Chapter 5 Homework Problems

1. A sociologist wants to know the opinions of employed adult women about government funding for day care. She obtains a list of the 520 members of local business and professional women's club and mails a questionnaire to 100 of these women selected at random. Only 48 questionnaires are returned. What is the population in this study? What is the sample?

2. A newspaper advertisement for USA Today: The Television Show once said:

Should handguns control be tougher? You call the hosts in a special call-in poll tonight. If yes, call 1-900-720-6181. If not, call 1-900-720-6182. Charge is 50 cents for the first minute.

Explain why this opinion poll is almost certainly biased.

3. You are in the staff of a member of Congress who is considering a bill that would provide government-sponsored insurance for nursing home care. You report that 1128 letters have been received on the issue, of which 871 oppose the legislation. "I'm surprised that most of my constituents oppose the bill. I thought it would be quite popular," says the congressman. Are you convinced that a majority of the voters oppose the bill? How would you explain the statistical issue to the congressman?

4. An educator wants to compare the effectiveness of computer software that teaches reading with that of a standard reading curriculum. He tests the reading ability of each student in a class of fourth graders, then divides them into two groups. One group uses the computer regularly, while the other studies a standard curriculum. At the end of the year, he retests all the students and compares the increase in reading ability in the two groups. Is this an experiment? Why or why not? What are the explanatory and response variables?

5. Many studies have found that people who drink alcohol in moderation have a lower risk of heart attacks than either nondrinker or heavy drinkers. Does alcohol consumption also improve survival after heart attacks? In the year before their heart attack, 47% of these people did not drink, 36% drank moderately, and 17% drank heavily. After 4 years, fewer of the moderate drinkers had died. Is this an observational study or an experiment? Why? What are the explanatory and response variables?

6. The National Halothane Study was major investigation of the safety of anesthetics used in surgery. Records of over 850,000 operations performed in 34 major hospitals showed the following rates for four common anesthetics:

Anesthetic	A	B	C	D
Death Rate	1.7%	1.7%	3.4%	1.9%

There is a clear association between anesthetic used and the death rate of patients. Anesthetic C appears to be dangerous.

A. Explain why we call the National Halothane Study an observational study rather than experiment, even though it compared the results of using different anesthetics in actual surgery.

B. When the study looked at the other variables that are confounded with a doctor's choice of anesthetic, it found that Anesthetic C was not causing extra deaths. Suggest several variables that are mixed up with that anesthetic a patient receives.

7. You must choose an SRS of 10 of the 440 retail outlets in New York that sell your company's product. How would you label this population? Use Table B, starting at line 105, to choose your sample.

8. A firm wants to understand the attitudes of its minority managers toward its system for assessing management performance. Below is a list of all the firm's managers who are members of minority groups. Use Table B at line 139 to choose 6 to be interviewed in detail about the performance appraisal system.

Agarwal	Gates	Peters
Anderson	Goel	Pliego
Baxter	Gomez	Puri
Bonds	Hernandez	Richards
Bowman	Huang	Rodriguez
Castillo	Kim	Santiago
Cross	Liao	Shen
Deward	Mourning	Vega
Fernandez	Naber	Wang
Fleming		

9. A club has 30 student members and 10 faculty members. The students are:

Abel	Fisher	Huber	Miranda	Reinmann	Carson	Ghosh	Jimenez	Moskowitz	Santos
Chen	Griswold	Jones	Neyman	Shaw	David	Hein	Kim	O'Brien	Thompson
Deming	Hernandez	Klotz	Pearl	Utts	Elashoff	Holland	Liu	Potter	Varga

The faculty are:

Andrews	Fernandez	Kim	Moore	West	Besicovitch	Gupta	Lightman	Phillips	Yang

The club can send 4 students and 2 faculty member to a convention. It decides to choose those who will go by random selection. Use Table B, beginning at line 123, to choose a simple random sample of 4 students and 2 faculty.

10. Your class in ancient Ugaritic religion is poorly taught and wants to complain to the dean. The class decides to choose 4 of its members at random to carry the complaint. The class list appears below. Choose an SRS of 4 suing the table of random digits, beginning at line 145.

