

MATH1180
Homework 1
Due Friday, January 27

Please read Chapters 1 (Introduction) and 2 (Study Designs) of the Baglivo text, and Workbook 1 through the bottom of page 19.

When submitting homework, please remember the following:

- Show all work leading to each solution.
- *Staple* all sheets together. A paper clip is not acceptable.
- Do not submit crossed-out or sloppy work.
- Do not submit ripped or torn pages.
- Be sure to submit your own work.

PROBLEM 1 (MM). Identify each boxed number as the value of a parameter or a statistic.

- (a) A carload of ball bearings has a mean diameter of $\boxed{2.503}$ centimeters (cm). This is within the specifications for acceptances of the lot by the purchaser. The inspector happens to inspect 100 bearings from the lot with a mean diameter of $\boxed{2.515}$ cm. This is outside the limits, so the lot is mistakenly rejected.
- (b) A telemarketing firm in Los Angeles uses a device that dials residential telephone numbers in that city at random. Of the first 100 numbers dialed, $\boxed{43}$ are unlisted. This is not surprising because $\boxed{52\%}$ of all Los Angeles residential phones are unlisted.
- (c) A researcher investigating the effects of a toxic compound in food conducts a randomized comparative experiment with young male white rats. A control group is fed a normal diet, while the experimental group is fed a diet with 2500 parts per million of the toxic material. After 8 weeks, the mean weight is $\boxed{335}$ grams for the control group and $\boxed{289}$ grams for the experimental group.

PROBLEM 2 (DL). Explain whether an experiment or an observational study would be more appropriate to investigate the following:

- (a) A sociologist is interested in whether large families (with 4 or more children) attend religious services more often than smaller families (with fewer than 4 children).
- (b) A manufacturer is interested in whether a new computer processor will improve the performance of its electronics equipment.
- (c) A pharmaceutical company wants to learn if its new drug will lower high blood pressure.
- (d) A financial researcher wants to learn whether companies that give large bonuses to their chief executive officers (CEOs) have higher stock prices.

PROBLEM 3 (MN). The most common treatment for breast cancer discovered in its early stages was once removal of the breast. It is now usual to remove only the tumor and nearby lymph nodes, followed by radiation. To study whether these treatments differ in their effectiveness, a medical team examines the records of 25 large hospitals and compares the survival times after surgery of all women who have had either treatment.

- (a) Identify the explanatory and response variables.
- (b) Explain carefully why this study is not an experiment.

- (c) Explain why confounding will prevent this study from discovering which treatment is more effective.

PROBLEM 4 (BM). Instrumental records show an increase in global mean surface air and ocean temperatures on the order of 1 degree Fahrenheit over the 20th century. This trend is also evident in the reduced extent in snow cover, the accelerated rate of rise of sea level, and the increasingly earlier arrival and breeding times of migratory birds. This global warming coincides with dramatic changes in atmospheric gas compositions due to human activity such as the burning of fossil fuels. The Committee on the Science of Climate Changes states: "Because of the large and still uncertain level of natural variability inherent in the climate record. . . , a causal linkage between the buildup of greenhouse gases in the atmosphere and the observed climate changes during the 20th century cannot be unequivocally established."

- (a) Is the evidence of global warming experimental or observational?
(b) What explanatory variable is thought to influence climate change? What lurking variable is confounded with that explanatory variable?

PROBLEM 5 (DL). Cholesterol researchers are investigating whether there is a difference between a new medication given in pill form and a placebo (inactive pill) in lowering LDL cholesterol levels in the bloodstream.

- (a) Identify the response and explanatory variables.
(b) Suppose there is a patient with very high LDL cholesterol levels, and his or her doctor assigns this patient to the group of patients who receive the new medication rather than the placebo. Which of the principles of experimental design has the doctor violated?

PROBLEM 6 (BM). An experiment that claimed to show that meditation reduces anxiety proceeded as follows. The experimenter interviewed the subjects and rated their level of anxiety. Then the subjects were randomly assigned to two groups. The experimenter taught one group how to meditate and they meditated daily for a month. The other group was simply told to relax more. At the end of the month, the experimenter interviewed all the subjects again and rated their anxiety level. The meditation group now had less anxiety. Psychologists said that the results were suspect because the ratings were not blind. Explain what this means and how lack of blindness could bias the reported results.

PROBLEM 7 (BM). Comment on each of the following as a potential sample survey question. Is the question clear? Is it slanted toward a desired response?

- (a) "Some cell phone users have developed brain cancer. Should all cell phones come with a warning label explaining the danger of using cell phones?"
(b) "Do you agree that a national system of health insurance should be favored because it would provide health insurance for everyone and would reduce administrative costs?"
(c) "In view of the negative externalities in parent labor force participation and pediatric evidence associating increased group size with morbidity of children in day care, do you support government subsidies for day care programs?"

