STA 225
Test II

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Summer 2004

Show all work, where appropriate, to receive full credit. For problems requiring written responses, give answers which are complete but brief. Good luck!

Part I. Multiple choice (2 points each). Circle the answer of the best response for each question. No work needs to be shown for this part. If you circle more than one response, your answer will be graded as incorrect even if one of your answers was correct.

1.   Researchers wish to determine if a new experimental medication will reduce the symptoms of allergy sufferers without the side effect of drowsiness. To investigate this question, the researchers give the new medication to fifty adult volunteers who suffer from allergies. Forty-four of these volunteers report a significant reduction in their allergy symptoms without any drowsiness. The experimental units are
        (a)   the researchers.
        (b)   the fifty adult volunteers.
        (c)   the forty-four volunteers who reported a significant reduction in their allergy symptoms without any drowsiness.
        (d)   the six volunteers who did not report a significant reduction in their allergy symptoms without any drowsiness.

2.   Will a fluoride mouthwash used after brushing reduce cavities? Twenty sets of identical twins were used to investigate this question. One member of each set of twins used the mouthwash after each brushing, the other did not. After six months, the difference in the number of cavities in those who used the mouthwash was compared with the number in those who did not use the mouthwash. This experiment uses
        (a)   random placeboes.
        (b)   double blinding.
        (c)   double replication.
        (d)   a matched pairs design.

3.   In order to assess the effects of exercise on reducing cholesterol, a researcher sampled fifty people from a local gym who exercised regularly and fifty people from the surrounding community who did not exercise regularly. They all reported to a clinic to have their cholesterol measured. The subjects were unaware of the purpose of the study, and the technician measuring the cholesterol was not aware of whether or not subjects exercised regularly. This is
        (a)   an observational study.
        (b)   an experiment, but not a double blind experiment.
        (c)   a double blind experiment.
        (d)   a matched pairs experiment.

4. For a random experiment with three possible outcomes A_1, A_2 and A_3, which of the following gives a legitimate probability assignment?
    (a) $P(A_1) = \frac{1}{4}, \; P(A_2) = \frac{1}{3}, \; P(A_3) = \frac{1}{2}.$
    (b) $P(A_1) = \frac{1}{4}, \; P(A_2) = 0.3, \; P(A_3) = 0.45.$
    (c) $P(A_1) = \frac{1}{4}, \; P(A_2) = \frac{1}{4}, \; P(A_3) = \frac{1}{4}.$
    (d) $P(A_1) = \frac{1}{4}, \; P(A_2) = \frac{1}{2}, \; P(A_3) = -\frac{1}{4}.$

5. Suppose that A and B are two independent events with $P(A)=0.2$ and $P(B)=0.4$. Then $P(A$ and not $B)$ is
    (a)   0.08.
    (b)   0.12.
    (c)   0.52.
    (d)   0.60.

6. Event A occurs with probability 0.2. Event B occurs with probability 0.8. If A and B are disjoint (mutually exclusive), then
    (a) $P(A$ and $B)=0.16.$
    (b) $P(A$ or $B)=1.0.$
    (c) $P(A$ and $B)=1.0.$
    (d) $P(A$ or $B)=0.16.$

7. A television station is interested in predicting whether or not voters are in favor of an increase in the state sales tax. It asks its viewers to phone in and indicate whether they support or are opposed to an increase in the state sales tax in order to generate additional revenue for education. Of the 2633 viewers who phone in, 1474 (55.98%) are opposed to the increase. The population of interest is
    (a)   all people who will vote on the sales tax increase on the day of the vote.
    (b)   all regular viewers of the television station who own a phone and have participated in similar phone surveys in the past.
    (c)   the 2633 viewers who phoned in.
    (d)   the 1474 viewers who were opposed to the increase.

8. In order to take a sample of 1200 people from a population, I first divide the population into men and women, and then take a simple random sample of 500 men and a separate simple random sample of 700 women. This is an example of a
    (a)   block design.
    (b)   stratified random sample.
    (c)   double blind simple random sample.
    (d)   randomized comparative experiment.

9. A group of college students believes that herbal tea has remarkable restorative powers. To test their theory, they make weekly visits to a local nursing home, visiting with residents, talking with them, and serving them herbal tea. After several months, many of the residents are more cheerful and healthy. The explanatory variable in this experiment is
   (a)   the emotional state of the residents.
   (b)   herbal tea.
   (c)   the fact that this is a local nursing home.
   (d)   visits of the college students.

10. An event A will occur with probability 0.5. An event B will occur with probability 0.6. The probability that both A and B will occur is 0.1. The conditional probability of A given B
   (a)   is 0.3.
   (b)   is 0.2.
   (c)   is $\frac{1}{6}$.
   (d)   Cannot be determined from the information given.

