Statistics One

Lecture 16

Repeated measures ANOVA

Two segments

- Repeated measures ANOVA: Benefits
- Repeated measures ANOVA: Risks

Lecture 16
Segment 1

Repeated measures ANOVA: Benefits

Repeated measures designs

- Benefits
  - Less cost (fewer subjects required)
  - More statistical power
    - This is the important new concept

Common data structure

	a1	a2	a3	a4
S1				
S2				
S3				
S4				
S5				
S6				
…				

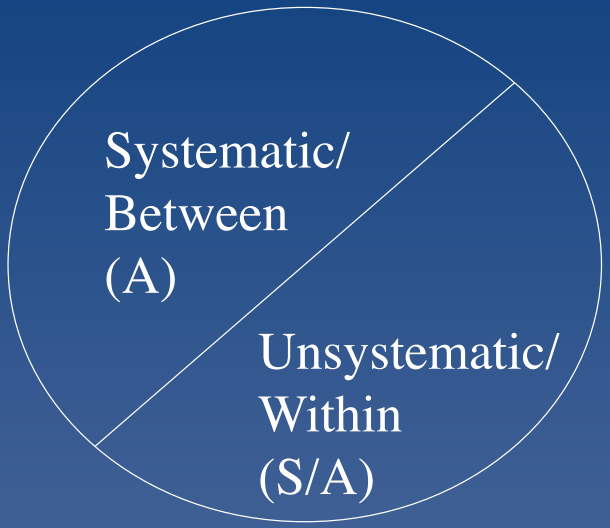
Data structure in R

	DV
S1.a1	
S1.a2	
S1.a3	
S1.a4	
S2.a1	
S2.a2	
…	

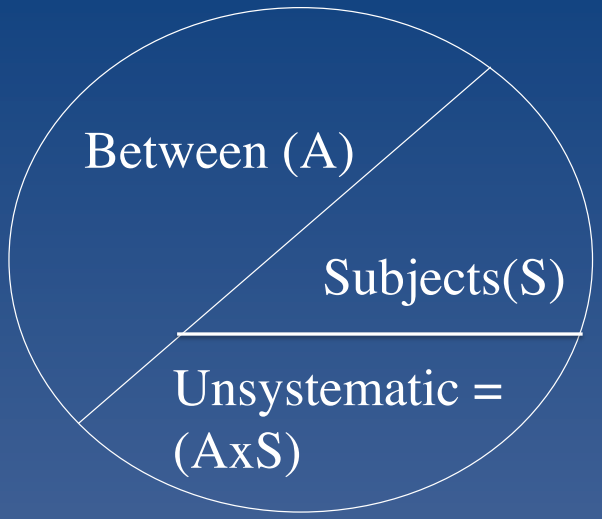
Repeated measures designs

- More statistical power
  - Variance across subjects may be systematic
  - If so, it will not contribute to the error term

Between groups design (SS)



Repeated measures design (SS)



Error in a repeated measures design is the inconsistency of subjects from one condition to another

Therefore:

$F_A = MS_A / MS_{AxS}$

MS and F

- $MS_A = SS_A / df_A$
- $MS_{AxS} = SS_{AxS} / df_{AxS}$

- $F = MS_A / MS_{AxS}$

Example

- A classic memory and learning paradigm is AB/AC paired associate learning
- Subjects learn a list of paired associates, A-B
- They then learn another list, A-C
- Subsequently, recall is impaired when cued with A and asked to recall B
- This is known as retroactive interference

Example

	AB	AC	AB’
S1	88	84	73
S2	89	83	74
S3	90	85	75
S4	90	85	75
S5	91	86	77
S6	92	87	76
	90	85	75

df

$df_A = a - 1 = 3 - 1 = 2$

$df_S = n - 1 = 6 - 1 = 5$

$df_{AxS} = (a - 1)(n - 1) = 10$

$df_{Total} = (a)(n) - 1 = 17$

MS and F

$MS_A = 700 / 2 = 350$

$MS_{AxS} = 2.67 / 10 = .267$

$F = 1310.86$

Example

	AB	AC	AB’
S1	88	84	73
S2	89	83	74
S3	90	85	75
S4	90	85	75
S5	91	86	77
S6	92	87	76

Example

	AB	AC	AB’
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S3	90	85	75
S4	90	85	73
S5	91	83	77
S6	88	87	76

MS and F

$MS_A = 700 / 2 = 350$

$MS_{AxS} = 27.33 / 10 = 2.73$

$F = 128.06$

Post-hoc tests

- The error term MS_{AxS} is *NOT* appropriate
  - Need to calculate a new error term based on the conditions that are being compared

Post-hoc tests

- $F_{\psi A} = MS_{\psi A} / MS_{\psi A x S}$
- $MS_{\psi A} = SS_{\psi A} / df_{\psi A}$
- $MS_{\psi A x S} = SS_{\psi A x S} / df_{\psi A x S}$

Post-hoc tests

- Correct for multiple comparisons
  - Bonferroni

Sphericity assumption

- Homogeneity of variance
- Homogeneity of correlation

Sphericity assumption

- Homogeneity of variance
- Homogeneity of correlation
  - $r_{12} = r_{13} = r_{23}$

Sphericity assumption

- How to test?
  - Mauchly's test
  - If significant then report the p value from one of the corrected tests
    - Greenhouse-Geisser
    - Huyn-Feldt