CHAPTER 13

1. a) No. There are no manipulated factors. Observational study.
   b) There may be lurking variables that are associated with both parental income and performance on the SAT.
2. a) No, there are no manipulated factors. It is a retrospective study.
   b) No, there may be lurking variables, such as patient's age.
3. a) This is a retrospective observational study.
   b) That's appropriate because MS is a relatively rare disease.
   c) The subjects were U.S. military personnel, some of whom had developed MS.
   d) The variables were the vitamin D blood levels and whether or not the subject developed MS.
4. a) This is a stratified sample. The question was about population values (the proportions of men and women who look forward more to the commercials). No treatment was applied, so it is not an experiment.
   b) Yes.
5. a) This was a randomized, placebo-controlled experiment.
   b) Yes, such an experiment is the right way to determine whether black cohosh has an effect.
   c) 351 women aged 45 to 55 who reported at least two hot flashes a day.
   d) The treatments were black cohosh, a multiherb supplement, a multiherb supplement plus advice, estrogen, and a placebo. The response was the women's symptoms (presumably frequency of hot flashes).
6. a) This is an experiment. The picture is the controlled factor. Randomization may have been used in deciding which days each picture appeared.
   b) The treatment was the picture behind the coffee station. The response was the average contribution.
   c) The differences in money collected were larger than could be reasonably attributed to usual day-to-day variation.
7. a) Experiment.
   b) Bipolar disorder patients.
   c) Omega-3 fats from fish oil, two levels.
   d) 2 treatments.
   e) Improvement (fewer symptoms?).
   f) Design not specified.
   g) Blind (due to placebo), unknown if double-blind.
   h) Individuals with bipolar disease improve with high-dose omega-3 fats from fish oil.
8. a) Observational study.
   b) Prospective.
   c) Disabled women aged 65 and older with and without a vitamin B_{12} deficiency, unknown selection process.
   d) Suffering severe depression.
   e) As there is no random assignment, there is no way to know that the deficiency caused the severe depression.
9. a) Observational study.
   b) Prospective.
   c) Men and women with moderately high blood pressure and normal blood pressure, unknown selection process.
   d) Memory and reaction time.
   e) As there is no random assignment, there is no way to know that high blood pressure *caused* subjects to do worse on memory and reaction-time tests. A lurking variable may also be the cause.
10. a) Experiment.
    b) People suffering from insomnia.
    c) 2 factors: desserts and exercise (2 levels each).
    d) 4 treatments.
    e) Improvement in ability to sleep.
    f) Completely randomized.
    g) Not blind.
    h) Insomniacs who exercise and refrain from desserts will experience improved ability to sleep.
11. a) Experiment.
    b) Postmenopausal women.
    c) Alcohol—2 levels; blocking variable—estrogen supplements (2 levels).
    d) 1 factor (alcohol) at 2 levels = 2 treatments.
    e) Increase in estrogen levels.
    f) Blocked.
    g) Not blind.
    h) Indicates that alcohol consumption *for those taking estrogen supplements* may increase estrogen levels.
12. a) Observational study.
    b) Retrospective.
    c) Women exposed to dioxin from an industrial accident.
    d) Risk of breast cancer.
    e) As there is no random assignment, there is no way to know that the dioxin levels caused the increase in breast cancer; there may have been lurking variables that were not identified.
13. a) Observational study.
    b) Retrospective.
    c) Women in Finland, unknown selection process with data from church records.
    d) Women's lifespans.
    e) As there is no random assignment, there is no way to know that having sons or daughters shortens or lengthens the lifespan of mothers.
14. a) Experiment.
    b) People exposed to cold virus.
    c) 1 factor: herbal treatment (2 levels).
    d) 2 treatments.
    e) Severity of cold symptoms.
    f) No discussion of randomness.
    g) Blind, as subjects did not know if they received the herbal treatment or the placebo. Not clear if it was double-blind.
    h) There is no indication that the herbal treatment is effective.
15. a) Observational study.
    b) Prospective.
    c) People with or without depression, unknown selection process.
    d) Frequency of crying in response to sad situations.
    e) There is no apparent difference in crying response (to sad movies) for depressed and nondepressed groups.
16. a) Experiment.
    b) Racing greyhounds.
    c) 1 factor, diet with 3 levels.
    d) 3 treatments.
    e) Speed.
    f) Random assignment to order of diets; matched design before and after diet.
    g) No blinding.
    h) Greyhounds who eat diets high in vitamin C seem to run more slowly.
17. a) Experiment.
    b) People experiencing migraines.
    c) 2 factors (pain reliever and water temperature), 2 levels each.
    d) 4 treatments.
    e) Level of pain relief.
    f) Completely randomized over 2 factors.
    g) Blind, as subjects did not know if they received the pain medication or the placebo, but not blind, as the subjects will know if they are drinking regular or ice water.
    h) It may indicate whether pain reliever alone or in combination with ice water gives pain relief, but patients are not blinded to ice water, so placebo effect may also be the cause of any relief seen caused by ice water.
18. a) Experiment.
    b) Inactive dogs.
    c) 1 factor: dog food (assuming amount of food to be determined by weight or size of dog) (2 levels).

