STAT502 Homework #5

due Monday, 7/31

1. Monthly data for this part are from Appendix C.3 in the text and applies to a large packaged foods manufacturer. Factor A is whether a discount price was used (1=yes, 0=no), and Factor B is whether or not a package promotion was used (1=yes, 0=no). The response is average monthly market share as a percent. Use the following commands to read in the data and assign the variables:

```
data = read.table('marketshare.txt',header=T)
share = data[,1]
A = as.factor(data[,4])
B = as.factor(data[,5])
```

   (a) State the ANOVA model (with interaction) for Y_{ijk}, where Y_{ijk} is the market share under the ith discount price, jth package promotion, and kth month. Also, state the ranges for i, j, and k. *Hint: use* `tapply(share,A:B,length)` *to get the sample sizes.*

   (b) Fit the ANOVA model above, and provide a residual plot and a normal probability plot. Comment on the ANOVA assumptions.

   (c) State the reduced model for testing for interaction effects. Fit this reduced model, and carry out the test using the full versus reduced F test approach using $\alpha = .05$. What is the conclusion?

   (d) State the reduced model for testing for a Factor A effect. Make an argument for why the full model for this test should be the reduced model from part (c). Conduct this test using $\alpha = .05$. Does there seem to be an effect in market share due to a discount price? Explain.

   (e) Repeat part (d) for Factor B. Does there seem to be an effect in market share due to a package promotion? Explain.

2. Each of the following describes a one-factor study. Indicate whether the fixed effects model or the random effects model is more appropriate and state your reasons:

   (a) In a study of anticipated annual income at retirement, the treatments are the four types of retirement plans available to employees;

   (b) In a study of tire wear in 18-wheel trucks, the treatments are four tire locations selected at random.

3. (*adapted from Exercise 25.9*) A plant contains a large number of coil winding machines. A production analyst studied a certain characteristic of the wound coils produced by these machines by selecting four machines at random and then choosing 10 coils at random from the day's output of each selected machines. The results are recorded in the file "coils.dat" and can be read into R with

```
data = read.table('coils.dat')
y = data[,1]
machine = as.factor(data[,2])
coil = as.factor(data[,3])
```

   (a) State the one-way random effects ANOVA for this situation. Define each term used.

(b) Test whether or not the mean coil characteristic is the same for all machines in the plant; use $\alpha = 0.1$. State the null and alternative hypotheses, critical value, and conclusion.

(c) Estimate the mean coil characteristic for all coil winding machines in the plant; use a 90% confidence interval.

(d) Obtain a point estimate of σ_μ^2.

(e) Estimate $\sigma_\mu^2/(\sigma_\mu^2 + \sigma^2)$ with a 90% confidence interval. Interpret your interval estimate.

(f) Test whether or not σ_μ^2 and σ^2 are equal; use $\alpha = 0.1$. State the alternatives, decision rule, and conclusion.