11. Which of the following is an example of a repeated measures design?
   (a)   A teacher compares the pre-test and post-test scores of students.
   (b)   A teacher compares the scores of students using a computer based method of instruction with the scores of other students using a traditional method of instruction.
   (c)   A teacher compares the scores of students in her class on a standardized test with the national average score.
   (d)   A teacher calculates the average of scores of students on a pair of test and wishes to see if this average is larger than 80%.

12. An experiment was conducted by some students to explore the nature of the relationship between a person's heart rate (measured in beats per minute) and the frequency at which that person stepped up and down on steps of various heights. Three rates of stepping and two different step heights were used. A subject performed the activity (stepping at one of the three stepping rates at one of the two possible heights) for three minutes. Heart rate was then measured at the end of this period. The variables "stepping rate" and "step height" are
   (a)   the factors.
   (b)   the levels.
   (c)   the controls.
   (d)   the units.

PART II. Show all your work to get full credit. Where possible, put your answer in a box.

1.(15pts.)   At a block party there are 100 men and 50 women. You want to ask opinions about how to improve the next party. You decide to choose a simple random sample of 10 men and 10 women from their respective groups.

(a) What type of sampling scheme is employed, and why?

(b)Why do you randomly select equal numbers from both groups even though the women's group is only half the size of the men's group?

(c) Using Line 116 of the Random Digits Table, randomly select the 10 women from the women's group. Write only the numbers of the randomly selected women.

(d) Suggest any other two plausible sampling schemes for this survey that you might have employed instead.

2.(15pts.)   A chemical engineer is designing the production process for a new product. The chemical reaction that produces the product may have higher or lower yield, depending on the temperature and stirring rate in the vessel in which the reaction takes place. The engineer decides to investigate the effects of combinations of two temperatures 50 $^\circ$C and 60 $^\circ$C) and three stirring rates (60 rpm, 90 rpm, and 120 rmm) on the yield of the process. She randomly assigns two batches of the product to each of the combinations of temperature and stirring rate.

(a) Briefly state the objective of this experiment.

(b) How many factors are considered in this experiment?

(c) How many treatment combinations do we have in this experiment?

(d) The experimental units are_____.

(e) The response variable is_____.

(f) What is the key assumption about those batches of products randomly assigned to the treatment combinations that must be made?

(g) If there is no justification for the assumption you give in part (f) to hold, what other experimental design will you recommend?

3.(15pts.)Two flower seeds are randomly selected from a package that contains
four seeds for red flowers and three seeds for white flowers.

(a)   Draw a TREE diagram to list all possible outcomes in the sample space S.

(b)   What is the probability that both seeds will result in red flowers?

(c)   What is the probability that one of each color is selected?

(d)   What is the probability that both seeds are for white flowers?

4.(20pts.) Call a household prosperous if its income exceeds $100,000. Call a
household educated if the householder completed college. Select an American
household at random, and let

A be the event that the randomly selected household is prosperous

And

B be the event that the randomly selected household is educated.

According to the Current Population Survey, P(A)=.134, P(B)=0.254, P(A and
B)=.080.

(a)   Draw a Venn diagram for this problem. Include the probability of each
part (four parts).

(b)   What is the probability that a randomly selected household is either
prosperous or educated?

(c)   What is the probability that a randomly selected household is neither
prosperous nor educated?

(d)   Calculate $P(A|B)$

(e)   Calculate $P(B|A)$

(f)   Are events A and B independent? Explain.

5.(15pts.) Cocaine addiction is hard to break. Addicts need cocaine to feel any pleasure, so perhaps giving them an antidepressant drug will help. A 3-year study with 78 chronic cocaine fusers compared an antidepressant drug called desipramine with lithium and a placebo. (Lithium is a standard drug to treat cocaine addiction. A placebo is a dummy drug, used so that the effect of being in the study but not taking any drug can be seen). One-third of the subjects, chosen at random, received each drug. The results are as follows:

	Desipramine	Lithium	Placebo
Relapse	10	18	20
No Relapse	16	8	6
Total	26	26	26

(a)   Are there clear explanatory and response variables in this study? If so, state them, and name them X and Y, respectively.

(b)   Calculate the conditional probabilities $P(Y|X)$ in a tabular form from the table above.

(c)   Compare the relative effectiveness of the three treatments in preventing relapse.

(d)   Would you conclude that a reduction in relapse actually depends on the type of treatment a cocaine user received?

(e)   Are there possible lurking variables in this study that may worry you?

6.(16pts.)   Two normal random variables are *independent* of each other. One has mean 150
and standard deviation 10; the other has mean 140 and standard deviation 15.

(a)   When are two events A and B said to be independent in general? State at
least two different conditions.

(b)   What is the probability that both random variables will exceed 160?

(c)   What is the probability that at least one of the two random variables will
exceed 160?

b) Why do you randomly select equal numbers from both groups even though the women's group is only half the size of the men's group?