

Math 243

Midterm 1

NAME: \_\_\_\_\_

2 May 2008

Student ID: \_\_\_\_\_

Section time (4, 5, 8, or 9): \_\_\_\_\_

White version

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### GENERAL INSTRUCTIONS

- (1) DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.
- (2) Closed book, except for a graphing calculator and one standard size ( $8.5 \times 11$ ) 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 100 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) Grading complaints must be submitted in writing by the end of the discussion section in which the exam is returned.
- (11) Time: 50 minutes.

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| MC | 1  | 2 | 3  | 4  | 5  | 6  | 7 | TOTAL |
|----|----|---|----|----|----|----|---|-------|
| 21 | 18 | 8 | 12 | 10 | 12 | 14 | 5 | 100   |
|    |    |   |    |    |    |    |   |       |

Multiple choice: 3 points/part; 21 points total. Circle the letter of the best answer.

MC1. As part of an investigation of the mean Math SAT score of University of Oregon students, the Registrar's office selects 100 students from the University of Oregon, and looks up their Math SAT scores in their application materials. What is the sample?

- a. The Registrar's office.
- b. All University of Oregon students.
- c. The 100 selected students.
- d. The Math SAT scores of the 100 selected students.
- e. The Math SAT scores of all University of Oregon students.
- f. Impossible to tell from the information given.
- g. None of the above.

MC2. Wang's Widgets Inc. has 20 employees. The mean of their annual salaries is \$50,000, the median is \$40,000, the standard deviation of the annual salaries is \$24,000, and the range of the annual salaries is \$75,000. The total payroll of Wang's Widgets Inc. is:

- a. \$1,500,000
- b. \$1,000,000
- c. \$800,000
- d. \$480,000
- e. Impossible to tell from the information given.
- f. None of the above.

MC3. A researcher wants to study the relationship between color and a certain genetic mutation in Rocky Mountain spotted frogs. He chooses a stream which looks like good frog habitat and collects for study all the frogs he can net on this stream. The frogs he collected form:

- a. A population.
- b. A simple random sample.
- c. A stratified random sample.
- d. A convenience sample.
- e. A voluntary response sample.
- f. A systematic random sample.

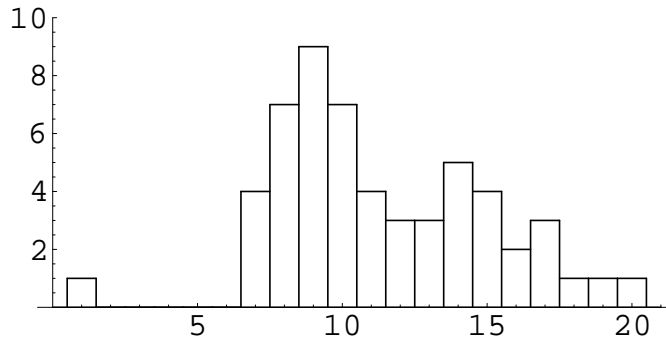
MC4. A magician has a coin which is biased in such a way that the probability of getting heads when the coin is tossed is  $1/3$ . Which of the following statement gives a valid interpretation of this probability?

- a. If the coin is tossed a very large number of times, the proportion of the tosses which are heads will be very close to  $1/2$ .
- b. Every third toss of this coin will be heads.
- c. In any three consecutive tosses of this coin, exactly one will be heads.
- d. In any three consecutive tosses of this coin, at least one will be heads.
- e. If the coin is tossed a very large number of times, the proportion of the tosses which are heads will be very close to  $1/3$ .
- f. The magician is intending to cheat in a game involving coin tosses.

MC5. Two variables in a study are said to be confounded if what?

- a. One cannot separate their effects on a response variable.
- b. They are highly correlated.
- c. They do not have a normal distribution.
- d. One of them is a placebo.
- e. Both are lurking variables.
- f. The statistician conducting the study is incompetent.

MC6. Consider the following histogram (made from integer data):



The distribution of the data plotted is:

- a. Roughly symmetric with no outliers.
- b. Roughly symmetric with one or more outliers.
- c. Skewed to the right with no outliers.
- d. Skewed to the right with one or more outliers.
- e. Skewed to the left with no outliers.
- f. Skewed to the left with one or more outliers.

MC7. Let  $\mu$  be the mean IQ of children in the Hicksville school system. Using a simple random sample of Hicksville school children, the following 95% confidence interval for the mean  $\mu$  is computed:  $103 \leq \mu \leq 112$ . Which of the following statements gives a valid interpretation of this interval?

- a. 95% of the sample of Hicksville school children have IQs between 103 and 112.
- b. 95% of all Hicksville school children have IQs between 103 and 112.
- c. If the procedure were repeated many times, approximately 95% of the resulting confidence intervals would contain the mean IQ of all Hicksville school children.
- d. If the procedure were repeated many times, approximately 95% of the resulting confidence intervals would contain the mean IQ of the sample of Hicksville school children.
- e. The mean IQ of all Hicksville school children is 95.
- f. The statistician must be wrong, since the mean IQ of all Hicksville school children is obviously less than 95.

1. (3 points/part; 18 points total. Work need not be shown.) The five number summary of the final exam scores in Professor Zhang's Math 315 is:

4 45 60 75 98.

The questions below are about the original data, which consists of one number for each of the 40 students in the class. For each of the following statements, circle "A" if the statement must be true, circle "S" if the statement might or might not be true, and circle "N" if the statement cannot be true. In other words, under the stated circumstances the statement is **A**lways true, **S**ometimes true, or **N**ever true.

A S N (a) At least one student received a score of 60.

A S N (b) The score 4 is an outlier.

A S N (c) The median score is 60.

