c|ccc}
 & \text{b1} & \text{b2} & \text{b3} \\
\text{b1} & & & \\
\text{b2} & & & \\
\text{b3} & & &
\end{array}
\end{array}
=
\begin{array}{c}
\text{a2} \\
\begin{array}{c|ccc}
 & \text{b1} & \text{b2} & \text{b3} \\
\text{b1} & & & \\
\text{b2} & & & \\
\text{b3} & & &
\end{array}
\end{array}
=
\begin{array}{c}
\text{a3} \\
\begin{array}{c|ccc}
 & \text{b1} & \text{b2} & \text{b3} \\
\text{b1} & & & \\
\text{b2} & & & \\
\text{b3} & & &
\end{array}
\end{array}
$$

If violated then report Greenhouse-Geisser or Huynh-Feldt values.
Alternatively, consider a moderation analysis.

Assumptions

- Within-subjects assumptions
  - Sphericity: the variances of the different treatment scores (b) are the same and the correlations among pairs of treatment means are the same
  - Again, if violated then report Greenhouse-Geisser or Huynh-Feldt values

Mixed factorial ~ Summary

- What's new?
  - Partitioning SS
  - Formulae for F_A, F_B, F_{AxB}
  - Error term for post-hoc tests
  - Approach to simple effects analyses
  - Assumptions