Between-groups vs. repeated measures designs

- Between-groups designs: individual differences may vary between groups meaning there is relatively more individual differences.
- Repeated measures designs: individual differences are constant within participants across groups so there is relatively less individual differences therefore unsystematic variance (variance that cannot be explained by the model) is reduced.

Repeated measures assumptions

- Same as between-groups assumptions (except independence).

What about variance?

- Because we're testing the same people in each group, within participants variance contains the experimental effect (because we've manipulated it within individuals as they pass from one group to another) and individual differences and other error.
- Between participants variation contains individual differences and other error.

Investigating main effects

- If significant main effects of factors with three or more levels, then post hoc testing is required.
- In SPSS – paired samples t-tests (with Bonferroni's correction).

Investigating interactions

- If an interaction is significant, we must carry out Simple Effect Analysis.
- When our factors are repeated, we can do one-way ANOVAs of Factor X within each level of Factor Y.

Mixed factorial ANOVA – at least one repeated factor and one independent factor.

Investigating the interaction

- When the design is mixed, we must be careful with the Simple Main Effects.
- SMEs of repeated factor within each level of an independent factor (one-way ANOVAs).
- SMEs of independent factor within each level of an independent factor (requires by-hand analysis).

Summary

- Two-way repeated measures ANOVA – investigate with simple main effects.
- Two-way mixed ANOVA – investigate with simple main effects where appropriate.

ANOVA Overview

Outline

- Assumptions.
- Workflow (effect sizes).
- Contrasts.
- ANCOVA.
- MANOVA.

Why use assumptions?

- Why are they important? – when violated our Type 1 error and Type 2 error rates change:
    1. Type 1 error rate (false positive rate) needs to be 5%, if its higher we'll start to see effect where none exist, if its lower, it'll be harder to detect effects.
    2. Type 2 error rate (false negative rate), as this increases, we're more likely to fail to detect true effects.

Assumptions of ANOVA

1. Observations should be independent – applies to between groups factors only.
2. Normality.

- Yet the shape of the distribution doesn't affect the ranks much.
- This is why nonparametric tests don't need to make assumptions about the population distribution.

Medians

- Remember, the median is the value separating the higher half of a number set from the lower half.
- Works better than mean as a measure of typicality for a distribution when the distribution is non-normal.

Comparing the two

	Parametric	Nonparametric
Central tendency sensitivity	Sensitive to mean differences	Sensitive to median differences
Sensitivity to outliers	High	Low
Power	Higher	Lower
Calculation difficulty	Harder	Easier

Mann-Whitney test – testing for differences between two groups of independent data

- Rationale: if you take all the data points in your sample, then rank them by size, then put them back into their original groups, you can conclude a significant group difference if the ranks are unevenly distributed between your groups.
- In other words, if the mean ranks are more similar, group difference is smaller; if the mean ranks are more dissimilar, group difference is larger.
- Mann-Whitney – rank all scores then calculate how many times one group is ranked higher than the other. If the groups differ a lot in ranks, then we can say there is statistical difference between their values.
    1. Rank scores: tied ranks get mean of rank.
    2. Note group.
    3. Sum ranks per group.
    4. Calculate mean rank/calculate Mann-Whitney U.
- Report Mann-Whitney *U* as *U*.
- *z* is useful as a standard effect size.
- Use exact significance.
- So report as *U* = ?, *z* = ?, *p* > ?.

Wilcoxon's matched pairs signed-ranks test – testing for differences between two groups of related data

- Rationale: when you have two related groups, a person can either increase (+), lower (-) or maintain their scores
- If no true difference between all pairs, the signs of the differences will be random.
- If there is a true difference between all pairs, the signs of the differences will be unbalanced across groups.
- Wilcoxon – obtain differences for all pairs of data, rank the differences, ignoring signs, and obtain the sum of ranks for the least occurring sign. If the sum suggests an imbalance in signs, then we have a group difference.
    1. Calculate paired differences.
    2. Rank paired differences (ignoring 0s).
    3. Calculate sum of ranks for least occurring sign.
- Sum of ranks = Wilcoxon *t.*
- SPSS output – *t* score has been converted directly to *z*.
- Reporting – *z* = ?, *p* < ?.

The Kruskal-Wallis one-way analysis of variance – testing for differences between many groups of independent data