Benefits of Using Multilevel Models on Longitudinal Nested Data
A brief illustration using Pressley Ridge data

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Objective
The objective of this presentation is to compare two statistical methodologies.

The main message is this: when dealing with longitudinal nested data multilevel models are more appropriate statistical tools than simple traditional methods.

Data at hand: Pressley Ridge Alliance Data
- This analysis uses alliance data collected in a partial hospitalization setting: Day School during the school year 2002-03.
- Each youth rated his/her relationship with the Teacher Counselor about once a month.
- Type of measure: Therapeutic Alliance Questionnaire is 30-item, 3-point scale.
- Youth Alliance rating is the mean of non-missing 20 items.
- Youth are assigned to classrooms; each class has 10-15 youth → nested data.

Day School: Alliance Data Structure

What do we want to know?
1. Did the relationship get better/worse over time? Was there any change? We want to determine each child’s growth trajectory – its shape and growth rate.
2. Was change the same or was it different across individuals?

Alliance Day School Data: Longitudinal -Nested
Data at hand:
- Each youth had a different number of repeated alliance measures: longitudinal data.
- Children are not randomly distributed –they are clustered in classrooms based on their main diagnoses, age, academic level, etc.
Let's use Traditional Methods

Ordinary Least Square Methods (OLS)

Traditional methods like OLS are simple to use. OLS fits a linear equation where the goal is to estimate averages chosen to minimize the distances between real data (dots) and estimated line:

\[ TA = \theta_0 + \theta_1 \text{Time} + \epsilon \]

Results of traditional approach:

Youth Alliance = 2.4 - .003*Month

\[ \begin{align*}
\theta_0 & \rightarrow \text{Intercept} = 2.4 \\
\theta_1 & \rightarrow \text{Slope} = \text{on average no change}
\end{align*} \]

Dots show actual alliance ratings

But we want to measure each child's trajectory—see how different they are.

This animated graph on the right shows the alliance ratings of 6 youths to illustrate how unique and different each child sees the alliance with his/her teacher counselor.

Youth 1001: started with high alliance but then it decreased a little

Youth 1004 reported an unfavorable alliance at the beginning of the school year but it improved significantly over time.

Youth 1003 started with a very high alliance and it did not change much over time.

Let's use Multilevel Models (MLM)

Why? Multilevel models are ideal for studying change, they deal with longitudinal and nested data.

MLM answers what we want to know:

1. Estimate a trajectory for each youth—level 1
2. Estimate whether the trajectory shapes & slopes are the same across youths—level 2

Comparing MLM vs. Traditional Methods

Estimated Coefficients

<table>
<thead>
<tr>
<th>Method</th>
<th>Interpretation from MLM</th>
<th>Traditional Least Sq</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>On average, children started above Neutral 2.34***</td>
<td>2.34***</td>
</tr>
<tr>
<td>Slope/rate of change</td>
<td>On average, there is no change -0.003</td>
<td>-0.004</td>
</tr>
<tr>
<td>Variance Component</td>
<td>Differences across individuals</td>
<td>n/a</td>
</tr>
<tr>
<td>Level 2 - Differences across individuals</td>
<td>Some started low-improved, others went down.</td>
<td>Some children's alliance improve - others don't change.</td>
</tr>
<tr>
<td>Level 1 - Within-individual youth</td>
<td>Each child has a different trajectory</td>
<td>Alliances at beginning of school differ among youth.</td>
</tr>
</tbody>
</table>

OLS ignores individual differences

But we want to measure each child's trajectory—see how different they are.

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MLM Results Showing Group of Children Improving their Alliance, Getting Worse, No Change Over Time

- 67 percent of children reported a flat alliance with no change over time.
- 17 percent reported an increasing alliance, the relationship got better (blue line).
- Remaining 16 percent said their relationship with her/his teacher counselor deteriorated over time (red line).

Conclusions

- MLM ideal to capture each child’s uniqueness and measure individual trajectories – growth curves.
- MLM ideal to capture differences across youths.
- Traditional approaches cannot handle longitudinal nested data – the results are misleading.
- Multilevel Models provide additional information not available in traditional methods.