An introduction to repeated measures

HIERARCHICAL AND MIXED EFFECTS MODELS IN R

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Repeated measures

- Follow same unit of study through time
- e.g., cohort of students, individuals
- More powerful because of individual-level variability observed

Paired t-test

- Special case of a t-test
- Example of change in test scores pre- and post-intervention
- Nice conceptual introduction to repeated measures

Paired t-test in R

```
t.test(x1, x2, paired = TRUE)
```

Repeated measures ANOVA

- Conceptual extension of paired t-test
- Tests if means are constant across time
- Example of change in student test-scores with >2 tests

Repeated measures in R

```
library(lmerTest)


anova(lmer(y ~ time + (1 | individual))
```

Extension to lmer and glmer

- Repeated measures a special type of mixed-effect
- Can be applied to `glmer` as well
- Powerful additional use of tool
- Degrees of freedom is an open research method

Let's practice!

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Sleep study

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Overview of sleep study

- Two soporific drugs
- 10 patients
- Classic dataset used by "Student"

Research question

- ANOVA type analysis:
  - H_0: Drug type term does not explain a significant amount of variability
  - H_a: Drug type term explains a significant amount of variability
- Regression coefficient approach
  - H_0: Drug type term is zero
  - H_a: Drug type term is not zero

Modeling approach

- Visualize data
- Build simple model
- Build model of interest
- Extract information of interest
- Visualize results

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Hate in NY state?

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Overview of data

- Data from **Data.gov**
- Collected by New York State
- Includes county, year, crime type (against property or person), and group targeted

Questions with data

- Is the state-wide number of hate crimes changing?
- Are the number of hate crimes changing differently in each county?

Know your target audiences

- Technical details
- Figures versus tables

Presenting for "pop" audiences

- Narrative important
- Avoid bogged down with details

Presenting for scientific audiences

- Reproducibility
- Technical details
- Code
- Match style of your field

Let's practice!

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Conclusion

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Happy coding!

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