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Section 1

MANE 6313

Subsection 1

Week 5, Module A

Student Learning Outcome

Analyze simple comparative experiments and experiments with a single factor.

Module Learning Outcome

Evaluate randomized block designs.

Chapter 4 Terminology

- *Nuisance Factor* is a design factor that probably has an effect on the response, but we are not interested in its effect.
- Some nuisance factors are *unknown and uncontrollable*. These variables are said to be "lurking"
- The only protection against unknown and uncontrollable nuisance factors is *randomization*
- If the factor is *known and uncontrollable* we can compensate by using analysis of covariance
- If the factor is *known and controllable*, we can use *blocking*.

Chapter 4 Terminology, continued

- *Blocking* allows the systematic elimination of a nuisance variables effect upon the statistical comparisons.
- A **Block** is a portion of the experimental material that is more homogeneous than the aggregate (total).
- If not recognized and accounted for, the variability associated with blocks will be grouped with the random error and result in an insensitive test.

Randomized Complete Block Design

- New model:

$$y_{ij} = \mu + \tau_i + \beta_j + \varepsilon_{ij} \quad \begin{cases} i = 1, 2, \ldots, a \\ j = 1, 2, \ldots, b \end{cases}$$

blocks

Note that $\sum_{i=1}^{a} \tau_i = 0$ and $\sum_{j=1}^{b} \beta_j = 0$

Notice: no "interactions" between blocks, β_j & treatments, τ_i, and

ANOVA Table

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Factor	SS_{Factor}	$a-1$	$\frac{SS_{\text{Factor}}}{a-1}$	$F_0 = \frac{MS_{\text{Factor}}}{MS_E}$
Blocks	SS_{Blocks}	$b-1$	$\frac{SS_{\text{Blocks}}}{b-1}$	
Error	SS_E	$(a-1)(b-1)$	$\frac{SS_E}{(a-1)(b-1)}$	
Total	SS_T	$N-1$		

new →

SS formula for CRBD

$$SS_T = \sum_{i=1}^{a}\sum_{j=1}^{b} y_{ij}^2 - \frac{y_{..}^2}{N}$$

$$SS_{\text{Treatments}} = \frac{1}{b}\sum_{i=1}^{a} y_{i.}^2 - \frac{y_{..}^2}{N}$$

$$SS_{\text{Blocks}} = \frac{1}{a}\sum_{i=1}^{b} y_{.j}^2 - \frac{y_{..}^2}{N}$$

$$SS_e = SS_T - SS_{\text{Treatments}} - SS_{\text{Blocks}}$$

More Details

- If the fixed effects model is used, multiple comparisons can be made.
- Blocking is a *restriction on randomization*. In a completely randomized design, there are *an* experimental units and treatments are randomly applied to each experimental unit
- A completely randomized block design, we have b blocks and randomization happens within each block (not experimental unit).