Repeated Measures ANOVA

BUS 735: Business Decision Making and Research

Goals of this section

Specific goals

- Learn background and implementation of RANOVA: a method to detect the impact of categorical variables measured over the same subjects (dependent samples).
- Learn how to incorporate ideas we have already learned in RANOVA models.

Learning objectives

- LO3: Be able to construct and use analysis of variance and analysis of covariance models to construct and test hypotheses considering complex relationships among multiple variables.
- LO6: Be able to use standard computer packages such as SPSS and Excel to conduct the quantitative analyses described in the learning objectives above.
- LO7: Have a sound familiarity of various statistical and quantitative methods in order to be able to approach a business decision problem and be able to select appropriate methods to answer the question.

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- Recall dependent samples T-test:
  - Involved *repeated measures*: same (dependent) variable was measured before and after some treatment.
  - Examined *within subject variability*: examined differences in dependent variable *for each subject*.
- Repeated Measures ANOVA (RANOVA): extends the analysis of Dependent Samples T-tests to two or more groups.
  - In much the same way ANOVA extended the Independent Samples T-test.
  - We call this **Within-Subjects Analysis of Variance**.
  - This is one type of RANOVA. We will examine another type.

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  - before advertising campaign begins,
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- Is there a difference in anxiety in torture victims...
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- Dependent samples T-Test and RANOVA have dependent samples as the same subjects are in each group.
- **Across Time Variation**... aka **Repeated Measures**... aka **Occasions variation**.
- **Different Conditions Variation**: measure the same dependent variable, among the same subject, but under different conditions:
  - Magnitude of headache pain with no treatment, after taking Advil, after taking Tylenol; each administered at different times.
- **Related Topics Variation**: *Slightly different* dependent variables are measured for the same subjects:
  - ESL proficiency score for writing.
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- Involved *independent groups*: different individuals randomly fell or assigned to into different groups.
- Examined *between-subject variability*: examined differences in dependent variable *between different groups of subjects*.
- Example: Is there is difference in sales revenue between businesses that advertise primarily on...
  - television,
  - radio, and
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- Example: Is there a difference in anxiety in torture victims between males and females?

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- Extends the *repeated-measures within subjects ANOVA* to also account for categorical explanatory variables that put subjects into *independent groups*.
- Combines:
  1. *repeated-measures within subjects ANOVA*, and
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Example for sales revenue and advertising:

1. Is there a difference in sales revenue for businesses...
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Hypothesis Tests:

- (Accounting for...) are there differences in sales revenue depending on time into the advertising campaign?
- (Accounting for...) are there differences in sales revenue depending on the type of advertising?
- Is there an interaction effect between type of advertising and time into the advertising campaign?
  - In other words, "Does the effect advertising has on sales revenue across time depend on the type of advertising?"

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- Null: Accounting for the other explanatory variables in the model, there is no difference in the mean dependent variable among the categories of the explanatory variable of interest.
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- Dependent variable: Sales revenue.
- Within-subjects explanatory variable: time into advertising campaign (categorical).
- Null: There is no difference in mean sales revenue for business before an advertising campaign begins, one week into advertising, one month into advertising, and one month after conclusion of advertising.
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Hypothesis Example: Within-Between-Subjects

Variables

- Dependent variable: Sales revenue.
- Within-subjects explanatory variable: time into advertising campaign.
- Between-subjects explanatory variable: advertising medium (TV, radio, outdoor).

Null Hypotheses 1

Accounting for advertising medium, there is no difference in mean sales revenue for business before an advertising campaign begins, one week into advertising, one month into advertising, and one month after conclusion of advertising.

Null Hypotheses 2

Accounting for time into advertising campaign, there is no difference in mean sales revenue for businesses advertising on TV, radio, and outdoor.

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- Sample size sufficiently large.
  - At least 30 subjects with repeated measures taken.
  - At least 30 subjects in each group for categorical explanatory variables.
- Dependent variable is interval data or above.
- Normally distributed dependent variable is helpful.
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