There are three parts to this exam. Within each part, there are a series of questions. Each question is worth 3 points each unless indicated otherwise.

Part I

This question is loosely based on a paper Gary recently reviewed for the *Journal of Real Estate Finance and Economics* for a special issue on "Real Estate and the Environment." Data are collected for a sample of cabins located in resort communities on or near lakes. The following variables are available for each cabin:

VALUE: The appraised real estate value (in dollars) of each cabin.

FRONTAGE: Whether the cabin has frontage on a lake or not ("yes" versus "no").

CLARITY: The clarity of the water of the nearest lake (clarity is measured as the depth in meters at which a black-and-white disk can be seen).

Specify the Models A and C that you would use to answer the following questions. Be sure to specify the definition of any new variables you construct.

1. The state office of tourism wants to know whether the average cabin is worth more than $75,000.

2. Is clarity of the nearest lake related to a cabin's price?

3. Supposing that clarity is related to a cabin's price, answer the question in (1) with a more powerful statistical test.

4. Poor clarity is due to eutrophication, which can reversed with intervention. A one meter improvement in clarity would cost about $5000 per cabin. Would the benefit of improving clarity by one meter be greater than the cost?

5. Is there an economic premium (i.e., houses are appraised higher) for having lake frontage?

6. Is the premium for lake frontage greater than $10,000?

7. [This is not a Model A/C question.] The study involved a total of 412 cabins on 34 lakes. What statistical assumption did this cause Gary to question in his review?

Part II

Willerman, Schutz, Rutledge, & Bilger (1991; In vivo brain size and intelligence, Intelligence, 15, 223-228) collected data from 38 introductory psychology students to examine the relationship between brain size and intelligence. Participants completed the Wechsler (1981) Adult Intelligence Scale. Magnetic Resonance Imaging (MRI) was used to determine the brain size of participants. Additionally, data were collected on the gender, height, and weight of all participants.

The SAS analyses on the following pages use the following variables from this dataset:

WIQ:	IQ scores based on the Wechsler (1981) inventory
X:	Gender, coded as Female = +1; Male = -1
WEIGHT:	Participant's weight in pounds
MRI:	Total pixel count of brain size from 18 MRI scans.

Below are univariate statistics on these four variables:

Variable	N	Mean	Std Dev	Minimum	Maximum
WIQ	38	113.5526316	23.8153906	77.0000000	144.0000000
X	38	0.0526316	1.0120188	-1.0000000	1.0000000
WEIGHT	38	151.0526316	23.4785093	106.0000000	192.0000000
MRI	38	906754.18	72561.75	790619.00	1079549.00

Based on the SAS output on the following pages, answer the following questions.

A. Is there a significant relationship in these data between brain size, as measured by MRI procedures, and intelligence, as measured by the Wechsler inventory? (Provide PRE, F*, n-pa, pa-pc, and a substantive answer.)

B. Regardless of whether or not this relationship is significant, explain why the slope for MRI in predicting WIQ is so incredibly small. Specifically, how could any effect be worth talking about when the slope equals approximately 1/10,000?

C. What is the mean intelligence score for female participants? What is the mean intelligence score for male participants? Are these two means significantly different from each other? (Provide PRE, F*, n-pa, pa-pc, and a substantive answer.)

D. Are there gender differences in brain size? (Provide PRE, F*, n-pa, pa-pc, and a substantive answer.)

E. Do people who weigh more have larger brains, as measured by MRI procedures? (Provide PRE, F*, n-pa, pa-pc, and a substantive answer.)

F. Compute the confidence interval for the WIQ mean (based on Chapter 5 procedures). If we were to test whether the mean WIQ scores equals 115 in these data, what would we conclude?

G. Now compute the confidence interval for the WIQ mean given that MRI is predictive of IQ scores.

H. Suppose we calculated a new weight variable by subtracting 100 from each individual's weight. And then we regressed MRI on this recomputed weight variable. What would the values of the intercept and slope be in this regression model?

