

1. Below is SAS output for a weighted least squares (WLS) ANOVA.

- (a) (1pt) Based on the boxplots, do you think it was reasonable to perform a WLS ANOVA? Justify your answer in at most three sentences.
- (b) (1pt) Suppose the researcher asks you to use a Box-Cox transformation on the data. Do you think this is a reasonable suggestion? Justify your answer in at most three sentences.

Weighted Least Squares ANOVA Output

The GLM Procedure

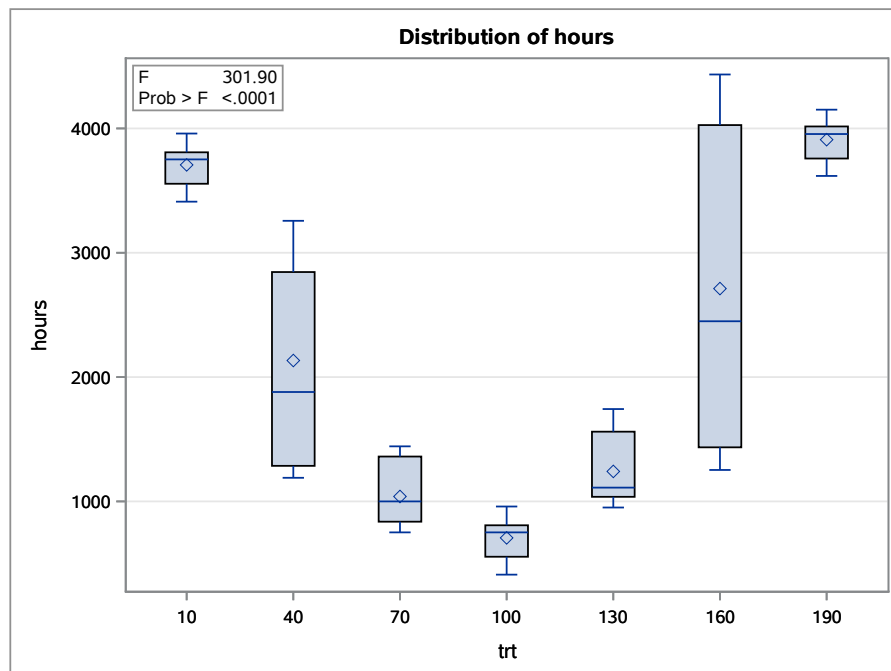
Dependent Variable: hours

Weight: wgt

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	1811.375008	301.895835	301.90	<.0001
Error	42	42.000000	1.000000		
Corrected Total	48	1853.375008			

R-Square	Coeff Var	Root MSE	hours Mean
0.977339	0.041034	1.00000	2437.025

Source	DF	Type III SS	Mean Square	F Value	Pr > F
trt	6	1811.375008	301.895835	301.90	<.0001



2. (1pt) Problem 3.44, page 136.
3. (2.5pt) Problem 3.45, page 137.

4. (7pt) Problem 4.10 (a) and (b), page 178, and also include

- A Bonferroni MCP using $\alpha = .05$ and interpret the results.
 - Estimates of μ , each τ_i , and each β_j assuming $\sum \tau_i = 0$ and $\sum \beta_j = 0$.
- SAS code to read in the data has been sent to you.

```
DATA IN410; INPUT nozzle velocity shape @@; LINES;
  1 11.73 .78  2 11.73 .85  3 11.73 .93  4 11.73 1.14  5 11.73 .97
  1 14.37 .80  2 14.37 .85  3 14.37 .92  4 14.37 .97  5 14.37 .86
  1 16.59 .81  2 16.59 .92  3 16.59 .95  4 16.59 .98  5 16.59 .78
  1 20.43 .75  2 20.43 .86  3 20.43 .89  4 20.43 .88  5 20.43 .76
  1 23.46 .77  2 23.46 .81  3 23.46 .89  4 23.46 .86  5 23.46 .76
  1 28.74 .78  2 28.74 .83  3 28.74 .83  4 28.74 .83  5 28.74 .75
;
PROC GLM DATA=IN410 PLOTS=(ALL);
  CLASS nozzle velocity;
  MODEL shape = nozzle velocity / SS3;
  MEANS nozzle / BON;
```

5. Implantable pacemakers contain a small circuit board called a substrate. Multiple substrates are made as part of a single ‘laminate’. In this experiment, seven laminates are chosen at random. The researcher suspects that substrate length may vary within a laminate. She decided that data should be collected at eight critical substrate locations within a laminate. Substrate lengths were then collected at those 8 locations on each of the seven laminates. Here are the responses:

Location	Laminate						
	1	2	3	4	5	6	7
1	28	20	23	29	44	45	43
2	11	20	27	31	33	38	36
3	26	26	14	17	41	36	36
4	23	26	18	21	36	36	39
5	20	21	30	28	45	31	33
6	16	19	24	23	33	32	39
7	37	43	49	33	53	49	32
8	4	9	13	17	39	29	32

- (1pt) Why is it better to perform an ANOVA that classifies laminates as blocks in comparison to performing an ANOVA assuming locations as fixed effects each having 7 replicates?
- (.5pt) Are these blocks ‘complete’? Justify your answer.
- (1pt) Does this experiment satisfy the conditions to be a RCBD? If yes, then why? If no, then why not?

6. **For Stat 541 students:** Look at the boxplots generated in Problem 3 (from the nozzle design analysis).

- (1pt) The boxplots across nozzle design suggest a quadratic pattern. Provide a condition for which we could reasonably interpret a nozzle design effect as being quadratic.
- (1pt) Consider the side-by-side boxplots across velocity. Suppose you took a ruler and drew a line so that you try to minimize the squared deviations between the line and the means in the boxplots. Does the slope of your line represent your guess at the fitted simple linear regression model between the means of the shape factor and the velocity?