Math 243 Final Exam NAME:_____

22 March 2006 Student ID:_____

Section time (3, 4, 8, or 9):____

GENERAL INSTRUCTIONS

(1) DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.
(2) Closed book, except for one graphing calculator and one standard size (8.5×11) page of notes. (Copies of Tables A, B, and C from the book are provided at the back.)
(3) THE EXAM PAGES ARE TWO-SIDED.
(4) The point values are as indicated in each problem; total 200 points.
(5) Write all answers on the test paper.
(6) Give at least three significant digits for all numerical answers.
(7) On multiple choice and true/false problems, always choose the one best answer unless otherwise specified. Work need not be shown.
(8) For other problems, show enough of your work that your method is obvious. If you use a calculator for a major step, show or explain what you entered in the calculator. Be sure that every statement you write is correct. Cross out any material you do not wish to have considered. Correct answers with insufficient justification or accompanied by additional incorrect statements will not receive full credit. Correct guesses to problems requiring significant work, and correct answers obtained after a sequence of mostly incorrect steps, will receive no credit.
(9) Be sure you say what you mean. Credit will be based on what you say, not what you mean.
(10) No help with calculators will be given during the exam.
(11) Time: 2 hours.

1	2	3	4	5	6
44	20	40	32	8	24

7	8	TOTAL	EC
8	24	200	20

1. (Multiple choice: 4 points/part; 44 points total.) Circle the letter of the best answer.

1A. We choose a sample of 100 entering freshmen at the University of New Pinchland, ask for their math SAT scores, and find that the mean of these 100 numbers is 489. Meanwhile, the registrar tells us that the mean of the math SAT scores of all entering freshmen is 507. The number 507 is what:

a. A population.
b. A parameter.
c. A sample.
d. A statistic.
e. Both (a) and (b).
f. Both (c) and (d).
g. None of the above.

1B. The margin of error for a 99% confidence interval is _____ the margin of error for a 95% confidence interval (calculated from the same sample). (Circle the letter of the answer that best fills in the blank.)

a. smaller than
b. larger than
c. equal to
d. any of the above are possible
e. none of the above

1C. An analysis of a particular two variable data set yielded a correlation $r = 0.5$. If the roles of the explanatory and response variables are switched, the new correlation will be:

a. 2
b. 0.5
c. -0.5
d. -2
e. Impossible to determine from the information provided.
f. None of the above.

1D. Let p be the true proportion of successes in a large population. (This is our standard notation.) For large samples (but no more than a tenth of the population), and assuming the other conditions for the one proportion z procedures are met, what is the sampling distribution of the sample proportion $\widehat{p}$?

a. Exactly normal with mean p and standard deviation $\sqrt{p(1-p)/n}$.
b. Approximately normal with mean p and standard deviation $\sqrt{p(1-p)/n}$.
c. Approximately normal with mean $\sqrt{p(1-p)/n}$ and standard deviation p.
d. Highly nonnormal with mean $\sqrt{p(1-p)/n}$ and standard deviation p.
e. A t distribution with mean p and $\sqrt{p(1-p)/n}$ degrees of freedom.
f. A t distribution with mean $\sqrt{p(1-p)/n}$ and p degrees of freedom.

1E. A researcher finds the mass (in grams) and tail length (in centimeters) of each member of a sample of white mice, and statistically analyzes the data he gets. With mass being the explanatory variable, the units of the correlation of mass and tail length are:

a. Tails per mouse.
b. Centimeters per gram.
c. Grams per centimeter.
d. Grams.
e. Centimeters.
f. None: the correlation has no units.
g. Cannot be determined from the information given.

1F. A laboratory tests 200 chemicals to determine whether they cause cancer in mice. For 11 of them, the laboratory obtains evidence that they cause cancer ($P < 0.05$ for each of these 11 chemicals). Which of the following is it safe to conclude?

a. The reported P-values greatly overstate the significance of the results.
b. It is very unlikely that, if these 11 chemicals did not cause cancer, the observed effects of these 11 chemicals would be as extreme or more extreme than they actually were.
c. At least one of these 11 chemicals is likely to cause cancer, although most probably only have a small effect on cancer rates.
d. If these 11 chemicals do not cause cancer, the probability is at most 0.05 that some 11 of these chemicals would give results as extreme or more extreme than the results actually observed with these 11 chemicals.
e. These 11 chemicals all show strong evidence causing cancer, although their effects on cancer rates may be small and of little practical significance.

