Question A

A researcher is interested in whether an aspirin regimen effectively reduces high temperatures among people suffering from flu. She collects data from 20 people with the flu, measuring the temperature both before taking the aspirin regimen and an hour after taking the aspirin regimen. She then calculates for each person the difference between the pre-regimen temperature and the post-regimen temperature (Pre minus Post, both in degrees Fahrenheit).

Below are the sample statistics for this difference variable:

	Mean	Variance	USS	CSS
TEMPDIFF	1.45	1.12	63.33	21.28

1. Based on these statistics, do a test of whether the mean temperature reduction is different from zero. Report PRE, F*, pa-pc, n-pa and a one sentence substantive conclusion.

A global rating of the severity of each person's flu symptoms was done at the start of the study by a nurse (who was blind to the person's temperature). This rating was done on a 10 point scale, where 10 meant very severe symptoms and 1 meant very minor symptoms.

Below are the sample statistics for this severity measure:

	Mean	Variance	USS	CSS
SEVER	5.91	10.30	894.34	195.78

This severity rating (SEVER) was then used to predict the TEMPDIFF variable, with the following results:

TEMPDIFF^ = .80 + .11 SEVER SSE = 18.91

2. From this model, is SEVER significantly related to TEMPDIFF? Report PRE, F*, pa-pc, n-pa and a one sentence substantive conclusion.

3. Now, suppose you were to redo the test of whether the mean TEMPDIFF is different from zero. But this time you did it controlling for SEVER (i.e., you mean deviate SEVER, run a PROC REG in which you predict TEMPDIFF with mean-deviated SEVER and then you test whether the intercept equals zero). What would be the results of this test? Report PRE, F*, pa-pc, n-pa and a one sentence substantive conclusion.

Question B

A common problem in medical testing is that the definitive or "gold standard" test is very expensive both in terms of money, time, and sometimes risks and side effects. In some situations it is useful first to give a cheaper and necessarily less accurate version of the test to screen for patients who should then receive the more expensive gold standard test. For such a test, the following variables are available for a number of patients:

GOLD	the patient's score on the expensive, more accurate version of the medical test on a 0-20 scale
SCREEN	the patient's score on the cheaper, less accurate screening version of the medical test on the same 0-20 scale
GENE	whether or not the patient has a genetic marker that researchers believe is related to the disorder detected by the medical test; the values on this variable are "Yes" and "No."
AGE	the patient's age in years
RISK	the patient's risk factor on a 1-10 scale as determined by family history, current health status, past behaviors (smoking or not), etc.

Note that in this study, assessing the usefulness of the screening test, all patients took both the screening and gold standard tests regardless of their scores on the screening test.

For each research question below, specify the MODELs A and C you would use to answer the question. In some instances you will need to construct new variables based on the variables described above. Provide explicit definitions of any new variables you construct. Unless otherwise requested, provide the least complex MODELs A and C that would answer the question.

1. A normal score on the gold standard test is 10. Do typical scores on the screening test differ significantly—either higher or lower—from the normal score expected for the gold standard test?

2. To be a useful screening test, scores on it must be related to scores on the gold standard. Is that the case?

3. Assuming that the screening test is indeed a useful predictor of the gold standard scores, provide a more powerful test of question (1).

4. Given that they are on the same scale, ideally the slope for the screening test when predicting the gold standard would be close to 1.0. Is it?

5. Do patients with the gene have higher scores on the gold standard than those without it?

6. Do patients who are 55-years old have scores on the gold standard that differ from the expected normal score of 10?

7. Is a patient's screen test score, on average, different from his or her gold standard score?

8. As a group, does the person's age and risk factor predict the gold standard? [Hint: this is a 'foreshadowing' question that is beyond what we've formally done in class]

<u>Question C</u>

Aon the next two pages is SAS output from the STAT.AUTO dataset. Two models are reported in which we are predicting FATRATE (auto fatalities per 100 million vehicle miles traveled). The first model uses DENSITY (# people per square mile) as a predictor. The second uses a dichotomous variable (DRINKC) which records whether or not the legal drinking age in the state was less than 21 (DRINKC = -1) or 21 (DRINKC = 1).

Based on these analyses, answer the following questions.

1. Interpret the <u>two</u> parameter estimates in the model where DENSITY is used to predict FATRATE.

2. Is DENSITY significantly related to FATRATE? (Provide PRE, F*, pa-pc, n-pa, and a once sentence conclusion.)

3. What is the correlation between FATRATE and DENSITY?

4. What is the mean FATRATE in states where the drinking age is 21?

5. Provide an interpretation for the intercept in the model where FATRATE is regressed on DRINKC.

6. Is there evidence in these data that the mean FATRATE differs between states having a legal drinking age below 21 and those with a 21 drinking age? (Provide PRE, F*, pa-pc, n-pa, and a once sentence conclusion.)

The REG Procedure
Model: MODEL1
Dependent Variable: FATRATE auto fatalities/100 mil vehicle miles

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	13.14898	13.14898	27.57	<.0001
Error	48	22.89182	0.47691		
Corrected Total	49	36.04080			

Root MSE	0.69059	R-Square	0.3648
Dependent Mean	3.57200	Adj R-Sq	0.3516
Coeff Var	19.33339		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value
Intercept	Intercept	1	3.91393	0.11738	33.34
DENSITY	population density/sq mile	1	-0.00236	0.00044996	-5.25

Parameter Estimates

Variable	Label	DF	Pr > |t|
Intercept	Intercept	1	<.0001
DENSITY	population density/sq mile	1	<.0001

Parameter Estimates

Variable	Label	DF	95% Confidence Limits	
Intercept	Intercept	1	3.67791	4.14994
DENSITY	population density/sq mile	1	-0.00327	-0.00146

The REG Procedure
Model: MODEL2
Dependent Variable: FATRATE auto fatalities/100 mil vehicle miles

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	0.03618	0.03618	0.05	0.8271
Error	48	36.00462	0.75010		
Corrected Total	49	36.04080			

Root MSE	0.86608	R-Square	0.0010
Dependent Mean	3.57200	Adj R-Sq	-0.0198
Coeff Var	24.24639		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value
Intercept	Intercept	1	3.57308	0.12258	29.15
drinkc		1	0.02692	0.12258	0.22

Parameter Estimates

Variable	Label	DF	Pr > |t|
Intercept	Intercept	1	<.0001
drinkc		1	0.8271

Parameter Estimates

Variable	Label	DF	95% Confidence Limits	
Intercept	Intercept	1	3.32661	3.81954
drinkc		1	-0.21954	0.27339

Question D

An educational researcher is interested in the relationship between testing and academic performance. She believes that children in school systems where more frequent testing is mandated (to assess yearly competence in mathematics), math performance shows a slight but significant improvement. She plans to randomly sample school districts around the country and measure two variables: how frequently math testing is done for students in high school in each school district and the mean mathematic SAT score of all graduating seniors in the district.

She expects that the correlation between the two variables (testing and mean math SAT) will be about .25. Assuming she is correct, if she sets alpha at .05 and she wants power of .80, from how many school systems should she collect data?