Show your work to get full credits. Each question is worth 5 points except where indicated. **Use alpha = .05 for all the hypothesis tests**.

1. The College Boards, which are administered each year to many thousands of high school students, are scored and the scores yield a mean of 500 and a standard deviation of 50. Assume scores are normally distributed.

a. An exclusive club wishes to invite those scoring in the top 10% on the College Boards to join. What score is required to be invited to join the club?

 b.What is probability that the average of 100 randomly selected scores is less than 450?

2. A cigarette manufacturer has advertised that it has developed a new brand of cigarette, LowTar, that has a different average tar content than the major brands. To evaluate this claim, a consumer testing agency randomly selected 50 cigarettes from each of the four major brands and the new brand. The results is shown below.

Brand	sample size	sample mean	sample s.d.
LowTar	50	8	0.3
A	50	10	0.4
B	50	10	0.4
C	50	11	0.5
D	50	11	0.5

a.Is there evidence to conclude that there is significant differences in the average tar contents from the above five brands of cigarettes? (8)

b.Was there any evidence of a violation in the required conditions to conduct the analysis in part a? (8)

3. A petroleum company was interested in comparing the miles per gallon achieved by four different gasoline blends (A, B, C and D). Because there can be considerable variability due to differences in car models, the company selected 4 car models and obtained gasoline consumption from A,B,C and D on each car model. The mileage (in mpg) obtained over each test run was recorded below.

Gasoline	car model				
	1	2	3	4	sum
A	15.5	33.8	13.7	29.2	92.2
B	16.3	26.4	19.1	22.5	84.3
C	10.5	31.5	17.5	30.1	89.6
D	14.0	34.5	19.7	21.6	89.8
Sum	56.3	126.2	70	103.4	355.9

(a) What experimental design is this one? Circle your answer.

Completely randomized design
Randomized block design

(b) Write an appropriate statistical model for this experimental situation. Please explain the symbols you use in the model.

(c) Please complete the ANOVA table. Show your work to get full points. (10)

(d) . State the hypothesis to determine if there is any difference among the treatment means. What is the test statistic for the hypothesis? What is the approximate p-value of your test? What is your decision?

(e). If you circled "randomized block design" in part (a), what is your extraneous variable? state the hypothesis to determine if there is any difference among the block effects. What is the test statistic for the hypothesis? What is the approximate p-value of your test? What is your decision?

(f). If you circled "randomized block design" in part (a), what is the relative efficiency for the experiment? (2)

4. Researchers record the yields of corn, in bushels per plot, for three different varieties of corn, A, B and C. In a greenhouse experiment, the researchers randomly assign each variety to 4 of 12 plots available for the study. The yields are listed here:

					sum
A	2.5	3.6	2.8	2.7	11.6
B	3.6	3.9	4.1	4.3	15.9
C	4.3	4.4	4.5	4.1	17.3
Sum	10.4	11.9	11.4	11.1	44.8

(a) What experimental design is this one? Circle your answer.

　　　　Completely randomized design
　　　　Randomized block design

(b) Please complete the ANOVA table for this data. (10)

(c) . State the hypothesis to determine if there is any difference among the averages from brand A,B and C. What is the test statistic for the hypothesis? What is the approximate p-value of your test? What is your decision?

 (d). If you circled "randomized block design" in part (a), what is your extraneous variable? State the hypothesis to determine if there is any difference among the block effects. What is the test statistic for the hypothesis? What is the approximate p-value of your test? What is your decision? (3) Don't answer this question if you circled "completely randomized design".

(e) If appropriate, use a method to determine if there is a difference between brand A and brand B. (3)

5. In a study to consider whether the price of a product can be used to predict quantity sold. Six random prices for a product were selected. Price (in dollars) and quantity sold in a day were recorded for each of the six prices. Assume the assumptions for conducting inference have been satisfied.

price	Quantity sold
58.7	20
59	15
60.1	17
61.3	16
63.2	13
64	11

(a) What is the dependent variable? What is the independent variable?   (3)

(b) Conduct a hypothesis test to determine if the independent variable is useful to predict the dependent variable.

6.A personnel director for a large, research-oriented firm categorizes universities as undesirable and adequate for purposes of hiring their graduates. The director collects data on 47 recent graduates, and has each rated by a supervisor.

Can the director safely conclude that rating is dependent on school type? (8 points)

School/rating	outstanding	average	poor
Undesirable	10	7	6
Adequate	14	8	2