Homework 8

QSCI 482: Hypothesis Testing & Estimation for Ecologists & Resource Managers

1. Consider an experiment taste-testing six types of chocolate chip cookies: 1 (brand A, chewy, expensive), 2 (brand A, crispy, expensive), 3 (brand B, chewy, inexpensive), 4 (brand B, crispy, inexpensive), 5 (brand C, chewy, expensive), 6 (brand D, crispy, inexpensive). We will use twenty different raters randomly assigned to each type (120 total raters). The texture / cost attributes suggest "natural" groupings among the treatments.

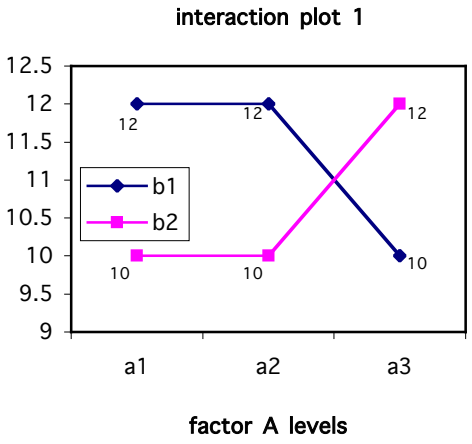
   [a] State in words four contrasts that would compare one group of cookies to another group.

   [b] Using the treatment groups (1 – 6) in the order given, list the contrast coefficients that would allow you to estimate the contrast values, i.e., the $\hat{L}$'s, for the contrasts that you defined in [a] above.

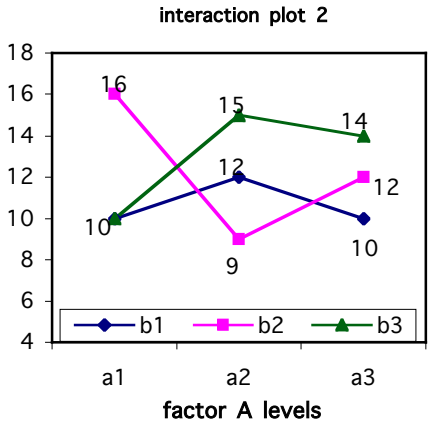
   [c] If MSE for this experiment was 1.37, what is the standard error for one of your contrasts?

2. Consider the following two plots of treatment means from two different experiments each using a CRD design with two-factor factorial treatment structure (but different factors, different levels, etc., from each other). Tell whether each treatment component (main effect of A, main effect of B, interaction of A & B) would be significant or not significant in the ANOVA and offer a brief explanation of why you think so. Assume Experimental Error MS is small enough to judge any differences found as statistical "discoveries." Treatment group means appear adjacent to their graphed points and the designs are balanced.

   [a] Experiment 1



   [b] Experiment 2



3. Brewer's Malt is produced from germinating barley, so brewer's like to know under what circumstances they should germinate their barley. As part of a larger experiment on barley germination, barley seeds were divided into 30 lots of 100 seeds, each lot of 100 seeds was assigned at random to each of the ten conditions, and then germinated. The conditions are the ten combinations of weeks after seed harvest (1, 3, 6, 9, or 12 weeks) and amount of water used in germination (4 or 8 ml). The response is the number of seeds germinating. We are interested in whether timing and/or amount of water affect germination. The data follow:

	Age of Seeds (weeks)				
H_2O (ml)	1	3	6	9	12
4	11	7	9	13	20
	9	16	19	35	37
	6	17	35	28	45
8	8	1	5	1	11
	3	7	9	10	15
	3	3	9	9	25

[a] Write down the null and alternate hypotheses for this experiment, assuming fixed effects for all factors, and set up the ANOVA table, including a column for observed F-statistics.

[b] Find the critical values for testing the water factor, the age factor, and the interaction of the two factors, using an experiment-wise Type I error rate of 10%. Perform the ANOVA tests.

[c] State your conclusions from testing in part [b] above in terms of the research context. Is any further testing indicated, i.e., would you perform any multiple comparisons? If so, would you compare all ten means, or a smaller number of means? If a smaller number, which comparisons would you test?

4. The yield of hybrid poplar was thought to be influenced by nutrients (Factor A) and available water (Factor B). A study was conducted that examined two different types of fertilizer chosen at random from the large assortment of types available on the market comprised of combinations of brand, pellet coating (for timed-release), and blends while three methods of irrigation were chosen purposefully, because they were specifically of interest. Four plots were randomized to receive each of the six treatment combinations. Results for yield (tons / plot) follow:

	Irrigation Method					
Fertilizer	b_1		b_2		b_3	
a_1	17.0	18.1	16.8	15.3	22.1	23.4
	17.5	16.9	14.6	16.1	22.8	21.9
a_2	18.3	17.8	14.9	15.8	24.2	26.2
	16.8	18.9	14.2	14.8	25.1	25.7

[a] Write down the null and alternate hypotheses for this experiment, assuming fixed effects for the irrigation factor and random effects for the fertilizer factor, and set up the ANOVA table, including a column for observed F-statistics.

[b] Find the critical values for testing the irrigation factor, the fertilizer factor, and the interaction of the two factors, using an experiment-wise Type I error rate of 5%. Perform the ANOVA tests.

[c] What do you conclude about the effects of type of fertilizer? What do you conclude about the effects of irrigation method? Perform the S-N-K multiple comparison procedure on irrigation means, if appropriate, i.e., if the ANOVA warrants it.