Formative Assessment #1

Fall 2025 PSQF 6272: Clustered Multilevel Models

Question 1

If patients from a single hospital clinic (seen by the same physician) are randomly assigned to one of two groups (treatment or control), how many *levels* of a model would you need to predict patient outcomes?

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- One level: similar to fit a *one-source* ANOVA model or a simple linear regression model.
- Why? Patients were randomly assigned to treatment or control group within a **single clinic**, so there should be no additional variation after accounting for the fixed effects of the groups.

Question 2

What if the previous study were extended to 50 hospitals, in which 25 hospitals were treatment sites and 25 hospitals were control sites — then how many *levels* of a model would be needed to predict patient outcomes?

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- Two levels: patients (level 1) nested within hospitals (level 2).
- Treatment would be a level 2 predictor.

Question 3

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- They assume independence of observations, which is violated in hierarchical data where observations are nested within higher-level units (e.g., patients within hospitals), leading to correlated residuals, biased standard errors, and *smushed* fixed effects.

Question 4

How is **ICC1** computed?

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ICC1 is computed as the proportion of total outcome variance that is attributable to differences between clusters:

$$\frac{\tau^2_{U_0}}{\tau^2_{U_0} + \sigma^2_e}$$

where $\tau^2_{U_0}$ is the between-cluster variance and σ^2_e is the within-cluster variance.

Question 4

What are three interpretations of ICC1?

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1. Proportion of total variance that is between clusters.
2. Average correlation of persons from same cluster.
3. Effect size for constant cluster dependency.

Question 5

How does **ICC2** differ from ICC1?

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ICC2 is computed similarly to ICC1 but focuses on the reliability of the cluster means:

$$ICC2 = \frac{\tau^2_{U_0}}{\tau^2_{U_0} + (\sigma^2_e / L1n)}$$

where $L1n$ is the number of individuals per cluster.

Question 5

What is an important caveat in thinking about ICC2 as a measure of reliability?

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An important caveat is *how much* variation in the outcome is attributable to between-cluster mean differences.

Thank You!

Questions?