Anderson	Aspin	Bennett	Bock	Breiman	Castillo	Dixon	Edwards	Gonzalez	Green
Gupta	Gutierrez	Harter	Henderson	Hughes	Johnson	Kemperthorne	Laskowsky	Liang	Olds
Patnaik	Pirelli	Rao	Rider	Robertson	Rodriguez	Sosa	Tran	Trevino	Wang

11. The list of individuals from which a sample is actually selected is called the sampling frame. Ideally, the frame should list every individual in the population, but in practice this is often difficult. A frame that leaves out part of the population is a common source of undercoverage.

A. Suppose that a sample of households in a community is selected at random from the telephone directory. What households are omitted from this frame? What types of people do you think are likely to live in these households? These people will probably be underrepresented in the sample.

B. It is more common in telephone surveys to use random digits dialing equipment that selects the last four digits of a telephone number at random after being given the exchange (the first three digits). Which of the households you mentioned in your answer to (a) will be included in the sampling frame by random digit dialing?

12. A common form of nonresponse in telephone surveys is “ring-no-answer.” This is, a call is made to an active number but no one answers. The Italian National Statistical Institute looked at nonresponse to a government survey of households in Italy during the periods January 1 to Easter and July 1 to August 31. All calls were made between 7 and 10 p.m., but 21.4% gave “ring-no-answer” in one period versus 41.5% “ring-no-answer” in the other period. Which period do you think had the higher rate of no answers? Why? Explain why a high rate of nonresponse makes sample results less reliable?

13. Here are two wordings for the same question:

A. Should laws be passed to eliminate all possibilities of special interests giving huge sums of money to candidates?

B. Should laws be passed to prohibit interest groups from contributing to campaigns, or do groups have a right to contribute to the candidates they support?

One of these drew 40% favoring banning contributions; the other drew 80% with this opinion. Which question produced the 40% and which got 80%? Explain why the results were so different?

14. Just before a presidential election, a national opinion polling firm increases the size of its weekly sample from the usual 1500 people to 4000 people. Why do you think the firm does this?

15. The author Shere Hite undertook a study of women’s attitudes toward sex and love by distributing 100,000 questionnaires through women’s groups. Only 4.5% of the questionnaires were returned. Based on this sample of women, Hite wrote *Women and Love*, a best-selling book claiming

that women are fed up with me. For example, 91% of the divorce who responded said that they had initiated the divorce, and 70% of the married women said that they had committed adultery.

Explain briefly why Hite's sampling method is nearly certain to produce a strong bias. Are the sample results cited (91% and 70%) much higher or much lower than the truth about the population of all adult American women?

16. Sample surveys often use a systematic random sample to choose a sample of apartments in a large building or dwelling units in a block at the last stage of a multistage sample. An example will illustrate the idea of a systematic sample.

Suppose that we must choose 4 addresses out of 100. Because 100/4=25, we can think of the list as four lists of 25 addresses. Choose 1 of the first 25 addresses at random using Table B. The sample contains this address and the addresses 25, 50, and 75 places down the list from it. If the table gives 13, for example, then the systematic random sample consists of the addresses numbered 13, 38, 63, 88.

A. Use Table B to choose a systematic random sample of 5 addresses from a list of 200. Enter the table at line 120.

B. Like an SRS, a systematic random sample gives all individuals the same chance of being chosen. Explain why this is true. Then explain carefully why a systematic sample is nonetheless not an SRS.

For each experimental situations described in Exercises 17 to 19, identify the experimental units or subjects, the factors, the treatments, and the response variables.

17. A manufacturer of food products uses package liners that are sealed at the top by applying heated jaws after the package is filled. The customer peels the sealed pieces apart to open the package. What effect does the temperature of the jaws have on the force required to peel the liner? To answer the question, the engineers prepare 20 pairs of pieces of package liner. They seal five pairs at each of 250° F, 275° , 300° F, and 325° F. Then they measure the strength needed to peel each seal.

18. How can we reduce the rate of refusals in telephone surveys? Most people who answer at all listen to the interviewer's introductory remarks and then decide whether to continue. One study made telephone calls randomly selected households to ask opinions about the next election. In some calls, the interviewer gave her name, in others she identified the university she was representing, and in still others she identified both herself and the university. For each type of call, the interviewer either did or did not offer to send a copy of the final survey results to the person interviewed. Do these differences in the introduction affect whether the interview is completed?

19. Sickle-cell disease is an inherited disorder of the red blood cells that in the United States affects mostly blacks. It can cause severe pain and many complications. Can the drug hydroxyurea reduce the severe pain caused by sickle-cell disease? A study by the National Institutes of Health gave the drug to 150 sickle-cell sufferers and a placebo (a dummy medication) to another 150. The researchers then counted the episodes of pain reported by each subject.

