Homework Assignment for Lesson 4

Please submit ONE document to the Dropbox for Homework 4. This can be a Word document (preferred) or a pdf file. **NOTE: For Question 1 and 2, which require use of statistical software, at least one analysis must be done in SAS. Both software programs will perform the analysis, and so the choice is up to you which one you apply to which question.**

**1)** Consider the following data, the result of a 2-factor factorial experiment with 5 replications. Treatment combinations were assigned at random to the 20 experimental units.

Experimental units.

A B resp

1 1 12.9

1 1 11.3

1 1 11.7

1 1 12.1

1 1 12.3

1 2 13.7

1 2 12.8

1 2 13.6

1 2 13.1

1 2 13.5

2 1 14.2

2 1 14.5

2 1 13.9

2 1 13.6

2 1 14.4

2 2 13.5

2 2 13.1

2 2 13.3

2 2 13.1

2 2 13.4

Make up and describe an experiment for which these data were obtained. This can be an experiment reflecting your area of study, or be a hobby, sports, anything. You can modify the response variable by adding or subtracting a constant amount to each value, so you can adjust the response variable values to be realistic for your experiment. (Hint: Do an exploratory data analysis (EDA) and run the ANOVA before you invent the experiment. It is important to think ahead on what the results will mean).

a) (10 pts) Provide a Study Diagram for your experiment

b) (10 pts) State the null and alternative hypotheses

c) (10 pts) Run an ANOVA and include any output you consider important (e.g., diagnostics).

d) (10 pts) Do a mean comparison (where appropriate based on the ANOVA) using the Tukey adjustment**.**

e) (10 pts) Produce a final graph (or graphs, if appropriate, depending on the results) to show the outcome of your experiment. The graph(s) can be either bar charts or means plots, but needs to include error bars (either +/- 1 standard error, or 95% CI limits) and Tukey mean comparison results. Include a figure caption that explains the symbols used. Provide a *brief* interpretation of the results.

**2)** Consider a hypothetical study in which hardwood chips are believed to differ from softwood chips in nitrogen concentration. They were specifically interested in 6 tree species currently used in biomass fuel production (3 species of hardwoods, 3 species of softwoods). Four samples of each species were tested for N concentration.

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| |  |  |  | | --- | --- | --- | | Type | Species | Nconc | | softwood | pine | 12 | | softwood | pine | 13 | | softwood | pine | 11 | | softwood | pine | 12 | | softwood | spruce | 15 | | softwood | spruce | 19 | | softwood | spruce | 17 | | softwood | spruce | 17 | | softwood | fir | 10 | | softwood | fir | 12 | | softwood | fir | 11 | | softwood | fir | 17 | | hardwood | maple | 18 | | hardwood | maple | 20 | | hardwood | maple | 21 | | hardwood | maple | 16 | | hardwood | oak | 20 | | hardwood | oak | 14 | | hardwood | oak | 17 | | hardwood | oak | 15 | | hardwood | ash | 19 | | hardwood | ash | 22 | | hardwood | ash | 21 | | hardwood | ash | 21 | |  |  |

a) (10 pts) Provide a study diagram for this experiment.

b) (10pts) Write out the statistical model for the ANOVA (You can use words instead of subscripted Greek symbols.)

c) (20 pts) Run the ANOVA, extract relevant output to submit, and conduct mean comparisons (Tukey method) where factors are significant.

d) (10 pts) Graph significant results in bar chart or means plot form showing the means, error bars, and results of the mean comparisons. Describe the graph in a Figure Caption.