Chapter 9 Solutions

9.1: This is an observational study: No treatment was assigned to the subjects; we merely observed cell phone usage (and presence/absence of cancer). The explanatory variable is cell phone usage, and the response variable is whether or not a subject has brain cancer.

9.2: This is an experiment: Each subject is (presumably randomly) assigned to a group, each with its own treatment (Arial or Brush font). The explanatory variable is the font, and the response variables are then perceived effort (in minutes) and willingness to make the exercise part of their daily routine.

9.3: This is an observational study, so it is not reasonable to conclude any cause-and-effect relationship. At best, we might advise smokers that they should be mindful of potential weight gain and its accompanying ailments.

9.4: Subjects: the "healthy people aged 18 to 40." Factor: the pill given to the subject. Treatments: ginkgo or placebo. Response variable: the number (or fraction) of e's identified by each subject.

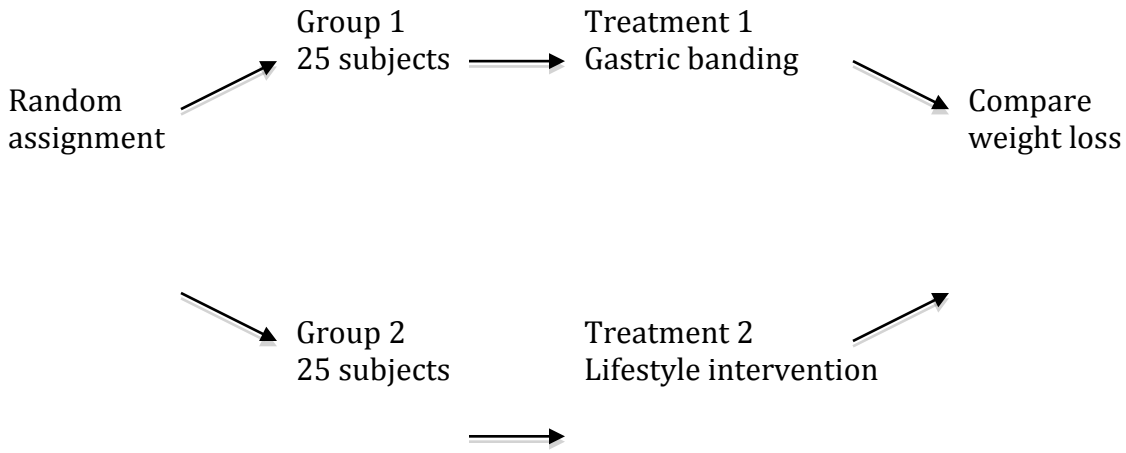
9.5: Individuals: pine seedlings. Factor: amount of light. Treatments: full light, 25% light, or 5% light. Response variable: dry weight at the end of the study.

9.6: Subjects: the students. Factors: type of attack, and prime used. Treatments: for the prime: *love thy neighbor* prime, or *eye-for-an-eye* prime; for the type of attack: on military target, or on cultural/educational target. Response variable: rating of U.S. reaction to attack.

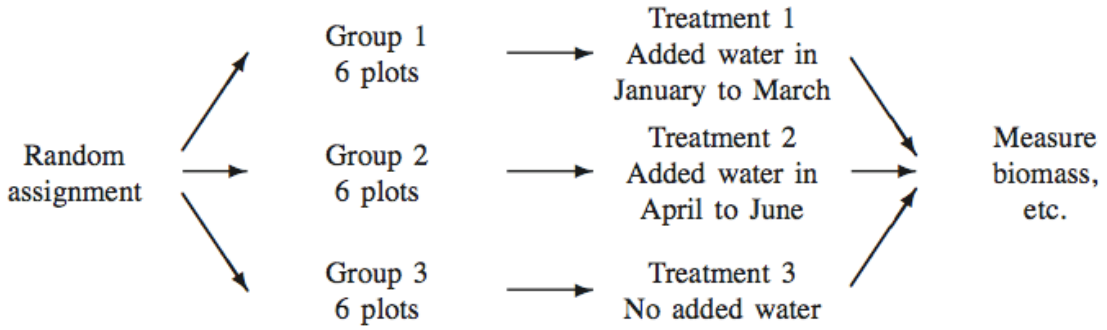
		Prime Used	
		Love thy Neighbor	Eye-for-an-Eye
Target	Military	1	2
	Cultural	3	4

9.7: Making a comparison between the treatment group and the percent finding work *last year* is not helpful. Over a year, many things can change: the state of the economy, hiring costs (due to an increasing minimum wage or the cost of employee benefits), etc. (In order to draw conclusions, we would need to make the $500 bonus offer to some people and not to others, and compare the two groups.)