20. A large study used records from Canada's national health care system to compare the effectiveness of two ways to treat prostate disease. The two treatments are traditional surgery and a new method that does not require surgery. The records described many patients whose doctors had chosen each method. The study found that patients treated by the new method were significantly more likely to die within 8 years.

A. Further study of the data showed that this conclusion was wrong. The extra deaths among patients who got the new method could be explained by lurking variables. What lurking variables might be confounded with the doctor's choice of surgical or nonsurgical treatment?

B. You have 300 prostate patients who are willing to serve as subjects in an experiment to compare the two methods. Use a diagram to outline the design of an experiment, be sure to indicate the size of the treatment groups and the response variables.

21. Will providing child care for employees make a company more attractive to women, even those who are unmarried? You are designing an experiment to answer the question. You prepare recruiting material for two fictitious companies, both in similar businesses in the same location. Company A's brochure does not mention child care. There are two versions of Company B's material, identical except that one describes the company's on-site child-care facility. Your subjects are 40 unmarried women who are college seniors seeking employment. Each subject will read recruiting material for both companies and choose the one she would prefer to work for. You will give each version of Company B's brochure to half the women. You expect that a higher percentage of those who read the description that includes child care will choose Company B.

A. Outline an appropriate design for the experiment.

B. The names of the subjects appear below. Use Table B, beginning at line 131, to do the randomization required by your design. List the subjects who will read the version that mentions child care.

Abrams	Adamson	Afifi	Brown	Cansico	Chen	Cortez	Curzakis	Danielson	Durr
Edwards	Fluharty	Garcia	Gerson	Green	Gupta	Gutierrez	Howard	Hwang	Iselin
Janke	Kaplan	Kim	Lattimore	Lippman	Martinez	McNeill	Morse	Ng	Quinones
Rivera	Roberts	Rosen	Sugiwara	Thompson	Travers	Turing	Ullmann	Williams	Wong

22. Does regular exercise reduce the risk of a heart attack? Here are two ways to study this question. Explain clearly why the second design will produce more trustworthy data.

A. A researcher finds 2000 men over 40 who exercise regularly and have not heart attacks. She matches each with a similar man who does not exercise regularly, and she follows both groups for 5 years.

B. Another researcher finds 4000 men and over 40 who have not had heart attacks and are willing to participate in a study. She assigns 2000 of the men to a regular of supervised exercise. The other 2000 continue their usual habits. The researcher follows both groups for 5 years.

23. The financial aid office of a university asks a sample of students about their employment and earnings. The report says that "for academic year earnings, a significant difference was found between sexes, with men earning more on average. No significant difference was found between the earnings of black and white students." Explain the meaning of "a significant difference" and "no significant difference" in plain language.

24. An experiment that claimed to show the meditation lowers 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.

25. Fizz Laboratories, a pharmaceutical company, has developed a new pain-relief medication. Sixty patients suffering from arthritis and needing pain relief are available. Each patients will be treated and asked an hour later, "About what percentage of pain relief did you experience?"

A. Why should Fizz not simply administer the new drug and record patients' responses?

B. Outline the design of an experiment to compare the drugs' effectiveness with that of aspirin and of a placebo.

C. Should patients be told which drug they are receiving? How would this knowledge probably affect their reactions?

D. If patients are not told which treatment they are receiving, the experiment is single blind. Should this experiment be double-blind also? Explain.

26. Twenty overweight females have agreed to participate in a study of the effectiveness to four weight-loss treatments: A, B, C, and D. The researcher first calculates how overweight each subject is by comparing the subject's actual weight with their "ideal" weight. The subjects and their excess weights in pounds are:

Birnbaum 35	Brown 34	Brunk 30	Cruz 34	Deng 24
Hernandez 25	Jackson 33	Kendall 28	Loren 32	Mann 28
Moses 25	Nevesky 39	Obrach 30	Rodriguez 30	Santiago 27
Smith 29	Stall 33	Tran 35	Wilansky 42	Williams 22

The response variable is the weight lost after 8 weeks of treatment. Because a subject's excess weight will influence the response, a block design is appropriate.

A. Arrange the subjects in order of increasing excess weight. From 5 blocks of 4 subjects each by grouping the 4 least overweight, then the next 4, and so on.

