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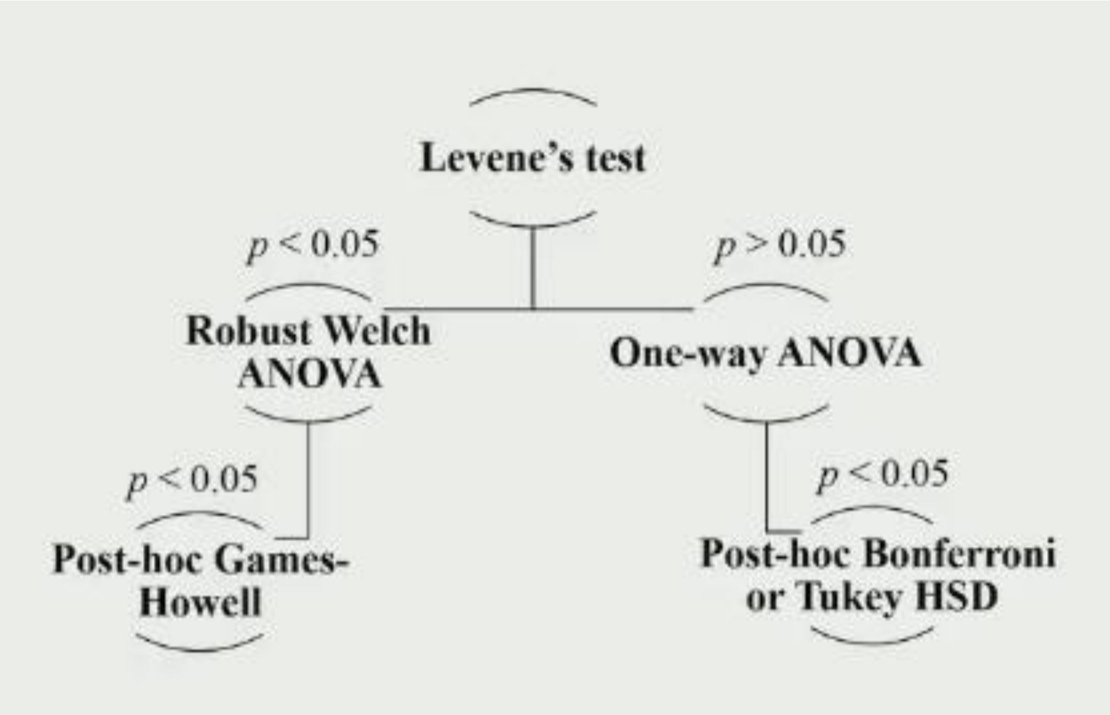
Week 3 – Factorial ANOVA

Overview



Factorial AVOVA

- Involve examining two or more factors (IV's) on a particular dependent variable (DV) called Factorial Designs
- Two-way: 2 factors
- Three-way: 3 factors, etc
- Factors can be
  - Independent-measures
  - Repeated-measures
  - Mixed-model (combination of both)
- Use a numerical code (e.g. 2 x 2) designate the number of levels of each factor
  - 2 x 3 means 2 levels of Factor A, 3 levels of Factor B
  - 2 x 3 x 4, two levels of factor a, 3 levels of factor b, 4 levels of factor c
    - 3 factors = 3-way design

What does a factorial ANOVA tell us?

- Examines the effects of each IV on its own, as well as the combined effects of the factors
- Main effect is the effect of one IV on its own.
- Interaction examines two or more factors at the same time (combined effect which may not be predictable based on the effects of either factor on their own)
- Factorial ANOVAs produce multiple F ratios, one for each main effect and interaction term

Two-way ANOVA

- What happens to DV as Factor A changes in levels?
- What happens to the DV as Factor B changes in levels?
- How do specific combinations of Factor A and B affect the DV?

What is a main effect?