9.8. (a) The diagram is provided. The response variable is weight loss. (b) Label the students from 01 to 50, and pick 25 to receive Treatment 1 (the rest will receive Treatment 2). If using Table B, line 130, the sample is 05, 16, 48, 17, 40, 20, 19, 45, 32, 41, 04, 25, 29, 43, 37, 39, 31, 50, 18, 07, 13, 33, 30, 21, 36.

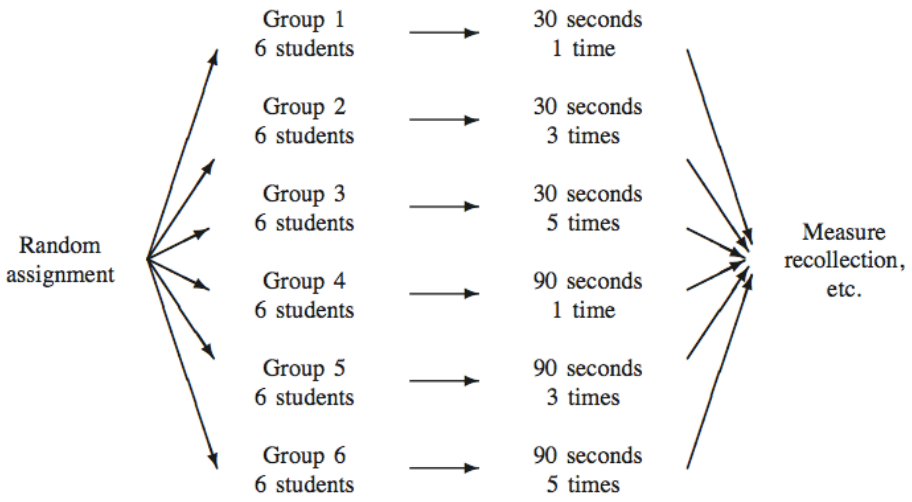


9.9. (a) Diagram below. (b) If using Table B, label 01 to 36 and take two digits at a time.



9.10. Assign 24/6 = 4 students to each treatment. The diagram is shown below. We assign labels 01 through 24, then use the first four 2-digit numbers in this range for Group 1, the next four for Group 2, etc. The table below shows the assignments. Note that with this many assignments, you will run through many lines of Table B. Once you've filled out members for 5 groups, the 6th group contains all the remaining, unassigned subjects.

Group 1: 20 Shi, 16 Kruger, 04 Baker, 18 Minor
Group 2: 07 Brower, 13 Greenberg, 02 Anthony, 05 Biery
Group 3: 19 Schwartz, 23 Truitt, 21 Stanley, 08 Carroll
Group 4: 10 Cote, 11 Delp, 15 Koster, 12 Disbro
Group 5: 14 Kessis, 09 Cohen, 24 Walsh, 22 Tory
Group 6: 01 Abramson, 03 Austen, 06 Blake, 17 Linder



9.11. In a controlled scientific study, the effects of factors other than the nonphysical treatment (e.g., the placebo effect, differences in the prior health of the subjects) can be eliminated or accounted for, so that the differences in improvement observed between the subjects can be attributed to the differences in treatments.

9.12. If this year is considerably different in some way from last year, we cannot compare electricity consumption over the two years. For example, if this summer is warmer, the customers may run their air conditioners more. The possible differences between the two years would confound the effects of the treatments.

9.13. (a) The researchers simply observed the diets of subjects; they did not alter them. (That is, no treatments were assigned.) (b) Such language is reasonable because with observational studies, no "cause and effect" conclusion would be reasonable.