B. Use Table B to randomly assign the 4 subjects in each block to the 4 weight-loss treatments.

27. An expert on worker performance is interested in the effect of room temperature on the performance of tasks requiring manual dexterity. She chooses temperature of $70°F$ and $90°F$ as treatments. The response variable is the number of correct insertions, during a 30-minute period, in a peg-and-hole apparatus that requires the use of both hands simultaneously. Each subject is trained on the apparatus and then asked to make as many insertions as possible in 30 minutes of continuous effort.

A. Outline a completely randomized design to compare dexterity at $70°F$ and $90°F$. Twenty subjects are available.

B. Because individuals differ greatly in dexterity, the wide variation in individual scores may hide the systematic effect of temperature unless there are many subjects in each group. Describe in detail the design of a matched pairs experiment in which each subject serves as his or her own control.

28. If children are given more choices within a class of products, will they tend to prefer that product to a competing product that offers fewer choices? Marketers want to know. An experiment prepared three "choice sets" of beverages. The first contained two milk drinks and two fruit drinks. The second had the same two fruit drinks but four milk drinks. The researcher divided 210 children aged 4 to 12 years into 3 groups. They offered each group one of the choice sets. As each child chose a beverage to drink from the choice set presented, the researchers noted whether the choice was a milk or a fruit drink.

A. What are the experimental units?

B. What is the factor, and what are its levels?

C. What is the response?

29. A survey of physicians found that some doctors give a placebo to a patient who complains of pain for which the physician can find a no cause. If the patient's pain improves, these doctors conclude that it had no physical basis. The medical school researchers who conducted the survey claimed that these doctors do not understand the placebo effect. Why?

30. Once a person has been convicted on drunk driving, one purpose of court-mandated treatment or punishment is to prevent future offenses of the same kind. Suggest three different treatments that a court might require. Then outline the design of an experiment to compare their effectiveness. Be sure to specify the response variables you will measure.

31. An opinion poll selects adult Americans at random and asks them, "Which political party, Democrat or Republican, do you think is better able to manage the economy?" Explain carefully how you would assign digits from Table B to simulate the response of one person in each of the following situations.

A. Of all American's, 50% would choose the Democrats and 50% the Republicans.

B. Of all adult Americans, 60% would choose the Democrats and 40% the Republicans.

C. Of all adult Americans, 40% would choose the Democrats, 40% the Republicans, and 20% undecided.

D. Of all adult Americans, 53% would choose the Democrats and 47% the Republicans.

32. Use Table B to simulate the response of 10 independently chosen adults in each of the four situations from the previous problem using lines 110, 112, 114, and 116 respectfully.

33. A basketball player makes 70% of her free throws in a long season. In a tournament game she shoots 5 free throws late in the game and misses 3 of them. The fans think she was nervous, but the misses may simply be chance. You shed some light by estimating a probability.

A. Describe how to simulate a single shot if the probability of making each shot is 0.7? Then describe how to simulate 5 independent shots.

B. Simulate 50 repetitions of the 5 shots and record the number missed on each repetition. Use Table B starting at line 125. What is the approximate likelihood that the player will miss 3 or more of the 5 shots?

34. Use your TI-83 to simulate a couple's having children until they have a girl or until they have four children, whichever comes first. Use the simulation to estimate the probability that they will have a girl among their children.

35. Suppose a major league baseball player has a current batting average of .320. Note that the batting average = (number of hits)/(number of at bats).

A. Describe an assignment of random numbers to provide results in order to simulate the player's next 20 at-bats.

B. Carry out the simulation for 20 repetitions, and report your results. What is the relative frequency of at-bats in which the player gets a hit?

C. Compare your simulation experimental results with the player's actual batting average of.320.

36. Use your TI-83 and the simulation method to show that in a class of 23 unrelated students, the chance of at least 2 people with the same birthday are about 50%. Show that in a room of 41, the chances of at least 2 people having the same birthday are about 90%. What assumptions are you using in your simulations?

37. Amarillo Slim is a cardshark who like to play the following game. Draw two cards from the decks of 52 cards. If at least one of the cards is a heart, then you win $1. If neither is a heart, then you lose $1.

A. Describe the correspondence between random numbers and possible outcomes in this game.

B. Simulate playing the game for 25 rounds. Shuffle the cared after each round. See if you can beat Amarillo Slim at his own game. Remember to write down the results of each game. Do you think this is a "fair" game? That is, do both you and Slim have an equal chance of winning?