1G. A statistical analysis was done in Salt Lake City which showed a strong positive correlation between the sale of sweaters and freeway car accidents. Which of the following is the most plausible explanation of this correlation?

a. A mistake, since there should be no correlation.
b. Wearing sweaters causes people to crash their cars.
c. Car accidents make people feel cold.
d. The effect of a lurking variable, such as the presence of snow.
e. Scientific dishonesty: the statistician doing the study didn't have enough publications to get tenure at his university, and had to produce some more in a great hurry.
f. There is no good explanation, since these two things are unrelated.

1H. The diameters of the balls in balls bearings from Wang's Bearings Inc. vary according to a normal distribution with mean 2.5 mm and standard deviation 0.1 mm. What is the sampling distribution for the sample mean of a simple random sample of 25 of these balls?

a. $N(0.5, 0.1)$.
b. $N(0.5, 0.02)$.
c. $N(2.5, 0.5)$.
d. $N(2.5, 0.1)$.
e. $N(2.5, 0.02)$.
f. $N(2.5, 0.004)$.
g. Impossible to determine from the information given.

1I. Gary owns 15 pieces of land. The mean value of the lots is \$30,000, the median value is \$20,000, the standard deviation of the values is \$12,000, and the range of the values is \$55,000. The total value of Gary's land is:

a. \$450,000
b. \$300,000
c. \$180,000
d. \$825,000
e. Impossible to tell from the information given.
f. None of the above.

1J. The P-value for a hypothesis test:

a. is the probability, assuming H_0 is true, of an outcome <u>at most</u> as extreme as the outcome we actually observed.
b. is the probability, assuming H_0 is true, of an outcome <u>at least</u> as extreme as the outcome we actually observed.
c. is computed assuming that H_0 is false.
d. is always smaller than α.
e. All of the above.

1K. While talking about the cars that fellow students drive, Jill made the claim that 15% of the students drive white cars. Jack found this hard to believe and decided to check the validity of Jill's claim with a confidence interval. In his simple random sample of size 200 there were 17 white cars. The standard error of $\widehat{p}$ is approximately:

a. 0.0004
b. 0.0252
c. 0.0006
d. 0.0197
e. None of the above.

2. (5 points/part; 20 points total) In the following situations, determine which one of the following statistical procedures is appropriate. (Do **not** worry about whether the procedure is safe to use.) Fill in each blank with the letter of the correct procedure. (Choices may be used more than once.)

Procedures:

A. one sample z test
B. one sample t test
C. matched pairs t test
D. two sample t test
E. one proportion z test
F. two proportion z test

Situations:

(1) _____ A researcher wishes to measure the effect of alcohol on reaction time. He measures the reaction times of 100 subjects with no alcohol, and the reaction times of the same subjects after two drinks.

(2) _____ In order to estimate the mean high school GPA of Oregonians, you take a simple random sample of 500 high school graduates in Oregon and obtain their GPAs.

(3) _____ Senator Snort's pollster conducts a telephone survey to gauge Senator Snort's support before he decides whether to seek reelection.

(4) _____ Senator Snort's opponent wants to know the effectiveness of a series of negative television ads featuring Senator Snort's recent conviction for drunk driving. His pollster asks in a telephone survey before the ads are run whether the respondents would vote for Senator Snort, and does the same thing, with an independent sample, after the ads have run.

3. a. (33 points. The steps do not all have the same point value.) A simple random sample of 714 adults (18 years or older) in a particular state showed that 535 of them voted in a particular election. A simple random sample of 634 adults in the same state showed that 437 of them voted in the next election.

Because of changes to the state voter registration laws, a researcher believes that the rates at which adults voted in the two elections are different. Test the researcher's belief at significance level $\alpha = 0.01$, using the following steps.

