

Math 484 HW 11 Fall 2022, due Monday, Dec. 5. Problems A)-E), 3 pages.
Exam 3 is Wednesday, Nov. 30.
The Final is Friday, Dec. 16, 10:15-12:15.
Q10 Wed, Dec. 7 covers this HW.

A) 6.1

Output for 6.1.

| Source | df | SS | MS | F | P |
|-------------|----|--------|-------|------|-------|
| A | 2 | 24.6 | 12.3 | 0.24 | 0.791 |
| B | 2 | 28.3 | 14.2 | 0.27 | 0.763 |
| Interaction | 4 | 1215.3 | 303.8 | 5.84 | 0.001 |
| Error | 36 | 1872.4 | 52.0 | | |

6.1. The above output uses data from Kutner et al. (2005, problems 19.16-17). A study measured the number of minutes to complete a repair job at a large dealership. The two explanatory variables were “A = technician” and “B = make of drive.” The output is given above.

- Give a four step test for no interaction.
- Give a four step test for the *B* main effects.

B) 6.3 Cut and paste the SAS program from (<http://parker.ad.siu.edu/Olive/lreghw.txt>) for 6.3 into the SAS Editor.

To execute the program, use the top menu commands “Run>Submit”. An output window will appear if successful. The data is from Montgomery (1984, p. 198) and gives the maximum output voltage for a typical type of storage battery. The two factors are material (1,2,3) and temperature (50, 65, 80°F).

- Copy and paste the SAS program into SAS, use the file command “Run>Submit.”
- Click on the “Graph1” window and scroll down to the second interaction plot of “tmp” vs “ymn.” Copy and paste the plot into *Word*.
- Is interaction present?
- Click on the output window then click on the printer icon. This will produce 5 pages of output, but only hand in the ANOVA table, response plot, and residual plots. (Cutting and pasting the output into *Word* may result in bad plots.)
- Do the residual and response plots look ok?

C) 6.5 Copy and paste the two source commands near the top of (<http://parker.ad.siu.edu/Olive/lreghw.txt>) to get the data. Then get the *R* commands from (<http://parker.ad.siu.edu/Olive/lreghw.txt>).

The Box et al. (2005, p. 318) poison data has 4 types of treatments (1,2,3,4) and 3 types of poisons (1,2,3). Each animal is given a poison and a treatment, and the response is survival in hours. Get the poison data from *lregdata*. (The above two source commands work.)

- Type the following commands to see that the output for the three models is the same. Copy and paste the output into *Word*.

```

out1<-aov(stime~ptype*treat,poison)
summary(out1)
out2<-aov(stime~ptype + treat + ptype*treat,poison)
summary(out2)
out3<-aov(stime~.^2,poison)
summary(out3)
#The three models are the same.

```

b) Type the following commands to see the residual plot. Include the plot in *Word*.

```

plot(fitted(out1),resid(out1))
title("Residual Plot")

```

c) Type the following commands to see the response plot. Include the plot in *Word*.

```

FIT <- poison$stime - out1$resid
plot(FIT,poison$stime)
abline(0,1)
title("Response Plot")

```

d) Why is the two way Anova model inappropriate?

e) Now the response $Y = 1/stime$ will be used. Type the following commands to get the output. Copy the output into *Word*.

```

attach(poison)
out4 <- aov((1/stime)~ptype*treat,poison)
summary(out4)

```

f) Type the following commands to get the residual plot. Copy the plot into *Word*.

```

plot(fitted(out4),resid(out4))
title("Residual Plot")

```

g) Type the following commands to get the response plot. Copy the plot into *Word*.

```

FIT <- 1/poison$stime - out4$resid
plot(FIT,(1/poison$stime))
abline(0,1)
title("Response Plot")

```

h) Type the following commands to get the interaction plot. Copy the plot into *Word*.

```

interaction.plot(treat,ptype,(1/stime))
detach(poison)

```

i) Test whether there is an interaction using the output from e).

D) 7.1

Output for 7.1.

| source | Df | Sum Sq | Mean Sq | F value | Pr(>F) |
|-----------|----|--------|---------|---------|---------|
| block | 4 | 49.84 | 12.46 | 2.3031 | 0.10320 |
| seed | 4 | 83.84 | 20.96 | 3.8743 | 0.02189 |
| Residuals | 16 | 86.56 | 5.41 | | |

7.1. Snedecor and Cochran (1967, p. 300) give a data set with 5 types of soybean seed. The response frate = number of seeds out of 100 that failed to germinate. Five blocks were used. Assume the appropriate model can be used (although this assumption may not be valid due to a possible interaction between the block and the treatment).

a) Did blocking help? Explain briefly.

b) Perform the appropriate 4 step test using the output above.

E) 7.4 Skip e) and f). This problem is for a one way block design and uses data from Box et al. (2005, p. 146).

a) Copy and paste the *SAS* program for this problem from (<http://parker.ad.siu.edu/Olive/lreghw.txt>). For *Word*, get the ANOVA table, residual plot, and response plot.

b) Do the plots look ok?

Skip c), d), e), and f).

g) Copy (<http://parker.ad.siu.edu/Olive/lregdata.txt>) into *R*. (Use the source command.)

Type the following commands to get the following ANOVA table.

```
z<-aov(yield~block+treat,pen)
summary(z)
```

| | Df | Sum Sq | Mean Sq | F value | Pr(>F) |
|-----------|----|---------|---------|---------|-----------|
| block | 4 | 264.000 | 66.000 | 3.5044 | 0.04075 * |
| treat | 3 | 70.000 | 23.333 | 1.2389 | 0.33866 |
| Residuals | 12 | 226.000 | 18.833 | | |

h) Did blocking appear to help?

i) Perform a 4 step *F* test for whether yield depends on treatment.