d) 2 treatments.
e) Weight.
f) Blocked by size of breed.
g) Blinded, assuming dog owners do not know which food the dog is receiving.
h) Assuming the dog owners followed the prescribed feeding levels, there could be a conclusion as to whether or not the dog food helped maintain healthy weight.

19. a) Experiment.
b) Athletes with hamstring injuries.
c) 1 factor: type of exercise program (2 levels).
d) 2 treatments.
e) Time to return to sports.
f) Completely randomized.
g) No blinding—subjects must know what kind of exercise they do.
h) Can determine which of the two exercise programs is more effective.

20. a) Observational study.
b) Prospective.
c) General public; two random samples.
d) The purpose of the study was to identify variables on which there was a difference, so no response variable(s) could be identified at the start of the study.
e) Identify differences between people who can be reached by regular polling methods and those who cannot.

21. They need to compare omega-3 results to something. Perhaps bipolarity is seasonal and would have improved during the experiment anyway.

22. They need a basis for comparison. Perhaps insomnia is related to the amount of daylight, and that changed during the time the experiment was conducted.

23. a) Subjects' responses might be related to many other factors (diet, exercise, genetics, etc). Randomization should equalize the two groups with respect to unknown factors.
b) More subjects would minimize the impact of individual variability in the responses, but the experiment would become more costly and time consuming.

24. a) Subjects' responses might be related to many other factors (diet, medications, genetics, etc.). Randomization should equalize the two groups with respect to unknown factors.
b) More subjects would minimize the impact of individual variability in the responses, but the experiment would become more costly and time consuming.

25. People who engage in regular exercise might differ from others with respect to bipolar disorder, and that additional variability could obscure the effectiveness of this treatment.

26. People who are overweight might have different sleep patterns, and that additional variability could obscure the effectiveness of this treatment.

27. Answers may vary. Use a random-number generator to randomly select 24 numbers from 01 to 24 without replication. Assign the first 8 numbers to the first group, the second 8 numbers to the second group, and the third 8 numbers to the third group.

28. Answers may vary. Use a random-number generator to randomly select 24 numbers from 01 to 24 without replication. Assign the first group of 4 numbers to the first treatment (no fertilizer, natural watering), the second group of 4 numbers to the second treatment (no fertilizer, daily water), the third group of 4 numbers to the third treatment (half fertilizer, natural watering), and so on to the sixth treatment.

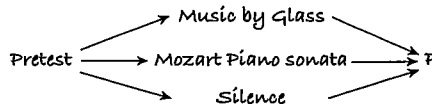
29. a) First, they are using athletes who have a vested interest in the success of the shoe by virtue of their sponsorship. They should choose other athletes. Second, they should randomize the order of the runs, not run all the races with their shoes second. They should blind the athletes by disguising the shoes if possible, so they don't know which is which. The timers shouldn't know which athletes are running with which shoes, either. Finally, they should replicate several times, since times will vary under both shoe conditions.
b) Because of the problems in (a), the results they obtain may favor their shoes. In addition, the results obtained for Olympic athletes may not be the same as for the general runner.

