**Winter, 2010 Biometry Quiz #2**

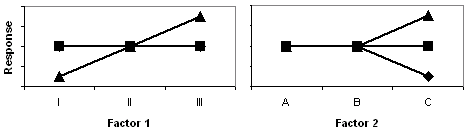
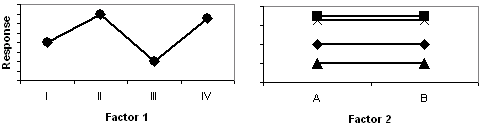
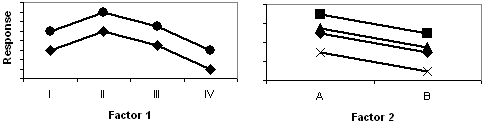
1. **[25 pts]** The number of eggs laid by whiteflies was determined in an experiment using two different types of plants – cotton and cucumber – and at three different temperatures – 70, 77, and 82oF. The results of this experiment can be seen with the partial ANOVA table below. Use this information to answer the questions further below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Source** | **df** | **SS** | **MS** | **F** | **p** |
|  |  |  |  | 12.29 | 0.002 |
|  |  | 487.47 |  |  | 0.160 |
|  |  |  | 55.60 |  | 0.642 |
|  | 24 |  | 123.02 |  |  |
| Total |  | 5063.37 |  |  |  |

* 1. Fill in the remainder of the ANOVA table above (note that (i) this table does NOT contain a row for the “overall” “Among” source of variability, (ii) a “Total” source row is included, (iii) the main effects should be labeled as “plant” and “temp”, respectively, and (iv) the sources should be ordered as R would order them (and with the main effects listed alphabetically)).
  2. How many treatments were in this analysis? \_\_\_\_\_
  3. What is the pooled estimate of the variance among individuals in each group? \_\_\_\_\_\_\_\_\_
  4. What is the estimate of the variance, ignoring group membership? \_\_\_\_\_\_\_\_\_
  5. Identify what effects are evident with these data at the 10% significance level.\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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1. **[9 pts]** To the right of each horizontally paired interaction plots below, list the “effects” that are illustrated in that pair of graphs. Explicitly say "*no effect*" for each effect that you feel is not illustrated and “*should not be interpreted*” for each effect for which you feel it is inappropriate to assess the effect.



1. **[6 pts]** Explain why one experiment where two factors are simultaneously manipulated is “better” than two separate experiments where one factor at a time is manipulated. Assume that the two situations have the same number of individuals to use for the manipulations.
2. **[30 pts]** The attached sheets contain a log of R commands and results for the following situation:

“The U.S. Fish and Wildlife Service, Ashland Fisheries Resources Office performed initial studies of ruffe in tributaries along the south shore of Lake Superior. One of the tributaries they studied was the Flag River in Bayfield County. As part of their study they recorded the sex (male and female) and weight (g) of ruffe captured in summer months for three years (1995, 1996, and 1997). They are interested in determining if the mean weight of ruffe in the Flag River differed between sexes and has changed over the course of those three years.”

Use this background information and the analysis results on the following pages to write

a) a thorough analysis of assumptions (on **both** the original and transformed scales if you decide that a transformation is required), and

b) a thorough interpretation of the results (including letters on a(n) appropriate graphic(s) that illustrate(s) any differences that you found -- make sure to note which graph(s) you marked).

Be as specific and as thorough as you possibly can from these results. Also note that there is more output (tables and graphs) then you will likely need for answering these two questions.

**> rf <- read.xls("RuffeFlag.xls")**

**> str(rf)**

'data.frame': 438 obs. of 6 variables:

$ year : num 1995 1995 1995 1995 1995 ...

$ month: num 7 7 7 7 7 7 7 7 7 7 ...

$ day : num 28 28 28 28 28 28 28 28 28 28 ...

$ tl : num 130 119 98 84 86 40 62 93 91 89 ...

$ wt : num 24.3 21.2 10.7 7.6 8.5 0.8 2.7 9.3 8.6 7.2 ...

$ sex : Factor w/ 3 levels "female","male",..: 1 2 1 1 2 2 1 1 2 2 ...