- Mean differences across level of one factor, collapsing (averaging, or sometimes called marginalizing) the other factor(s).
  - Examine one factor's effects, ignoring other factors

Geographical Location

Sex		VIC	NSW	QLD	SA	
	Male	10.60	13.00	9.18	12.36	11.29
	Female	16.07	15.80	13.86	14.08	14.95
		13.33	14.40	11.52	13.22	

- Blue numbers are the main effects.

Interactions

- What is their combined effect? May not be predictable based on the effects of either factor on their own
- Whenever mean differences between individual treatment conditions are different from what would be predicted from the overall main effects of the factors.
- E.g. interaction between geographical local and sex will examine whether sex on number of days exercised depends upon geographical location
  - Do mates and females exercise different amounts based on where they live?

13.33 14.40 11.52 13.22

If no interaction, expect: average of marginal effects: $\frac{14.95 + 13.22}{2} = 14.09$

Geographical Location

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		13.33	14.40	11.52	13.22	

If no interaction, expect: average of marginal effects: $\frac{11.29 + 13.33}{2} = 12.31$

Possible effects in a 2-way ANOVA

- No effect of A, no effect of B, no interaction effect. (two straight lines at the same level)
  - Very bad result
- Main effect of A, no effect of B, no interaction effect (A is sloping, no B line)
- No effect of A, main effect of B, no interaction effect (two flat parallel lines)
- Main effect of A, main effect of B, no interaction effect (two sloping parallel lines)
- Main effect of A, main effect of B, interaction effect (two sloping lines, different gradients)
- No effect of a, no effect of b, interaction effect (lines are an X shape)
- No effect of a, main effect of b, interaction effect (< shape)
- Main effect of a, no effect of b, interaction effect. (one line straight the other line sloped and intersecting it)

- Graphs are useful but don't show you statistical significance

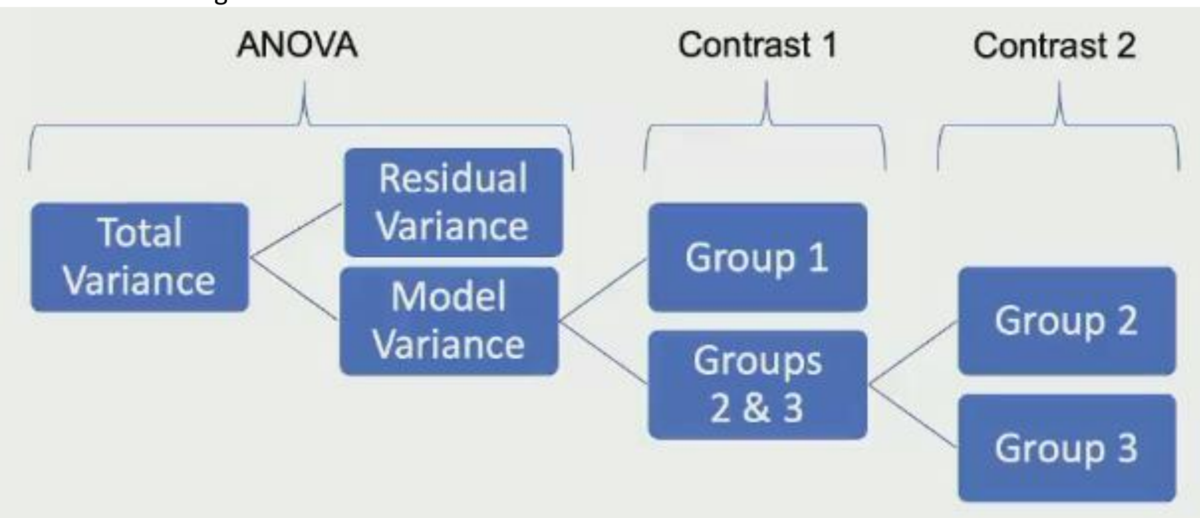
Contrasts

Planned comparisons

- Variability accounted for by the model is due to differences between the groups (e.g. treatment effects)
  - Can be further broken down to test specific hypotheses about which groups might differ from anotehr
  - Break down the variance according to hypotheses made a priori (before experiment)
  - If hypotheses are independent of one another, family wise type I error will be controlled.
    - When breaking down variance, think of cutting up a a cake – you can up slices into smaller bits, but can't stick chunks back together

