Name _____

MATH 160A Introduction to Applied Statistics Fall 2007 Exam #2

Instructions: Do your work and record your results on separate paper. You can work on the problems in any order. Clearly number your work for each problem.. You do not need to write answers on the question sheet.

This exam is a tool to help me (and you) assess how well you are learning the course material. As such, you should report enough written detail for me to understand how you are thinking about each problem. If you use your calculator, write down enough details of the arithmetic to make clear what calculation you are doing. (114 points total)

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1. Here is brief article from the June 16, 2007 edition of *Science News* that describes an experimental study:

> Children in Uganda recover from malaria faster when taking an herb-based combination therapy than when given standard drugs, solidifying the herbal drugs as frontline treatments for malaria in Africa.
>
> Artemisinin is made from the leaves of the Chinese wormwood shrub, and the drugs artesunate and artemether are derivatives known to kill the parasites that cause malaria.
>
> Researchers monitored the health of 601 children for up to 19 months. During that time, 329 came down with malaria caused by the protozoan *Plasmodium falciparum*. The scientists randomly assigned some of these kids to get one of the artemisinin derivatives in combination with longer-acting drugs. Others received pills combining sulfadoxine and pyrimethamine, an old, inexpensive therapy still used extensively in Africa.
>
> Only 7 percent of children getting the artemether combination failed to recover within a month, compared with 17 percent of those getting the artesunate combination and 26 percent receiving the sulfadoxine-pyrimethamine pills, Philip J. Rosenthal of the University of California, San Francisco and his colleagues report in the May 23/30 Journal of the American Medical Association. In light of earlier results, the researchers are confident that the artemisinins are the greater contributors to the combinations' success.
>
> Unlike the case for chloroquine and most other antimalarials, "there's probably no resistance to the artemisinins in Africa," Rosenthal says. "We used chloroquine for 50 years. Now, we're clearly settling in with the artemisinin combination therapies as our new answer."

   (a) Identify the nature and number of subjects in this experimental study. (4 points)

   (b) Describe the treatments in this study. (4 points)

   (c) Describe the response variable in this study. (4 points)

   (d) This experimental design is missing one important feature. Identify the missing feature. Explain why the researchers in this case might reasonably choose this design in spite of this missing feature. (4 points)

2. A sample survey is being designed to get information on how much time students at a particular college spend studying. Describe one reasonable way that a stratified random sample could be set up. (That is, describe the strata that could be used.) Explain why this stratification might be of interest for this study. (8 points)

3. A newspaper food critic wants to choose a simple random sample of 4 pizza places from among the following 12:

Pizza Hut	Pizza Time	Pizza Answer	Domino's
Farelli's	Puget Sound Pizza	Round Table	Papa John's
Garlic Jim's	Cerello's	Upper Crust	Godfather's

Give the names of the 4 pizza places in a sample determined using Line 175 of Table B. (8 points)

4. A well-designed experiment includes a control group in which the subjects might have no treatment or a placebo treatment.

   (a) Explain what is meant by *placebo treatment* and explain the importance of using a placebo treatment. (4 points)

   (b) Ideally, an experiment that includes a placebo treatment is *double-blind*. Explain what *double-blind* means and explain why this is important. (4 points)

5. A retail store and a lightbulb manufacturer have an agreement that the store can reject any shipment of lightbulbs if more than 1% of them are defective. In one shipment, the store receives 3500 lightbulbs. The store manager will sample 100 of these lightbulbs and test each one in this sample for defects.

   (a) Give a significant reason why using a simple random sample is better than taking the first 100 bulbs that are unpacked from the shipment. (4 points)

   (b) What is the parameter of interest in this situation? (3 points)

   (c) What statistic is being used to estimate the parameter? (3 points)

   (d) Would the variability in the sample proportion change if a sample size of 200 was used? If so, would the variability increase or decrease? (4 points)

   (e) In comparison to the original situation, would the variability in the sample proportion change if the shipment contained 7000 bulbs and a sample size of 100 was used? If so, would the variability increase or decrease? (4 points)

6. The M&M's web site gives the following proportions for colors:

Color	Brown	Yellow	Red	Blue	Orange	Green
Proportion	0.13	0.14	0.13	0.24	0.20	0.16

   (a) Consider the process of buying a bag of M&M's at the store and then selecting one M&M at a time from the bag without looking. Explain why it is reasonable to use the proportions given above as probabilities for each of the colors. (4 points)

   (b) Is M&M color a random variable? (2 points)

   (c) Determine the probability that the color of a selected M&M is neither red nor green. (5 points)

   (d) Determine the probability that two independently selected M&M's are the same color. (5 points)

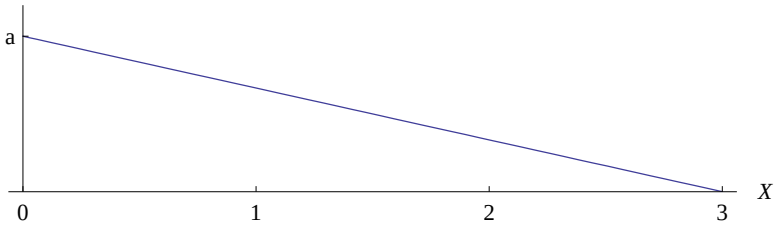
7. Consider the random process of flipping one coin and rolling one die. For the coin, assign a value of 0 to tails and a value of 1 to heads. For the dice, assign the usual values of 1 through 6.

   (a) Let X be the value for the coin. Give the probability distribution for X. Compute the mean and standard deviation for X. (8 points)

   (b) Let Y be the value for the dice. Give the probability distribution for Y. Compute the mean and standard deviation for Y. (8 points)

   (c) Let Z be the sum of the value for the coin and the dice. Compute the mean and standard deviation for Z. (6 points)

8. Suppose X is a continuous random variable having values from 0 to 3 and with a probability density curve given by



   (a) Show that the correct value for a is $\frac{2}{3}$. (4 points)

   (b) Determine $\mathrm{P}(2 < X < 3)$. (4 points)

   (c) How does $\mathrm{P}(2 \leq X \leq 3)$ compare with the result for (b)? (2 points)

9. You and a friend are bored one night and decide to make up a game. One of you will be the player and the other will be the casino. The player will pay \$1 to roll a die. The casino will pay out \$3 for a 6, \$1 for a 5 or 4, and \$0 for a 3, 2, or 1. You plan to play many times. Would you choose to be the player or the casino? Explain how you reach your conclusion. (8 points)