**> rf$fyear <- factor(rf$year)**

**> rf1 <- Subset(rf,sex!="unknown")**

**> lm1 <- lm(wt~fyear\*sex,data=rf1)**

**> trans.chooser(lm1)**



**> anova(lm1)**

Response: wt

Df Sum Sq Mean Sq F value Pr(>F)

fyear 2 451 225 2.2823 0.103674

sex 1 986 986 9.9866 0.001724

fyear:sex 2 529 264 2.6783 0.070184

Residuals 327 32284 99

**> mc2 <- glht(lm1,mcp(fyear="Tukey"))**

**> summary(mc2)**

Linear Hypotheses:

Estimate Std. Error t value p value

1996 - 1995 == 0 2.0995 1.2452 1.686 0.208

1997 - 1995 == 0 2.5009 1.6028 1.560 0.260

1997 - 1996 == 0 0.4014 1.7358 0.231 0.971

**> fit.plot(lm1,legend="topleft",main="",ylim=c(6,14)) # next page left**

**> fit.plot(lm1,which="sex",main="",ylim=c(6,14)) # next page middle**

**> fit.plot(lm1,which="fyear",main="",ylim=c(6,14)) # next page right**



**> rf1$logwt <- log(rf1$wt)**

**> rf1$logtl <- log(rf1$tl)**

**> lm2 <- lm(logwt~fyear\*sex,data=rf1)**

**> trans.chooser(lm2)**



**> anova(lm2)**

Response: logwt

Df Sum Sq Mean Sq F value Pr(>F)

fyear 2 5.906 2.953 4.0149 0.018942

sex 1 6.313 6.313 8.5843 0.003629

fyear:sex 2 9.951 4.975 6.7651 0.001322

Residuals 327 240.497 0.735

**> mc4 <- glht(lm2,mcp(fyear="Tukey"))**

**> summary(mc4)**

Linear Hypotheses:

Estimate Std. Error t value p value

1996 - 1995 == 0 0.1061 0.1075 0.987 0.5810

1997 - 1995 == 0 0.3845 0.1383 2.780 0.0155

1997 - 1996 == 0 0.2784 0.1498 1.858 0.1497

**> fit.plot(lm2,legend="topleft",main="",ylim=c(1.4,2.2)) # next page left**

**> fit.plot(lm2,which="sex",main="",ylim=c(1.4,2.2)) # next page middle**

**> fit.plot(lm2,which="fyear",main="",ylim=c(1.4,2.2)) # next page right**



**> rf1$comb <- rf1$sex:rf1$fyear**

**> lm3 <- lm(logwt~comb,data=rf1)**

**> anova(lm3)**

Response: logwt

Df Sum Sq Mean Sq F value Pr(>F)

comb 5 22.170 4.434 6.0288 2.355e-05

Residuals 327 240.497 0.735

**> mc5 <- glht(lm3,mcp(comb="Tukey"))**

**> summary(mc5)**

Linear Hypotheses:

Estimate Std. Error t value p value

female:1996 - female:1995 == 0 0.49631 0.14206 3.494 0.00675

female:1997 - female:1995 == 0 0.44522 0.19353 2.300 0.18855

male:1995 - female:1995 == 0 -0.02325 0.12840 -0.181 0.99997

male:1996 - female:1995 == 0 -0.30732 0.15216 -2.020 0.32227

male:1997 - female:1995 == 0 0.30057 0.19034 1.579 0.60136

female:1997 - female:1996 == 0 -0.05110 0.20980 -0.244 0.99987

male:1995 - female:1996 == 0 -0.51956 0.15182 -3.422 0.00851

male:1996 - female:1996 == 0 -0.80363 0.17238 -4.662 < 0.001

male:1997 - female:1996 == 0 -0.19574 0.20686 -0.946 0.93071

male:1995 - female:1997 == 0 -0.46846 0.20080 -2.333 0.17592

male:1996 - female:1997 == 0 -0.75253 0.21677 -3.472 0.00723

male:1997 - female:1997 == 0 -0.14464 0.24508 -0.590 0.99114

male:1996 - male:1995 == 0 -0.28407 0.16131 -1.761 0.48023

male:1997 - male:1995 == 0 0.32382 0.19773 1.638 0.56223

male:1997 - male:1996 == 0 0.60789 0.21392 2.842 0.05071