Choosing contrasts

1. Use a control group as reference point
2. Only use 2 pieces
3. Independence
   a. Contrasts must not interfere with each other
   b. Orthogonal



Coding contrasts

- To perform planned comparisons using SPSS/JASP be have to teell it which groups to compare by assigning contrast weights
- These weights form a linear combination of the group means where k = number of groups
- We also choose the weights such the sum of the weights is equal to zero.
  - E.g. '- 1 and +1', or' '-1, +1 and 0', or '+2, -1, and -1'

Guidelines for contrasts

- Choose sensible comparisons
- Groups coded with positive weights will be compared against groups coded with negative
- The num of weights for a comparison should be zero
- If a group is not involved in a comparison, automatically assign it a weight of 0
- For a given contrast, the weights assigned to the groups in a one chunk of a variation should be equal to the number of groups in the opposite chump of variation

Orthogonal contrasts

- Means independent
- Contrasts which all tap into different things
- Not required but facilitates interpretation, because each effect is independent of other effects.
- Two contrasts are orthogonal if the product of their weights sum to zero
- To fully partition the variability for by the model, for k groups, there are k - 1 possible orthogonal contrasts
    - E.g. with 4 groups means we have 3 possible orthogonal contrasts, thus 3 contrasts required to fully separate the variance explained by the model.
    - A vs B + C +D --> B vs C+ D --> C vs D (no overlap)

Quiz 2 Prep

In JASP

- ANOVA --> ANOVA
- 'y' --> Dependent variable box
- 'group' --> fixed factors box
- Model --> group --> model terms box
- Assumption checks --> tick homogeneity tests and Q-Q plot of residuals
- Contrasts --> Helmert (I think all are fine but Helmert is orthogonal)
- Post hoc tests --> move group into box on the right, tick effect size, bonferroni, standard
- Additional options --> move groups into box on the right, tick descriptive statistics, estimates of effect size, eta squre and omega square

Week 3 Tutorial

1. Eta sqaure vs Cohen's d?
    a. The percentage of the impact vs percentage of the error.
2. Independence of observations? Situation where this is violated for ANOVA.

Milestone 1

- Intro
- Method
    - Materials
        - The different questionnaires (NPII, etc.)
    - Procedure
        - The participants did a survey
    - Participants
        - N might be a bit different if some participants are taken out because they didn't fill out a lot of the sections that we're interested in

- Data Analysis Plan

Rubric

- **Intro**
    - Introduce key concepts, define key terms
    - Key elements: rationale, aim, hypotheses
    - Synthesise data, good linking words
- **Method**
- **Data analysis plan**
    - Use subheadings!
    - Data management
        - Check for assumptions, deal with violations, check and deal with outliers
        - How you will transform variables if need be
        - Missing data will be excluded
        - Outliers checked using histograms and box plots
        - Checked with z-score transformation
        - Values producing score of more that x will be considered an outlier
        - Normality will be checked with x test, homogeneity of variance will be checked with x
        - Transformations of continuous variables used to reduce positive/negative skew and unequal variance.
    - Descriptive statistics
        - Which variables, how you will calculate and present
        - M, SD, CI, range, variances obtained for gender, using PSS for each variable,
        - Presented in tabular format
    - Primary analyses
        - These are your main analyses you will be doing, to test your hypotheses – make sure they match!
        - E.g. if you are looking at relationship between variables then you are looking at regression as opposied to ANOVA
        - Effect sizes
            - Reference to books that recommend which effect size measurement to use
        - Any supplementary analyses (post hoc tests)
        - Multiple linear regression is the primary statistical test for the hypotheses
        - The predictor variables are x and y with z