STA 2201 S 2011 Assignment 2

In this assignment, the goal is to use a Wald test to compare several different treatments or groups. The dependent variable is assumed to be normally distributed, but the variances may be different. Of course the sample size is "large."

1. Here is the model. Independently for $j = 1, \ldots, k$ and $i = 1, \ldots, n_j$, $X_{i,j} \sim N(\mu_j, \sigma_j^2)$. The objective is to test $H_0 : \mathbf{L}\boldsymbol{\theta} = \mathbf{h}$. The raw data will not be available (yet). Instead you will have a table of sample means, standard deviations and sample sizes like the one below. The standard deviations use $n - 1$ in the denominator.

   (a) If there are k treatments, how many rows does $\boldsymbol{\theta}$ have? How many columns?

   (b) Write the minus log likelihood, simplifying as much as you need to. The final product will be the function you minimize. Show your work.

   (c) Provide a listing of your `R` function for the minus log likelihood. It must work for any number of treatments k.

   (d) For the following data table, conduct Wald tests as requested below. In each case your `R` code should produce the value of the Wald chi-square statistic, the degrees of freedom, and the p-value. Use the $\alpha = 0.05$ significance level for all tests.

	Treatment					
	1	2	3	4	5	6
Mean	9.3600	10.0400	8.8197	9.9255	10.1165	9.7616
Standard Dev.	3.0765	1.8582	1.5853	2.8761	2.8779	2.6428
Sample size	100	100	100	75	75	75

   For each of the following, circle the Wald chi-square statistic, the degrees of freedom, and the p-value on your printout. Write the question number beside it.

   i. The first task is to test whether all the variances are equal. If you can't reject this null hypothesis it might be better to turn to a standard analysis of variance.

   ii. Now test for equality of the six means.

   iii. Before getting started with pairwise comparisons, we find that the experiment has a two-factor design.

	Diet		
	A	B	C
Drug	Treatment 1	Treatment 2	Treatment 3
Placebo	Treatment 4	Treatment 5	Treatment 6

   Theoretically, diet should not affect the response at all (either in the mean or the variance) if the drug is absent. Therefore, the next step is to test equality of means and equality of variances (one test) for treatments 4 through 6. Does this test provide evidence against the theory? Write your answer (a few words at most) on the printout.

   iv. Test equality of the variance in response to diet, just for those getting the drug.

   v. Follow up the preceding test with all pairwise comparisons of variances. What is the conclusion? My conclusion is that one of the variances is bigger than the other two. Do you agree?