30. The "control" in this experiment is not the same for all swimmers. We don't know what "their old swimsuit" is. They should compare their new swimsuit to the same suit design. The order in which the swims are performed should be randomized. There may be a systematic effect from one swim to the next. Finally, there is no way to blind this test. The swimmers will know which kind of suit they have on, and this may bias their performance.

31. a) Allowing athletes to self-select treatments could confound the results. Other issues such as severity of injury, diet, age, etc., could also affect time to heal; randomization should equalize the treatment groups with respect to any such variables.
b) A control group could have revealed whether either exercise program was better (or worse) than just letting the injury heal.
c) Doctors who evaluated the athletes to approve their return to sports should not know which treatment the subject had.
d) It's hard to tell. The difference of 15 days seems large, but the standard deviations indicate that there was a great deal of variability in the times.

32. a) Self-selection could result in groups that were very different at the start of the experiment, making it impossible to attribute differences in the results to their diet.
b) This assured that the diets were followed and that all subjects in each group received comparable treatments.
c) The researchers can compare the change in blood pressure observed in the DASH group to the control group. They need to rule out the possibility that external variables (the season, news events, etc.) affected everyone's blood pressure.
d) We'd like to know the standard deviation of the changes, too. If it's very small, then 6.7 points would seem to be significant.

33. a) The differences among the Mozart and quiet groups were more than would have been expected from sampling variation.
b)



c) The Mozart group seems to have the smallest median difference and thus the *least* improvement, but there does not appear to be a significant difference.
d) No, if anything, there is less improvement, but the difference does not seem significant compared with the usual variation.

34. Use a retrospective observational study. For example, collect records from a random selection of police and emergency room logs for the past 3 years. Find the number of cases for the days when there is a full moon, when there is a waxing moon, when there is a waning moon, and when the moon is nearly dark. Compare the numbers for each group.

35. a) Observational, prospective study.
b) The supposed relation between health and wine consumption might be explained by the confounding variables of income and education.
c) None of these. While the variables have a relation, there is causality indicated for the relation.

36. a) The difference in the depression rates for the two groups is greater than would be expected by natural sampling variation.
b) Observational study. There was no experimental treatment.
c) The difference could be explained by lurking variables. Perhaps swimmers are more affluent (can afford a membership

the Y or have access to a pool), or perhaps depressed people tend to swim less.

d) Answers may vary. Give the subjects a test to measure depression. Then randomly assign the 120 subjects to one of three groups: the control group (no exercise program), the anaerobic exercise group, and the aerobic exercise group. Monitor subjects' exercise (have them report to a particular gym or pool). At the end of 12 weeks, administer the depression test again. Compare the post-exercise and pre-exercise depression scores.

37. a) Arrange the 20 containers in 20 separate locations. Use a random-number generator to identify the 10 containers that should be filled with water.

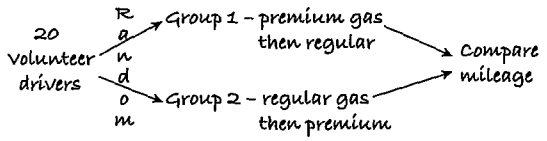
b) Guessing, the dowser should be correct about 50% of the time. A record of 60% (12 out of 20) does not appear to be significantly different.

c) Answers may vary. You would need to see a high level of success—say, 90% to 100%, that is, 18 to 20 correct.

38. Answers may vary. Randomly select half of the patients who agree to the study to get large doses of vitamin E after surgery. Give the other half a similar-looking placebo pill. Monitor their progress, recording the time until they have reached an easily agreed upon level of healing. Have the evaluating doctor blinded to whether the patient received the placebo or not. Compare the number of days until recovery of the two groups.

39. Randomly assign half the reading teachers in the district to use each method. Students should be randomly assigned to teachers as well. Make sure to block both by school and grade (or control grade by using only one grade). Construct an appropriate reading test to be used at the end of the year, and compare scores.

40.



Answers may vary. This experiment has 1 factor (type of gasoline), at 2 levels (premium and regular), resulting in 2 treatments. The response variable is gas mileage. An experiment diagram for a matched design appears above. Have each of the volunteers use each kind of gas for a month. Randomly assign 10 of them to use regular first, the other 10 to use premium first. Ask them to keep driving logs (the number of miles driven and the gallons of gasoline) for each month. Compare the differences in the fuel economy for the two kinds of gasoline.

