

CRM 7008: Repeated Measure ANOVA example with Wysocking Bay dredging data set

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This is an example of repeated measures ANOVA for the Wysocking Bay data. In this analysis, we have four dredging treatments: 0 cm, 2 cm, 4 cm, and 10 cm sediment "thin-layers". Note that before I ran the **Repeated Measures ANOVA**, I took the original file in Systat format, called jrbi9296.syd, and imported it to R using foreign package. Systat uses a multivariate approach to Repeated Measures ANOVA, so the data in that format are arranged with each record representing a series of measurements taken on the plots over time. Measurements of *Juncus roemerianus* biomass on different dates are in the columns in Systat (wide format). For repeated measures in the R AOV package, we need a different format, with the dates listed as a column of categorical factors (long format). I rearranged the data in this different format of one record per date replicate for this analysis. I first "melted" the data using reshape2 package, and then converted it to a text file jrmelth2.csv using a **write.csv()** command. I also fixed one missing value to get rid of an unbalanced design. This is the file I will begin with by importing it to R data frame called *jr*. Then I ran the **aov()** putting the output into the object *fit2*. Next I call a **summary (fit2)** to see the ANOVA F table output, finally I use the command **model.tables(fit2)** to compute the treatment means and grand means.

```
> jr<-read.csv(file="jrmelth2.csv")
> fit2 = aov(JR.Biomass ~ factor(TREAT)*factor(BLOCK) +
+           Error(Date/factor(TREAT)*factor(BLOCK)), data=jr)
> summary(fit2)
```

```
Error: Date
      Df Sum Sq Mean Sq F value Pr(>F)
Residuals  4   3565    891.2
```

```
Error: factor(BLOCK)
      Df Sum Sq Mean Sq
factor(BLOCK)  3   1523    507.6
```

```
Error: Date:factor(TREAT)
      Df Sum Sq Mean Sq F value Pr(>F)
```

```

factor(TREAT) 3 25802 8601 9.799 0.00151 **
Residuals 12 10532 878
---
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Error: Date:factor(BLOCK)
      Df Sum Sq Mean Sq F value Pr(>F)
Residuals 12 5371 447.6

Error: Date:factor(TREAT):factor(BLOCK)
      Df Sum Sq Mean Sq F value Pr(>F)
factor(TREAT):factor(BLOCK) 9 17169 1907.6 8.959 6.18e-07 ***
Residuals 36 7665 212.9
---
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Error: Within
      Df Sum Sq Mean Sq F value Pr(>F)
Residuals 240 62738 261.4

> model.tables(fit2)

Tables of effects

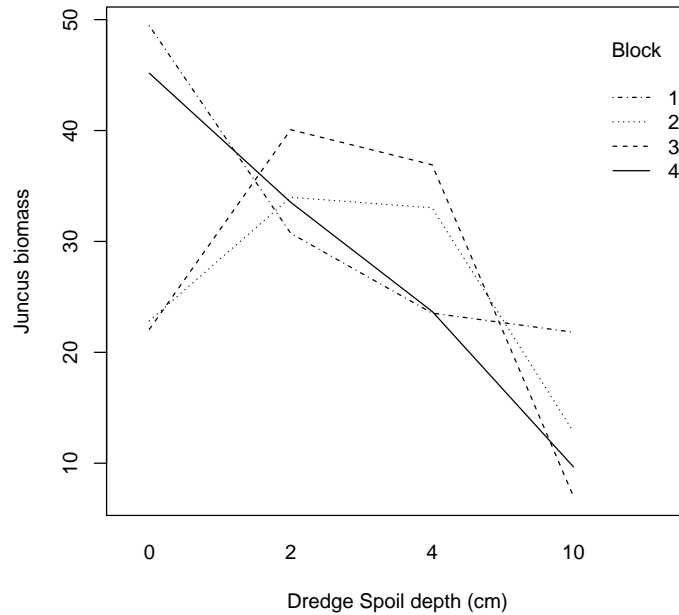
factor(TREAT)
factor(TREAT)
      0      2      4      10
6.984 6.685 1.400 -15.070

factor(BLOCK)
factor(BLOCK)
      1      2      3      4
3.487 -2.226 -1.382 0.122

factor(TREAT):factor(BLOCK)
      factor(BLOCK)
factor(TREAT) 1      2      3      4
      0 11.076 -9.817 -11.425 10.166
      2 -7.335 1.627 6.878 -1.170
      4 -9.240 5.962 8.998 -5.720
      10 5.500 2.227 -4.452 -3.275

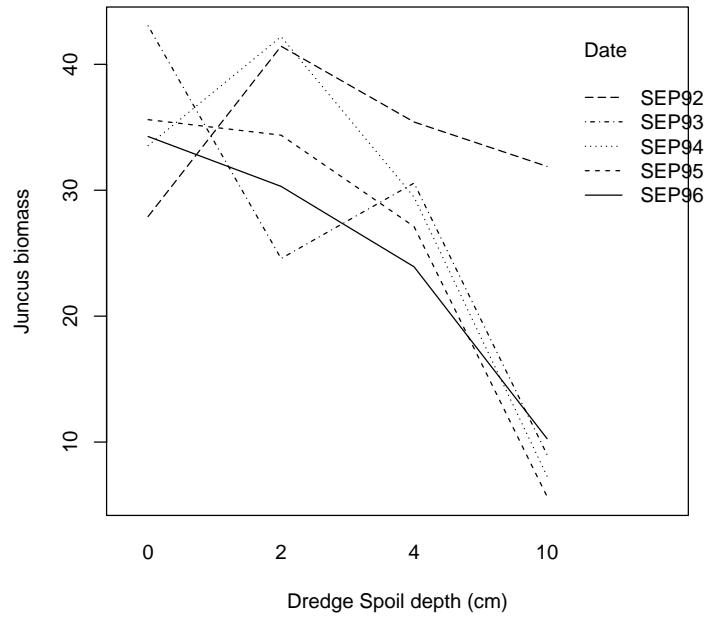
```

Let's look at some plots of the means, using the **interaction.plot()** command. This command will make the dredge spoil treatments appear on the x-axis, and plots the mean *Juncus roemerianus* biomass for each Block as the y-axis:



This plot is the mean response over all dates. An interaction plot is useful to see if the lines cross - then there is likely to be a significant interaction between the factors. An interaction is when one factor affects the response variable differently at different levels of another factor. Here it shows that the dredge spoil effect was not the same across all the Blocks, so that the end Blocks, Block 1 and Block 4, showed different responses than the middle two Blocks, Blocks 2 and Block 3. The mean linear pattern, in which Juncus biomass decreased as dredge spoil increased.

Now let's look at a different interaction plot, where dredge treatment is along the x-axis and date is "trace" factor - it looks at how treatments changes over time.



This shows that the plots did not vary among treatments in Sep92, but this was the before we added the drdege spoil. After this date, evey year in September through 1996, there was a significant decline in Juncus biomass in the 10 cm plots.