(1) State which test you will use (for example, one sample t or z procedure, or some other appropriate test from this course).
(2) Check that you can safely use the test in this case.
(3) State the hypotheses you will test.
(4) Calculate the test statistic.
(5) Give a P-value (or give two values between which P lies), and illustrate your answer with a graph.
(6) Draw and state the appropriate conclusion, expressing it in words appropriate for the context of the problem.

b. (7 points.) Give at least one plausible reason why your results may not correctly represent the effect of the change in the laws on the rate at which adults vote in elections in this state.

4. (32 points. The steps do not all have the same point value.) An automobile company is testing a an engine modification to determine if it results in better gas mileage. It tests with 20 new cars, identical except that 10 of them incorporate the engine modification and 10 don't. Each automobile gets 10 gallons of gasoline and is then driven until it runs out of gasoline.

The cars without the engine modification went a mean distance of 278 miles on the ten gallons of gasoline, with standard deviation 2.09 miles. The cars with the engine modification went a mean distance of 282 miles on the ten gallons of gasoline, with standard deviation 3.10 miles.

Is there significant evidence at the 0.01 level that the mean miles driven with the engine modification is larger than the mean miles driven without it? Assuming that the appropriate test is safe to use, test using the following steps.

(1) State which test you will use (for example, one sample t or z procedure, or some other appropriate test from this course).
(2) State the hypotheses you will test.
(3) Calculate the test statistic.
(4) Give a P-value (or give two values between which P lies), and illustrate your answer with a graph.
(5) Draw and state the appropriate conclusion, expressing it in words appropriate for the context of the problem.

5. (8 points.) A researcher is studying the effect of a new headache relief medication. He administers it to a group of 50 subjects with headaches (which we may treat as a simple random sample), and reports that 37 of them experienced substantial relief. Is it appropriate and safe to use the one proportion z procedures to estimate the effectiveness of this medication? Why or why not? (Do **not** carry out the test.)

6. a. (15 points.) Based on a simple random sample of 250 credit card holders, a large department store found that 12 card holders missed at least one payment during the last 6 months. Find a 90% confidence interval for the proportion of credit card holders who missed at least one payment during the last 6 months. Be sure to check that the procedure is safe to use.

b. (9 points.) (This was part of the problem about the proportion of credit card holders who missed a payment.) How large should the sample size be if we want a 98% confidence interval with a margin of error of 0.03 (or less)?

7. (8 points.) A researcher has been told that 8% of students at the University of Oregon are left handed. In a simple random sample of 100 University of Oregon students, 11 are found to be left handed. Is it appropriate and safe to use the one proportion z procedures on this outcome to carry out a hypothesis test on this claim? Why or why not? (Do **not** carry out the test.)

8. (24 points) You want to determine whether a new drug (administered as a pill once per day) can speed the healing of broken bones in people. You have 200 test subjects available, all with similar bone fractures. Use a diagram to outline in detail the design of a randomized comparative double blind experiment. Include information about the treatment groups and the response variable. Be sure that one can tell from your description that your experiment has all the characteristics expected of such experiments.

Extra credit on next page.

Extra credit. (20 extra credit points. Do not attempt this problem until you have checked all your answers to the other problems on this exam. It will be graded only if your score on the main part of the exam is 80% or better, and if your course grade without it is better than C^-. It will be graded much more severely; in particular, your answer must be clear, well written, and concise.)

Alice and Bob each have a bag containing a mixture of ordinary fair coins and coins with tails on both sides. Alice's bag contains 1024 ordinary coins and one coin with tails on both sides, and Bob's bag contains 512 coins of each kind. Each person chooses a coin at random from the corresponding bag. Alice flips her coin 10 times, and it comes up tails every time. Bob flips his coin 5 times, and it comes up tails every time. We want to understand the strength of the evidence that each of the coins has tails on both sides.

(1) (2 extra credit points.) State appropriate hypotheses.

(2) (6 extra credit points.) Give, with reasons, P-values for both outcomes. (The credit is all for the justification. In particular, no credit for just a number.)

(3) (12 extra credit points.) Given the contents of the bags, for which of Alice and Bob is the evidence stronger that the coin has tails on both sides? Explain precisely the reasons for your conclusion.