Discussion # 12: Write-up Assignment due Monday, 21 April

Use REML to analyze a two-way mixed-effect model with interaction (as in Eqn. 25.84 in the text) for the data on the antibiotic effects of the three coral species from the three sites, treating species as a fixed effect and site as a random effect.

Do not do any analyses using the additive model without the species x site interaction.

In your write-up, state what software you used. If JMP, report any changes you made from the default options. If R, say what package(s) you loaded and show all your function calls. See the end of this assignment for further instructions on how to do in R.

(1) Assess the following assumptions:
   (a) independence of the observations
   (b) equality of the residual variances across the nine site x species groups
   (c) Normality of the residuals

Comment: The preceding assessments all concern assumptions about the residuals, the \( \varepsilon_{ijk} \): that they are independent \( \mathcal{N}(0, \sigma^2) \). Similar assumptions are made about the site and interaction effects [the \( \beta_j \) and \( (\alpha\beta)_{ij} \) in the text’s notation, or the \( B_j \) and \( (AB)_{ij} \) in the notation I used in lecture]. The assumptions of independence for these terms can be assessed by considering the design of the study, but the assumptions of equal variance and Normality are essentially impossible to assess with so few sites.

(2) Obtain estimates and 95% CIs for the three variance components. What do you conclude?

(3) Test the significance of the species effect. What do you conclude?

(4) Conduct multiple comparisons among the species, using some form of adjustment for multiple testing (specify what adjustment you used). What do you conclude?

What to do in R:

- Use the lme4 and lmerTest packages.
- Specify the model formula as
  \[
  \text{growth} \sim \text{species} + (1 \mid \text{site}) + (1 \mid \text{site:species})
  \]
- Use confint in lme4 to get CIs for the variance estimates.
- Use the lmerTest ANOVA method to test the fixed effect, using the Kenward-Rogers method for estimating the denominator degrees of freedom.
- Use diffTtest in lmerTest to do the multiple comparisons; apply a Bonferroni adjustment in drawing your conclusions.