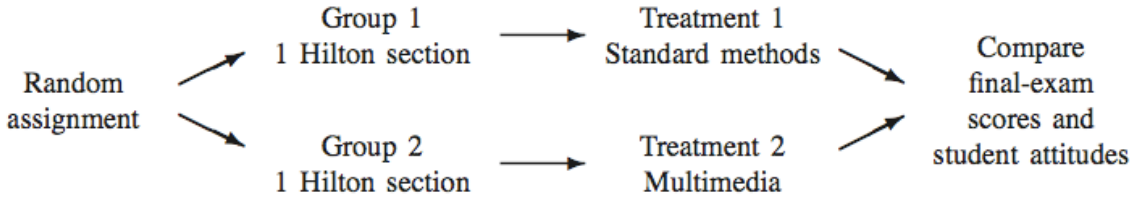
9.14. "Double-blind" means that the treatment (testosterone or placebo) assigned to a subject was unknown to both the subject and those responsible for assessing the effectiveness of that treatment. "Randomized" means that patients were randomly assigned to receive either the testosterone supplement or a placebo. "Placebo-controlled" means that some of the subjects were given placebos. Even though these possess no medical properties, some subjects may show improvement or benefits just as a result of participating in the experiment; the placebos allow those doing the study to observe this effect.

9.15. In this case, "lack of blindness" means that the experimenter knows which subjects were taught to meditate. He or she may have some expectation about whether or not meditation will lower anxiety; this could unconsciously influence the diagnosis.

9.16. (a) Each swimmer swims one time using each breathing technique (B2 and B4). A coin is tossed to determine the order in which these techniques are used. (b) In a completely randomized design, the 10 male collegiate swimmers would be assigned randomly to the two treatments, 5 swimmers using technique B2 and the other 5 using technique B4. (c) If swimmers select their own technique, it would be an observational study.

9.17. (a) *Completely randomized design:* Randomly assign 15 students to Group 1 (easy mazes) and the other 15 to Group 2 (hard mazes). Compare the time estimates of Group 1 with those of Group 2. (b) *Matched-pairs design:* Each student does the activity twice, once with the easy mazes, and once with the hard mazes. Randomly decide (for each student) which set of mazes is used first. Compare each student's "easy" and "hard" time estimate (for example, by looking at each "hard" minus "easy" difference). *Alternate matched-pairs design:* Again, all students do the activity twice. Randomly assign 15 students to Group 1 (easy first) and 15 to Group 2 (hard first).

9.18. For each block (pair of lecture sections), randomly assign one section to be taught using standard methods and the other to be taught with multimedia. Then (at the end of the term) compare final-exam scores and student attitudes. The diagram below is *part* of the whole block diagram; there would also be three other pieces like this (one for each of the other instructors). The randomization will vary with the starting line in Table B—or the randomization can be done by flipping a coin for each block.



9.19. (a) This is an observational study: behavior (alcohol consumption) is observed, but no treatment is imposed.

9.20. (b) This is an experiment (a treatment is imposed), but there is no control group.

9.21. (c) two factors, each with two levels.

9.22. (b) completely randomized design.

9.23. (b) the score on the memory test of their recall of advertisements is the response.

9.24. (a) Each of the 36 subjects needs a label.

9.25. (b) The communities are paired up, then one is chosen to have the advertising campaign.

9.26. (a) The choice should be made randomly.

9.27. (b) This was a (matched-pairs) experiment, but in order to give useful information, the subjects should be chosen from those who might be expected to buy this car.

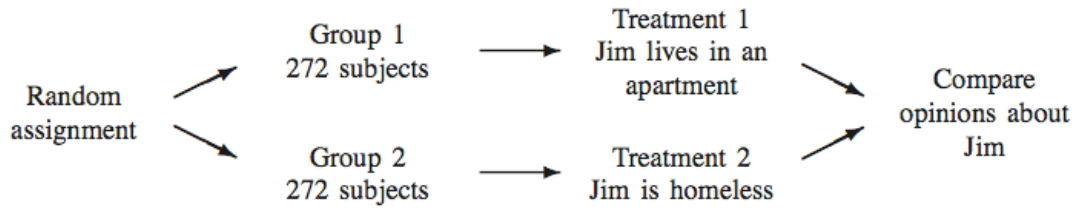
9.28. (a) This is an observational study; the subjects chose their own "treatments" (how much to drink). The explanatory variable is alcohol consumption, and the response variable is whether or not a subject dies. (There may have been other variables, but these were the only ones mentioned in the problem.) (b) Many answers are possible. For example, some nondrinkers might avoid

drinking because of other health concerns. We do not know what kind of alcohol (beer? wine? whiskey?) the subjects were drinking.