41. a) They mean that the difference is higher than they would expect from normal sampling variability.

b) An observational study.

c) No. Perhaps the differences are attributable to some confounding variable (e.g., people are more likely to engage in riskier behaviors on the weekend) rather than the day of admission.

d) Perhaps people have more serious accidents and traumas on weekends and are thus more likely to die as a result.

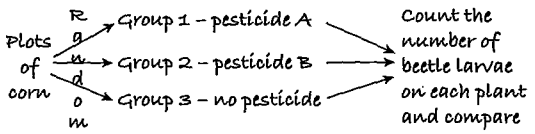
42. a) Answers may vary. Randomly assign the eight patients to either the current medication or the new medication. Have nurses assess the degree of shingles involvement for the patient. Ask patients to rate their pain levels. Administer the medications for a prescribed time. Have nurses reassess the degree of shingles involvement. Ask patients to rate their pain levels post-medication. Compare the improvement levels.

b) Let A = 1, B = 2 . . . H = 8.
Assign the first four randomly selected to the first group, the remainder to the second. So Group 1 is D, A, H, C, and Group 2 is B, E, F, G.

c) Assuming that the ointments look alike, it would be possible to blind the experiment for the subject and for the administrator of the treatment.

d) A block design with factors for gender and for ointment would be appropriate. Subjects would be randomly assigned to each treatment group in the blocked design.

43. Answers may vary. This experiment has 1 factor (pesticide), at 3 levels (pesticide A, pesticide B, no pesticide), resulting in 3 treatments. The response variable is the number of beetle larvae found on each plant. Randomly select a third of the plots to be sprayed with pesticide A, a third with pesticide B, and a third with no pesticide (since the researcher also wants to know whether the pesticides even work at all). To control the experiment, the plots of land should be as similar as possible with regard to amount of sunlight, water, proximity to other plants, etc. If not, plots with similar characteristics should be blocked together. If possible, use some inert substance as a placebo pesticide on the control group, and do not tell the counters of the beetle larvae which plants have been treated with pesticides. After a given period of time, count the number of beetle larvae on each plant and compare the results.



44. a) The students were not randomly assigned. Those who signed up for the prep course may be a special group whose scores would have improved anyway.

b) Answers may vary. Find a group of volunteers who are willing to participate. Give all volunteers the SAT. Randomly assign the subjects to the review or no review group. Give the tutoring to the one group. After a reasonable time, retest both groups. See if the tutored group had a significant improvement in scores when compared with the no-review group.

c) After the volunteers have taken the first SAT, separate the volunteers into blocks of low, average, and high SAT score performance. Now assign half of each block to the review and half to the no-review groups. Give the tutoring. Now retest all groups. Compare the differences between treatments for each block.

45. Answers may vary. Find a group of volunteers. Each volunteer will be required to shut off the machine with his or her left hand and right hand. Randomly assign the left or right hand to be used first. Complete the first attempt for the whole group. Now repeat the experiment with the alternate hand. Check the differences in time for the left and right hands.

46. Answers may vary. There are two factors: temperature of the water and wash cycle. Since each factor has 2 levels, there are 4 treatment groups (hot-reg., cold-reg., hot-del., cold-del.). It would be nice to have 32 shirts, but equal numbers of shirts in each group is not necessary. Randomly assign shirts to each of the 4 treatment groups. Rate the level of cleaning for the grass-stained shirts. Compare the 4 groups and determine the best use of the product.

47. a) Jumping with or without a parachute.

b) Volunteer skydivers (the dimwitted ones).

c) A parachute that looks real but doesn't work.

d) A good parachute and a placebo parachute.

e) Whether parachutist survives the jump (or extent of injuries).

f) All should jump from the same altitude in similar weather conditions and land on similar surfaces.

g) Randomly assign people the parachutes.

h) The skydivers (and the people involved in distributing the parachute packs) shouldn't know who got a working chute. And the people evaluating the subjects after the jumps should not be told who had a real parachute either!