

4. **[3 points]** Conceptual exercise 3(b) of the *Sleuth* states that the assumption of normality is assisted by considering averages of groups of 10 plants in the analysis. However the use of averages as the responses in an analysis may have an impact on the estimate of variability in plant responses.

True or False. Circle one. The effect of using averages as responses in the meadowfoam study could decrease variability in the response (number of flowers), thereby decreasing the width of associated confidence intervals for the study and increasing Type I error.

5. Fit the model “flowers~intensity+timing”. Under “Results”, check the box for “means”. Under “Plot”, click the button for “Residuals vs. Fit”. Copy the ANOVA table to a Word file so you can save it for future questions. We will refer to this model as “Model A”.

(a) **[5 points]** Is there a light intensity effect? Give hypotheses in terms of the problem, test statistic, distribution of test statistic, and p-value. Give a 1-sentence conclusion in terms of the problem.

(b) **[5 points]** Give the assumptions of the 2-way ANOVA that can be verified by the Residuals vs. Fit plot.

(c) **[10 points]** Give a 95% confidence interval for the difference in the number of flowers at 600 and at 300 $\mu\text{ mol/ m}^3$ / sec based on the additive model.

(d) **[2 points] True or False. Circle one.** The p-value you gave in 5(a) can be viewed as inaccurate because it does not reduce variation by explicitly accounting for the effect of timing.

6. Now we will perform a one-way analysis of variance on the same dataset. Go to the quiz web page to find the re-formatted data you will need. We will consider each combination of timing and intensity as a separate group. Thus we have 16 groups in our ANOVA, with 2 measurements per group.

Fit the ANOVA model, making sure to check “means” under “Results” and “Residuals Normal QQ” under “Plot”. Copy the ANOVA table to a Word file so you can save it for future questions. We will refer to this model as “Model B”.

- (a) **[10 points]** Use the 1-way ANOVA to calculate a 95% confidence interval for the difference in the number of flowers at 600 and at 300 $\mu\text{ mol/ m}^3 / \text{ sec}$. Clearly write out the contrasts you use to construct the interval. Is the confidence interval here different from the one in 5(c)? Why or why not?

- (b) **[2 points]** Use the QQ plot of the residuals to compare the shape of the distribution of the residuals to that of the normal distribution. **Select one.**

- (i) The distribution of the residuals has longer tails than the normal distribution.
- (ii) The distribution of the residuals has shorter tails than the normal distribution.
- (iii) The distribution of the residuals is skewed right.
- (iv) The distribution of the residuals is skewed left.

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