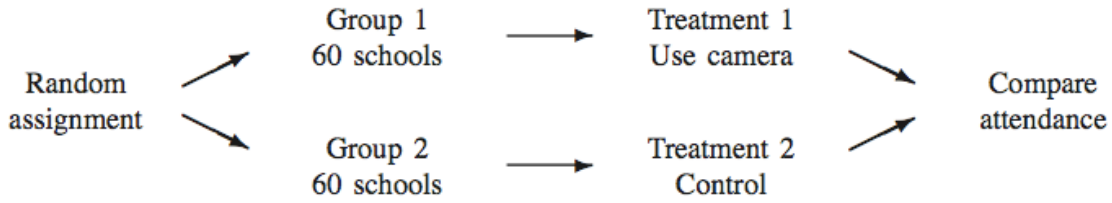
9.29. This is an experiment, because the treatment is selected (randomly, we assume) by the interviewer. The explanatory variable (treatment) is the level of identification, and the response variable is whether or not the interview is completed.

9.31. (a) In an observational study, we simply observe subjects who have chosen to take supplements and compare them with others who do not take supplements. In an experiment, we *assign* some subjects to take supplements and assign the others to take no supplements (or better yet, assign the others to take a placebo). (b) "Randomized" means that the assignment to treatments is made randomly, rather than by some other method (e.g., asking for volunteers). "Controlled" means that some subjects were used as a "control" group—probably meaning that they received placebos—which gives a basis for comparison to observe the effects of the treatment. (c) Subjects who choose to take supplements have other characteristics that are confounded with the effect of the supplements; one of those characteristics is that people in this group are more likely to make healthy lifestyle choices (about smoking, drinking, eating, exercise, etc.). When we randomly assign subjects to a treatment, the effect of those characteristics is erased, because some of those subjects will take the supplement, and some will take the placebo.

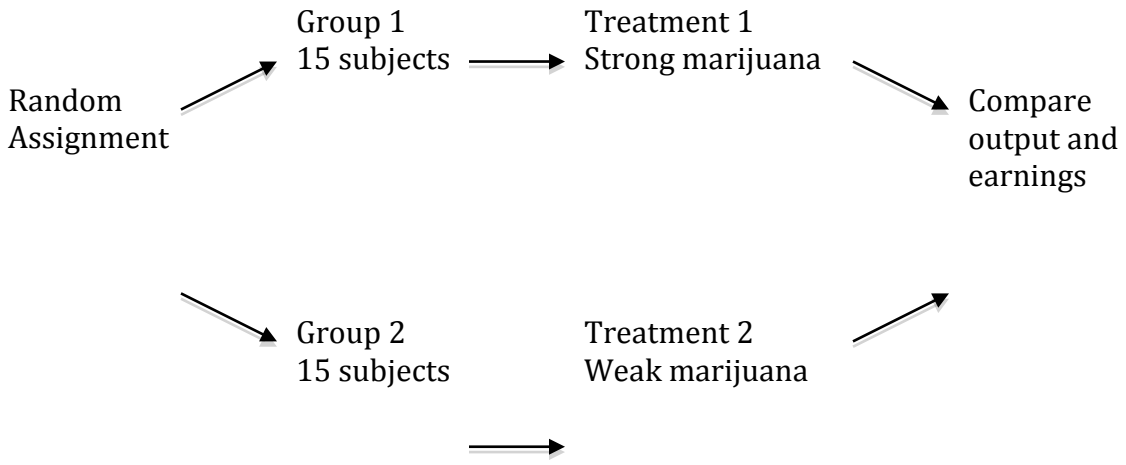
9.32. In the diagram below, equal numbers of subjects are assigned to each treatment.



