There are three major questions on this exam. The first has 6 sub-questions, the second has 7, and the third has 5. Each sub-question will be equally weighted in determining your overall exam score.

Question A

A large organization has given a test to measure the stress level of each of their 152 managers. The scores on this test make up the variable STRESS. In addition, the company has the following information available about each manager: SUPER — number of employees supervised and GENDER. The company would like to ask the following questions about these data. For each question, specify the MODEL C and the MODEL A you would use to answer the question. Also indicate PC and PA, the number of parameters for each model. If you create any new variables, be sure to define them explicitly.

1. From prior research, it is known that an unhealthy level of stress has the score STRESS = 15. Is the average stress level of this company's managers lower than 15?

2. Do male and female managers differ in their average stress levels?

3. Do managers who supervise more employees have higher stress levels?

4. Assuming that managers who supervise more employees have higher stress levels, ask the question of whether average stress levels = 15 with a statistically more powerful test.

5. Someone in the personnel department believes that it is too stressful to ask a manager to supervise more than 20 employees. Again assuming that managers who supervise more employees have higher stress levels, does the stress level exceed 15 for managers who supervise 20 employees?

6. Is it useful to make predictions of a manager's stress level conditional on both gender and the number of employees supervised? [This is beyond any model we've directly discussed so far, but the required models are not difficult.]

Question B

In several of the homework problems, we examined the RATS dataset. Each datum is the time (in secs) for the rat to flick its tail after the tail is exposed to a hot light. This is a measure of pain sensitivity, the quicker the rat flicks its tail to avoid the hot light, the greater the sensitivity to pain. To prevent damage to the rat's tail, all trials are stopped by 10 secs if the rat hasn't flicked its tail by then. The variable S100 contains the tail flick times after the rats have each received 100 small shocks. From prior studies it is known that experiencing these small shocks will make them less sensitive to pain, but that isn't the question of interest here. Instead, we want to know whether the administration of a drug that is an endorphin antagonist will affect the pain sensitivity of these rats compared to a control group of rats who receive a placebo drug. In the following analyses, the variable COND codes condition, with drug coded +1 and control coded –1. Use the outputs on the following page to answer the following questions.

1. Does the drug affect the pain sensitivity of the rats after receiving 100 small shocks (i.e., do the S100 tail flick times differ for the drug and control groups)? (In addition to answering this question, give the PRE, F*, PA-PC, n-PA and p values that accompany your answer.)

2. There were 7 rats in each group. What are the mean tail flick times for each group? What is the grand mean?

3. Construct a 95% confidence interval for the mean difference between the groups.

4. It is important theoretically that the change in pain sensitivity be temporary. Is there any evidence that the baseline scores measured a few hours after the experiment (BLAFT) differ by drug condition? Give the PRE, F*, PA-PC, n-PA, and p values that answer this question.

5. When the desired outcome is the null hypothesis, such as in the case of BLAFT times, power is an important concern. Having only 7 rats in each group doesn't provide much statistical power. Approximately what is the power of detecting a difference corresponding to a "medium" effect?

6. Question 5 (just above) started with the following assertion: "When the desired outcome is the null hypothesis, such as in the case of BLAFT times, power is an important concern." In one sentence, explain why power is an important concern when the desired outcome is the null hypothesis.

7. Sometimes a useful response to criticism of a study for having low statistical power is to state the number of observations that would have been required for the obtained difference to have been statistically significant. Assuming that the PRE (in this case, don't use the unbiased estimate!) obtained in this study were obtained in a larger study, approximately how many rats would be needed in each group to have obtained a significant difference for the BLAFT variable?

Model: MODEL1
Dependent Variable: S100

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	48.24586	48.24586	9.936	0.0083
Error	12	58.26730	4.85561		
C Total	13	106.51316			

Root MSE	2.20354	R-square	0.4530
Dep Mean	6.02934	Adj R-sq	0.4074
C.V.	36.54704		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	6.029338	0.58892205	10.238	0.0001
COND	1	-1.856376	0.58892205	-3.152	0.0083

Model: MODEL2
Dependent Variable: BLAFT

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	0.05161	0.05161	0.262	0.6182
Error	12	2.36643	0.19720		
C Total	13	2.41803			

Root MSE	0.44407	R-square	0.0213
Dep Mean	2.57786	Adj R-sq	-0.0602
C.V.	17.22649		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	2.577857	0.11868389	21.720	0.0001
COND	1	-0.060714	0.11868389	-0.512	0.6182

Question C

An important outcome variable in the treatment of bipolar disorder in clinical psychology is time to relapse. Researchers are interested in variables that significantly predict time to relapse. One such predictor variable has been found to be how critical the family of the patient is of the patient in general and, especially, of his or her disease. Assume that a researcher measures 30 patients and their families. RELAPSE for each is the number of weeks since initial diagnosis until the patient is rehospitalized for significant symptoms. Thus it is measured in units of weeks. CRIT is a measure of how critical a familty is. It is coded from half hour taped interactions between the family and patient and is measured as the number of critical comments made by the family during that half hour period.

To assess the relationship between the two variables, RELAPSE is regressed on CRIT, yielding the following SAS output:

Dependent Variable: RELAPSE

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	316.02887	316.02887	6.014	0.0207
Error	28	1471.47113	52.55254		
C Total	29	1787.50000			

Root MSE	7.24931	R-square	0.1768
Dep Mean	20.50000	Adj R-sq	0.1474
C.V.	35.36250		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	30.976309	4.47242883	6.926	0.0001
CRIT	1	-1.159739	0.47292659	-2.452	0.0207

1. Provide a one sentence substantive interpretation of the meaning of the slope.

2. Provide a one-sentence substantive interpretation of the meaning of the intercept.

3. Specify the models for testing whether the slope is significantly different from zero. Provide PRE, F*, PA-PC, and n-PA that test that comparison and indicate whether MODEL C is rejected.

4. Assume the mean value of crit is 9.33. What would be the values of both the intercept and the slope if 9.33 were subtracted from every CRIT score and then RELAPSE was regressed on the transformed CRIT?

5. Given that CRIT is predictive of RELAPSE, test the null hypothesis that the mean value on RELAPSE is 25 weeks, using the most powerful test. Provide models A and C, SSE(A) and SSE(C), PRE, F*, PA-PC, and n-PA for this test.