I. (Extra credit – worth 1 point only) Is there evidence that the relationship between MRI and Gender is due to the fact that women on average weigh less than men? Why or why not?

```
Model: MODEL1
Dependent Variable: WIQ

                            Analysis of Variance

                              Sum of         Mean
   Source          DF        Squares       Square      F Value       Prob>F

   Model            1   2337.03506   2337.03506        4.512       0.0406
   Error           36  18648.35968    518.00999
   C Total         37  20985.39474

       Root MSE      22.75983     R-square       0.1114
       Dep Mean     113.55263     Adj R-sq       0.0867
       C.V.          20.04342

                            Parameter Estimates

                     Parameter      Standard    T for H0:
    Variable  DF      Estimate         Error   Parameter=0    Prob > |T|

    INTERCEP   1     14.237917   46.90291331         0.304        0.7632
    MRI        1      0.000110    0.00005157         2.124        0.0406
```

Model: MODEL2
Dependent Variable: WIQ

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	115.31696	115.31696	0.199	0.6583
Error	36	20870.07778	579.72438		
C Total	37	20985.39474			

Root MSE	24.07747	R-square	0.0055
Dep Mean	113.55263	Adj R-sq	-0.0221
C.V.	21.20379		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	113.644444	3.91130187	29.055	0.0001
X	1	-1.744444	3.91130187	-0.446	0.6583

Model: MODEL3
Dependent Variable: MRI

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	82112651607	82112651607	26.229	0.0001
Error	36	112700003494	3130555652.6		
C Total	37	194812655102			

Root MSE	55951.36864	R-square	0.4215
Dep Mean	906754.18421	Adj R-sq	0.4054
C.V.	6.17051		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	909204	9089.1080573	100.032	0.0001
X	1	-46550	9089.1080573	-5.121	0.0001

Model: MODEL4
Dependent Variable: MRI

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	51344331775	51344331775	12.884	0.0010
Error	36	143468323327	3985231203.5		
C Total	37	194812655102			

Root MSE	63128.68764	R-square	0.2636
Dep Mean	906754.18421	Adj R-sq	0.2431
C.V.	6.96205		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	667090	67551.125966	9.875	0.0001
WEIGHT	1	1586.627115	442.03369950	3.589	0.0010

Model: MODEL5
Dependent Variable: MRI

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	2	85620946421	42810473211	13.722	0.0001
Error	35	109191708680	3119763105.2		
C Total	37	194812655102			

Root MSE	55854.83959	R-square	0.4395
Dep Mean	906754.18421	Adj R-sq	0.4075
C.V.	6.15987		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	828100	77017.735705	10.752	0.0001
X	1	-38738	11686.983151	-3.315	0.0021
WEIGHT	1	534.204715	503.75629327	1.060	0.2962

Part III

A career counselor collected data on the degree of liking for particular academic subjects (e.g., English, math), and interest in different careers from a random sample of his adult clients. One thing he examined was the assumption that men are more interested in math-related courses than women. Below is the output from his test of the effect of gender on liking for mathematics [Note: GENDER is coded as 0 for men and 1 for women; MATHMTCS is a scale of liking for math that ranges from - 4 (*do not like at all*) to + 4 (*like very much*)].

```
Model: MODEL1
Dependent Variable: MATHMTCS

Analysis of Variance

                          Sum of         Mean
Source          DF       Squares       Square      F Value       Prob>F

Model            1       3.67859      3.67859        4.216       0.0511
Error           24      20.93845      0.87244
C Total         25      24.61705

    Root MSE       0.93404     R-square       0.1494
    Dep Mean       0.20462     Adj R-sq       0.1140
    C.V.         456.48697


Parameter Estimates

                  Parameter      Standard    T for H0:
Variable  DF       Estimate         Error   Parameter=0    Prob > |T|

INTERCEP   1       1.307381    0.56742422         2.304        0.0302
GENDER     1      -0.754524    0.36745038        -2.053        0.0511
```

1. Compute the 95% confidence interval for the mean difference between men and women in their liking of math, based on these data.

2. From her years of experience, a middle-school math teacher believes that her male students are more interested in math than her female students, thus, she wishes to replicate the career counselor's result with her students. Assuming that she obtains data from an equal number of girls and boys, how many girls and how many boys will she need to include in the study to have an 85% chance of finding the effect?