STAT502 Homework #3

due Monday, 7/17

1. Marine biologists obtained the mean dissolved oxygen contents (in ppm) of four areas at increasing distance (1km, 5km, 10km, and 20km) from the mouth of the Mississippi. The data can be input with the following:

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oxy1 = c(1,5,2,1,2,2,4,3,0,2)
oxy5 = c(4,8,2,3,8,5,6,4,3,3)
oxy10 = c(20,26,24,11,28,20,19,19,21,24)
oxy20 = c(37,30,26,24,41,25,36,31,31,33)
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   (a) Produce side-by-side box plots of the original data. Do the treatments appear to have equal variances?

   (b) Carry out a test for equality of variances. What's your conclusion with $\alpha = .05$?

   (c) It appears that the variances are proportional to the treatment means, so a square root transformation might be appropriate. Carry out a test of equal variances using the square-root data. What's the conclusion with $\alpha = .05$?

   (d) Finally, run a one way ANOVA analysis using the transformed data. Look at the residual plots. Do the residuals appear to be normal?

2. The following values represent the population means μ_{ij} for a two-way ANOVA model with $a = 3$ and $b = 4$.

$$\begin{array}{rrrr} 10 & 5 & 9 & 8 \\ 12 & 7 & 11 & 10 \\ 8 & 3 & 7 & 6 \end{array}$$

   (a) Calculate the effects $\mu_{\cdot\cdot}$, α_i, and β_j for each i and j.

   (b) What does this model say about interaction? Explain.

3. The following values represent the population means μ_{ij} for a two-way ANOVA model with $a = 3$ and $b = 4$.

$$\begin{array}{rrrr} 8 & 5 & 9 & 10 \\ 12 & 11 & 7 & 10 \\ 8 & 3 & 7 & 6 \end{array}$$

   (a) Calculate the effects $\mu_{\cdot\cdot}$, α_i, and β_j for each i and j.

   (b) What does this model say about interaction? Explain.

4. (*adapted from 19.13 in the text*) In a study of the effect of applicant's eye contact (Factor A) and personnel officer's sex (Factor B) on the personnel officer's assessment of likely job success of applicant, 10 male and 10 female personnel officers were shown a front view photograph of an applicant's face and were asked to give the person in the photograph a success rating on a scale of 0 (total failure) to 20 (outstanding success). The data can be found in the file "CH19PR12.txt". Columns correspond to success rating, eye contact (1=eye contact present and 2=eye contact absent), and officer's sex (1=male and 2=female).

   (a) Provide an interaction plot for the data. Comment on the evidence for main effects and interaction.

(b) Fit the two-way ANOVA model with interaction, and include the ANOVA table here.

(c) Test whether or not interaction effects are present. State the hypotheses and conclusion with $\alpha = 0.05$.

(d) Test whether or not eye contact and sex main effects are present. In each case, state the hypotheses and conclusion with $\alpha = .05$. Is it meaningful here to test for main factor effects? *Hint: consider the interaction*