PROBLEM 8 (FPP). Breast cancer is one of the most common malignancies among women in the United States. If it is detected early enough—before it starts to spread—chances of successful treatment are much better. Do screening programs speed detection by enough to matter?

The first large-scale trial was run by the Health Insurance Plan (HIP) of Greater New York, starting in 1963. The subjects (all members of the plan) were 62,000 women age 40 to 64. These women were divided at random into two equal groups. In the treatment group, women were encouraged to come in for annual screening, including examination by a doctor and X-rays. About 20,200 women in the treatment group did come in for the screening; but 10,800 refused. The control group was offered usual health care. All the women were followed for many years. Results for the first 5 years are shown in Table 1.

Answer the following questions based on all this information:

- (a) Does screening save lives? Which numbers in the table prove your point?
- (b) Compute the deaths in the first five years of the HIP screening trial from *all causes* as rates per 1,000 women in
 - (i) the treatment group,
 - (ii) the control group,
 - (iii) the women who were examined, and
 - (iv) the women who refused screening.

Use one decimal place accuracy in your answers.

- (c) The death rate (from all causes) among women who refused screening is about double the death rate among women who came in for the exam. Did the screening cut the death rate in half? Explain briefly.
- (d) Was the study done blind? Explain briefly.

		<i>Cause of Death</i>			
		<i>Breast Cancer</i>		<i>All Other Causes</i>	
		<i>Number</i>	<i>Rate</i>	<i>Number</i>	<i>Rate</i>
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Treatment Group					
Examined	20,200	23	1.1	428	21.2
Refused	10,800	16	1.5	409	37.9
Total	31,000	39	1.3	837	27.0
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Control Group	31,000	63	2.0	879	28.4

TABLE 1. DEATHS IN THE FIRST FIVE YEARS OF HIP SCREENING TRIAL. RATES ARE PER 1,000 WOMEN.

PROBLEM 9 (AF). The Science Daily Web site described a study at Washington University that exposed rats to two common types of cell phone radiation for four hours a day, five days a week, for two years. One third of the rats were exposed to analog cell phone frequency, one third to digital cell phone frequency, and one third served as controls and received no radiation. At the end of two years, the brain, spinal cord, and other organs were examined for cancerous tumors. The results showed no clear difference in the percentage of tumors among the groups.

- (a) For this study, identify the subjects, explanatory and response variables, and treatments.
- (b) What is a difference between this study and the Australian cell phone study given in Example 2.9 (pages 21–22) of the Baglivo text that could explain the different conclusions?

PROBLEM 10 (MN). A campus club has 4 student officers

President (P), Vice President (VP), Secretary (S) and Treasurer (T), and three faculty advisors: A1, A2 and A3. The club can send 2 individuals from among these seven to a convention. List all possible samples with

- (a) Two student officers,
- (b) One student officer and one faculty advisor and
- (c) Two faculty advisors.

PROBLEM 11 (AF). You plan to sample residents of registered nursing homes in your county. You obtain a list of all 97 nursing homes in the county, which you number from 1 to 97, and use the computer to choose a random subset of 5 of the 97. You then obtain lists of residents from those 5 nursing homes and interview all residents in each home.

- (a) Are the nursing homes clusters or strata? Explain.
- (b) Explain why the sample chosen is not a simple random sample of registered nursing home residents in your county.

PROBLEM 12 (BM). *Systematic random samples* go through a list of the population and choose individuals at fixed intervals from a randomly chosen starting point. For example, a study of exercise and diet among college students takes a systematic sample of 200 students at a university with 9000 students as follows:

“Start with a list of all 9000 students. Because $9000/200 = 45$, choose one of the first 45 names on the list at random and then every 45th name after that.”

Explain carefully why a systematic random sample is not a simple random sample.

PROBLEM 13 (AF). In each case, summarize negative aspects of the study design.

- (a) An anthropology professor wants to compare attitudes toward premarital sex of physical science majors and social science majors. She administers a questionnaire to students in her *Comparative Human Sexuality* course. She finds no appreciable difference in attitudes between the two majors, so she concludes that the two student groups are about the same in their views about premarital sex.
- (b) A principal in a large high school wants to sample student attitudes toward a proposal that seniors must pass a general achievement test in order to graduate. She lists all of the first period classes. Then, using a random number table, she chooses a class at random and interviews every student in that class about the proposed test.
- (c) A new restaurant opened in January. In June, after six months of operation, the owner applied for a loan to improve the building. The loan application asked for the annual gross income of the business. The owner’s record book contains receipts for each day of operation since opening. The owner decides to calculate the average daily receipt based on a sample of the daily records and multiply that by the number of days of operation in a year. She samples every Friday’s record. The average daily receipt for this sample was then used to estimate the yearly receipts.