A S N (d) About 30 students had scores of 75 or better.

A S N (e) The standard deviation of the scores is 15.

A S N (f) If Professor Zhang multiplies all the scores by 2 (since the final exam counts twice as much as the midterm), the new first quartile will be 90.

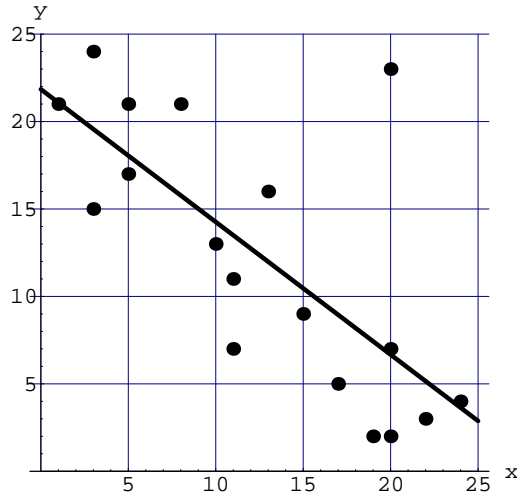
2. (4 points/part; total 8 points.) The weights of zucchinis harvested in a certain California valley are approximately normally distributed with mean 2.41 pounds and standard deviation 0.62 pounds. A truckload of zucchinis is taken to market.

In each of the following parts, show your work, and draw a picture of the appropriate normal curve with the relevant points on the horizontal axis clearly marked and with the appropriate area shaded and clearly identified. The curve must look reasonable.

a. Approximately what percentage of the zucchinis weigh between 1.79 and 3.65 pounds? (You must make your method clear and show 4 significant digits.)

b. Approximately 10% of the zucchinis weigh more than \_\_\_\_\_ pounds.

3. (4 points/part; total 12 points.) Consider the following scatterplot and regression line.



a. What is the approximate correlation between the variables? Circle one.

- 2.00      1.00      0.70      0      - 0.70      - 1.00      - 2.00

b. Give the approximate coordinates of any outliers. If there are none, write “NONE”.

c. The residual for the observation with approximate coordinates (17, 5) is closest to: (circle one)

- 12      - 8      - 4      0      4      8      12

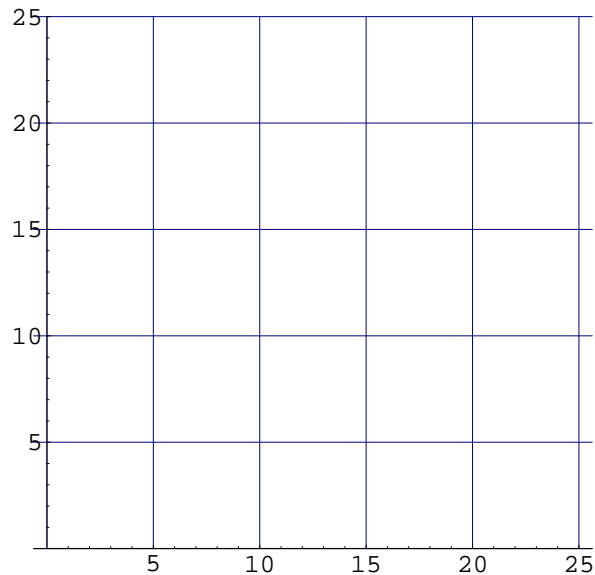
4. (2 points/part; 10 points total.) For a biology project, a student measures the tail length (in centimeters) and the weight (in grams) of each of 12 mice of the same variety. What units of measurement do each of the following have? (Write “none” if appropriate.)

- The mean of the lengths of the tails.
- The standard deviation of the weights.
- The  $z$ -score of the weight of the seventh mouse.
- The correlation between weight and tail length.
- The damages awarded in a lawsuit after the student was bitten by a mouse with rabies.

5. (4 points/part; total 12 points.) A scientist studying the fire-breathing monsters of the planet Yuggxth wants to know if egg size is a good predictor of adult mass for these creatures. At considerable personal risk, he has managed to obtain the following data on five individuals.

| Individual | Egg diameter (cm) | Adult mass (tons) |
|------------|-------------------|-------------------|
| A          | 20                | 19                |
| B          | 10                | 12                |
| C          | 15                | 18                |
| D          | 8                 | 14                |
| E          | 15                | 14                |

a. Draw a scatterplot on the axes provided. Be sure to label your axes, and make an appropriate choice of which variable to put on the horizontal axis.



b. Find the equation of the least squares regression line and plot it on the graph above.

c. What is the correlation between egg diameter and adult mass? What percentage of the variation in adult mass is explained by egg diameter?

6. (7 points/part) Repeated measurements of the concentration of helium in a gas with a particular scientific instrument vary normally with standard deviation 3.6 milligrams/liter (mg/l) and with mean equal to the true concentration.

a. The true concentration of helium in one gas is 70.3 mg/l. If the concentration is measured 9 times with this instrument, what is the probability that the mean of the measurements is at least 70 mg/l? Illustrate your answer with a graph in which the appropriate areas are labelled.

b. For another gas, four measurements of the concentration of helium with this instrument gave  $\bar{x} = 47$  mg/l. Construct a 95% confidence interval for the true concentration of helium in this gas. Be sure to show the critical value you used, and how you used it.

7. (5 points.) In 2002, Jane Smith got a score of 690 on the mathematics part of the SAT, and John Doe got a score of 28 on the ACT Assessment mathematics test. SAT math scores in 2002 were normally distributed with mean 516 and standard deviation 114, and ACT math scores in 2002 were normally distributed with mean 20.6 and standard deviation 5.0. Find the standardized scores for both students. Assuming both tests measure the same kind of ability, who did better?