STA 3180 Statistical Modelling: Multilevel Modeling

STA 3180 Statistical Modelling - Multilevel Modeling Lecture Notes

Definition

Multilevel modeling (MLM) is a statistical technique used to analyze data that is nested or clustered within higher-level groups. It is also known as hierarchical linear modeling, mixed-effects modeling, random coefficient modeling, and split-plot analysis. MLM is used to account for the effects of clustering in data, such as when individuals are grouped into classrooms, or when students are nested within schools.

Key Concepts

1. Fixed Effects: Fixed effects are effects that are assumed to be constant across all observations. These effects are usually related to individual characteristics, such as gender, race, or age.

2. Random Effects: Random effects are effects that vary across observations. These effects are usually related to group characteristics, such as classroom or school.

3. Nested Data: Nested data is data that is organized in a hierarchical structure, with observations nested within higher-level groups.

4. Level-1 Model: The level-1 model is the model used to explain the variation in the outcome variable at the lowest level of the hierarchy.

5. Level-2 Model: The level-2 model is the model used to explain the variation in the outcome variable at the highest level of the hierarchy.

Coding Examples

Example 1: Fixed Effects Model

```
Start of Code
library(lme4)
model <- lmer(outcome ~ predictor + (1|group), data = data)
summary(model)
End of Code
```

Example 2: Random Effects Model

```
Start of Code
library(lme4)
model <- lmer(outcome ~ predictor + (predictor|group), data = data)
summary(model)
End of Code
```

Practice Multiple Choice Questions

Q1. Which of the following is NOT a type of multilevel modeling?

A. Linear regression

B. Hierarchical linear modeling

C. Random coefficient modeling

D. Split-plot analysis

Answer: A. Linear regression