Problem 3 [34 points total] [SHOW ALL WORK]

A clinical trial was designed to test three competing treatments (medications) for joint pain. Subjects with osteoarthritis (15 male and 15 female) were each given one of the three treatments, and they were told to take the assigned medication when they experienced joint pain. Then they were instructed to record the time, in minutes, until their pain was relieved. The raw data is shown on the next page, as well as the SAS output from fitting a two-way non-additive ANOVA model.

(a) (6 pts) Give the theoretical ANOVA model for this study. Be sure to define all of the model parameters.

(b) (4 pts) Calculate the predicted effect of Treatment B on the mean time to pain relief.

(c) (4 pts) Calculate the predicted effect of being female on the mean time to pain relief.

(d) (4 pts) Calculate the predicted interaction effect of being female and taking Treatment B on the mean time to pain relief.

(e) (4 pts) What is the residual associated with the female subject who was assigned Treatment C and reported a time to pain relief of 36 minutes.

(f) (4 pts) Based on the ANOVA results, how many pairwise comparisons would you want to test? Explain.

(g) (4 pts) Suppose that the statisticians used the same raw data to fit a *one-way* ANOVA model that used *Treatment* as the only factor. What would the SSE be for this model? (You can calculate this using only the output given on the next page.)

(h) (4 pts) Suppose that different statisticians want to repeat this study, except this time they also want to include *Age* as a factor. They decide to use three different age groups (Young Adult, Adult, Senior), and they test one subject for each combination of *Treatment*, *Sex*, and *Age*. Give the theoretical ANOVA model for this new study.

Table of Time to Pain Relief by Treatment and Sex		
Treatment	Male	Female
A	12	21
	15	19
	16	18
	17	24
	14	25
B	14	21
	17	20
	19	23
	20	27
	17	25
C	25	37
	27	34
	29	36
	24	26
	22	29

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	966.966667	193.393333	20.68	<.0001
Error	24	224.400000	9.350000		
Corrected Total	29	1191.366667			

R-Square	Coeff Var	Root MSE	Time Mean
0.811645	13.63051	3.057777	22.43333

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Treatment	2	651.4666667	325.7333333	34.84	<.0001
Sex	1	313.6333333	313.6333333	33.54	<.0001
Treatment*Sex	2	1.8666667	0.9333333	0.10	0.9054

If there is still time, go back through the exam and double check your answers!