Random Effects vs Fixed Effects

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What does “Fixed Effect” mean?

- Fixed Effect: "treatment" levels which are the only levels of the variable in question in which we have an interest.
- In a simple experiment we might have a treatment group and a control group. The purpose is to compare these two groups.
- No attempt to generalize to other treatments.

What does “Random Effect” mean?

- Random Effect: "treatment" levels are a random sample from the variable in question
- A variable's effects might be treated as random effects if the levels of the variable are a sample drawn from some larger population of levels that could have been selected
- Generalization to other treatments is possible

Why does it matter which we use?

- The analysis of the data is different, depending on whether the factor is treated as fixed or as random.
- Inferences may be incorrect if the factor is classified inappropriately.
- Mistakes in classification are most likely to occur when there is more than one factor in the study.

Fixed Effect Example

- A drug is administered at 1mg, 5mg, and 10mg dosages in a study.
- The purpose of the study is to compare these specific dosages, no inferences about other dosages will be made.
- Understanding the differences in the mean response at these three levels is the goal.

Random Effect Example

- A manufacturer of widgets is studying the effect of machine operator on the quality of the final product. A random sample of operators is taken from the large number of operators at the various facilities that manufacture the widgets. The factor is called "operator.“
- The analysis will not estimate the effect of each of the operators in the sample, but will instead estimate the variability attributable to the factor
- Understanding the amount of variability attributable to “operator” is the goal.

Summary

- The key statistical issue between fixed and random effects is whether the effects of the levels of a factor are thought of as being a draw from a probability distribution of such effects.
- If so, the effect is random
  - Most blocking factors are treated as random.
  - Interactions of fixed and random effects are random.
- If the levels of a factor are not a sample of possible levels, the effects are fixed.
  - Usually treatment effects are fixed.

A final word about SAS

- PROC GLM – initial computations are done assuming that all effects are fixed
  - The RANDOM statement causes SAS to perform some postprocessing on the initial analysis to obtain an approximate random effect model
- PROC MIXED – performs more accurate analyses when random effects are present