

1. (20 pts) Two envelopes, Envelope A and Envelope B, contain vouchers with dollar amounts written on them. The distributions of dollar amounts are indicated in the following frequency distributions.

Envelope A		Envelope B	
Dollar Amt	Number	Dollar Amt	Number
10	2	10	6
20	3	20	3
30	5	30	3
40	7	40	2
50	8	50	1

You are presented with one of the envelopes, but you do not know which one. You draw one voucher from the envelope at random, read its value, and decide which envelope you believe it is. The hypotheses are

$H_0$ : The envelope is Envelope A.

$H_1$ : The envelope is Envelope B.

- (a) (6 pts) Draw frequency plots of the contents of the two envelopes.
- (b) (2 pts) What is the direction of extreme?
- (c) (4 pts) Suppose your decision rule is to reject  $H_0$  if the selected voucher is at least as extreme as \$20. What is the value of  $\alpha$ ?
- (d) (4 pts) What is the value of  $\beta$ ?
- (e) Describe a Type I error in this situation. Be specific.
- (f) (4 pts) If the selected voucher is worth \$30, what is its  $p$ -value?
2. (6 pts) In each of the following pairs of statements, tell which would be the null hypothesis and which would be the alternative hypothesis.
- (a) The deceased was murdered.  
The deceased died of natural causes.
- (b) Coffee made with filtered water tastes the same as coffee made with tap water.  
Coffee made with filtered water tastes better than coffee made with tap water.
- (c) Putting a “deer whistle” on the front of a car will prevent collisions with deer.  
Putting a “deer whistle” on the front of a car will not prevent collisions with deer.

3. (26 pts) The following paragraphs were excerpted from an article appearing on MSNBC.com<sup>1</sup>.

#### **Good News for Slackers: Naps Can Help the Heart**

Daytime snooze cuts risk of fatal heart attack by 37 percent, study finds. Research shows midday snoozes at least three times a week, benefit the heart by reducing stress.

Feb 13, 2007 CHICAGO - Office nappers now have the perfect excuse: New research shows that a little midday snooze seems to reduce the risk of fatal heart problems, especially among men.

In the largest study to date on the health effects of napping, researchers tracked 23,681 healthy Greek adults for an average of about six years. Those who napped for about half an hour at least three times weekly had a 37 percent lower risk of dying from heart attacks or other heart problems than those who did not nap.

Most participants were in their 50s, and the strongest evidence was in working men, according to the study, which appears in Mondays issue of Archives of Internal Medicine.

The researchers said naps might benefit the heart by reducing stress, and jobs are a common source of stress.

It's likely that women reap similar benefits from napping, but not enough of them died during the study to be sure, said Dr. Dimitrios Trichopoulos, the study's senior author and a researcher at Harvard University and the University of Athens Medical School.

Heart problems killed 48 women who were studied, six of them working women, compared with 85 men, including 28 working men.

A daytime siesta has long been part of many cultures, especially those in warmer climates. Mediterranean-style eating habits featuring fruits, vegetables, beans and olive oil have been credited with contributing to relatively low rates of heart disease in those countries, but the researchers wanted to see if napping also plays a role.

The researchers in the latest study factored in diet, exercise, smoking and other habits that affect the heart but still found napping seemed to help.

Previous studies have had conflicting results. Some suggested napping might increase risk of death, but those mostly involved elderly people whose daytime sleepiness reflected poor health, Trichopoulos said.

His research team studied a broader range of people, ages 20 to 86, who were generally healthy when the study began.

Still, it's possible that study participants who napped "are just people who take better care of themselves," which could also benefit the heart, said Dr. Marvin Wooten, a sleep specialist at Columbia St. Marys Hospital in Milwaukee.

- (a) (3 pts) Describe the sample.
- (b) (4 pts) Identify the explanatory and response variables of primary interest in this study.
- (c) (4 pts) Does this study appear to be an observational study or an experimental study? Explain your reasoning.
- (d) (3 pts) Does this study appear to be prospective or retrospective? Explain your reasoning.
- (e) (3 pts) Identify three other explanatory variables for which the researchers controlled.
- (f) (3 pts) Identify one variable that was a confounding variable in previous studies.

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<sup>1</sup><http://www.msnbc.msn.com/id/17115245/>

- (g) (3 pts) One sentence states, “Heart problems killed 48 women who were studied, six of them working women, compared with 85 men, including 28 working men.” The figures 48, 6, 85, and 28 are (choose one)
- statistics
  - parameters
  - variables
  - strata
- (h) (3 pts) Another sentence states, “It’s likely that women reap similar benefits from napping, but not enough of them died during the study to be sure, said Dr. Dimitrios Trichopoulos.” Does this statement indicate that (choose one)
- The data for women were statistically significant.
  - The data for women were statistically insignificant.
  - Dr. Trichopoulos wishes more women had died.
4. (14 pts) A recent Internet poll conducted by ABC News<sup>2</sup> reported that 1069 people out of the 2263 people who participated in the poll agree with the statement “Although it is cold today, average temperatures for the year are rising.” In this poll, people who are visiting the ABC News website are invited to click on the “Vote” button and give their opinion.
- (4 pts) The web page states, “Not a scientific survey.” Explain one source of bias that is likely to occur in this kind of survey.
  - (4 pts) What statistic is the best choice for summarizing these data? Calculate its value.
  - (6 pts) The survey also reported that 649 people disagreed with the statement and 545 were not sure. Draw a pie chart or a bar graph (your choice) to display the data of this survey.
5. (10 pts) A professor on a college campus with 1100 students wishes to conduct a survey of the students at that college similar to the one conducted by ABC News. He wants to select randomly 100 students and see how many agree with the statement in the previous problem about global warming.
- (4 pts) Explain how to use the TI-83 or TI-84 (or a similar calculator) to find a random sample of size 100 from this population. Assume that the professor wishes to sample without replacement.
  - (3 pts) Using a seed of 121, find the labels of the first 5 students selected to be in the sample.
  - (3 pts) The professor thinks about his survey a little more and decides, rather than select 100 students from the student body at large, he will

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<sup>2</sup><http://abcnews.go.com/>

select 25 freshmen, 25 sophomores, 25 juniors, and 25 seniors. What sampling method is he using?

6. (6 pts) Suppose that in the previous problem, the professor decides to use 1-in- $k$  systematic sampling. He wants a sample of 100 students out of the 1100 students in the student body.
  - (a) (3 pts) What value of  $k$  should he use?
  - (b) (3 pts) Using a seed of 262, find the labels of the first 5 students that he selects.
  
7. (12 pts) In an effort to make its burgers as tasty as possible, a fast-food chain conducts a study in which it prepares hamburgers using three different levels of fat content (5 g, 7.5 g, and 10 g) and three different core cooking temperatures (150°, 155°, and 160°). Ten hamburgers are prepared for each combination of levels.
  - (a) (4 pts) How many hamburgers are needed for this study?
  - (b) Is this study an observational study or an experiment? Explain.
  - (c) (4 pts) If the people who eat and rate the hamburgers are told the fat content of the hamburger they are eating, what kind of bias might this introduce?
  - (d) (4 pts) If the researchers used only high-school seniors for their study, what kind of bias might this introduce?
  
8. (6 pts) Identify each of the following variables as (i) qualitative, (ii) quantitative discrete, or (iii) quantitative continuous.
  - (a) (2 pts) The total length of time a person spends napping between 8:00 am and 5:00 pm during a specific week.
  - (b) (2 pts) A person's response to the question "Do you agree with the following statement about global warming, ..."
  - (c) (2 pts) A subject's rating of the taste of a hamburger on a scale from 1 to 5.