CHAPTER 9

THE ONE-WAY MODEL

9.4. (a) (**8 points**)) The table is

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Stat	Prob > F
Treatment	6	**1.32**	0.22	3.38	**0.0207**
Blocks	3	2.28	**0.76**	**11.69**	0.0002
Error	**18**	**1.17**	**0.065**		
C Total	**27**	4.77			

(b) (**6 points**)) There are seven treatments.

(c) (**6 points**)) There are four blocks.

9.6. (a) (**5 points**)) Randomize the order of the runs.

(b) (**10 points**)) Means model: $Y_{ij} = \mu_i + \epsilon_{ij}$, or effects model: $Y_{ij} = \mu + \tau_i + \epsilon_{ij}$. For the means model the estimates of the means are:

$$\hat{\mu}_1 = 600.21, \ \hat{\mu}_2 = 913.64, \ \hat{\mu}_3 = 1523.20, \ \hat{\mu}_4 = 478.31.$$

(c) (**10 points**)) Plots of the studentized residuals (Figure 1), reveal one possible outlier. Their distribution has a short upper tail compared with the normal distribution.
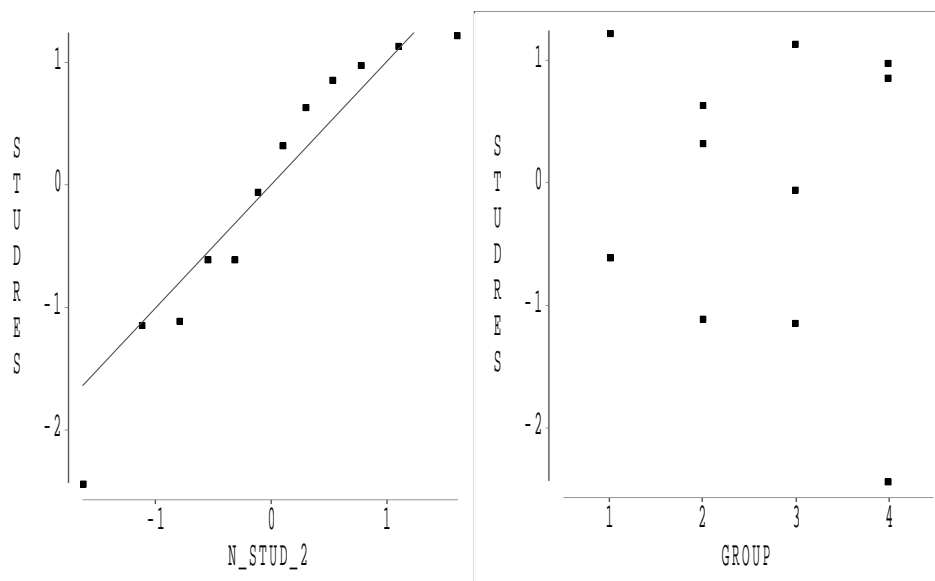

Figure 1: *Studentized residual plots, 9.6(c)*

(d) (**10 points**)) The ANOVA table is

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Stat	Prob > F
Model	3	1.96×10^6	6.54×10^5	50	0.0001
Error	8	1.05×10^5	13089		
C Total	11	2.07×10^6			

The p-value of the F test is ≤ 0.0001, indicating a highly significant difference in means. The means are ordered: $3 > 2 > 1 > 4$. Level 0.95 Tukey intervals are

Comparison	Interval
$3 - 2$	$(310.42, 908.71)$
$3 - 1$	$(623.84, 1222.14)$
$3 - 4$	$(745.74, 1344.04)$
$2 - 1$	$(14.28, 612.57)$
$2 - 4$	$(136.18, 734.47)$
$1 - 4$	$(-177.25, 421.05)$

From this we see that the mean of 3 is significantly larger than the other means, and the mean of 2 is significantly larger than that of 1 or 4. There are no differences among the other means.

(e) (**10 points**)) The report should state:

(i) A one-way means model fit reasonably well (one possible outlier).

(ii) The F test revealed a significant difference in means for different configurations.

(iv) A Tukey multiple comparison test showed that the mean force under configuration 3 exceeded that under the other three configurations; that the force under configuration 2 exceeded that under configurations 1 and 4; and that the force under configurations 1 and 4 are not significantly different.

9.10. (**10 points**)) The one-way model
$$RMS_{ij} = \mu + SHAPE_i + \epsilon_{ij},$$

was fit. The MSE was 0.007, compared with 0.004 for the full data model in Exercise 9-9. Without the reduction in variation due to cams, the F test is no longer significant ($p = 0.1497$).