9.33. (a) Diagram below. (b) Assign labels 001 to 120. If using Table B, line 108 gives 090, 009, 067, 092, 041, 059, 040, 080, 029, 091

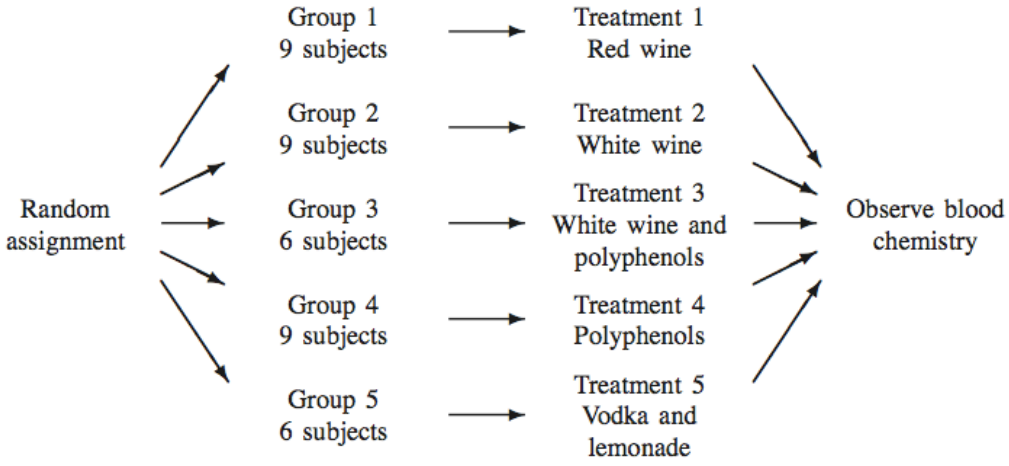


9.34. (a) A diagram is shown below. (b) Label the subjects from 01 through 30. From line 120, we choose subjects corresponding to the numbers 16, 04, 26, 21, 19, 07, 22, 10, 25, 13, 15, 05, 29, 09, 08 for the first group, and the rest for group 2. Hence, the marijuana group consists of Mattos, Bower, Williams, Sawant, Reichert, Deis, Scannell, Giriunas, Stout, Kennedy, Mani, Burke, Zaccai, Fritz, and Fleming. All other subjects are assigned to the non-marijuana group. (c) This could be a double-blind experiment, assuming that subjects can't distinguish between the types of marijuana smoked. Also, the persons measuring output and earnings of subjects don't know what kind of marijuana a subject smoked.



9.35. Use a completely randomized design; the diagram is provided. Labeling the men from 01 through 39, and starting on line 107 of Table B, we make the assignments shown in the table on the right.

Group 1: 20, 11, 38, 31, 07, 24, 17, 09, 06
Group 2: 36, 15, 23, 34, 16, 19, 18, 33, 39
Group 3: 08, 30, 27, 12, 04, 35
Group 4: 02, 32, 25, 14, 29, 03, 22, 26, 10
Group 5: Everyone else

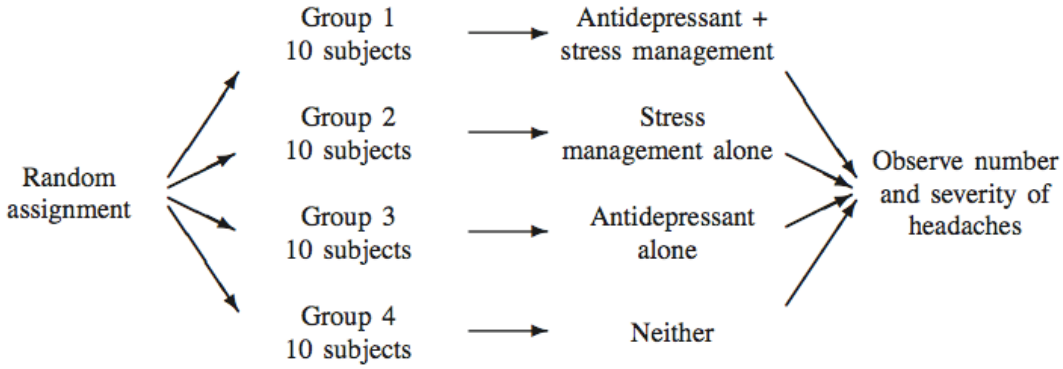


9.36. (a) There are 2 factors. The first factor is Type of granola, and has two levels (regular and low-fat). The second factor is Serving size label, and has three levels (2 servings, 1 serving, and no label). Hence, there are 6 treatment combinations (regular granola at 2 servings, regular granola at 1 serving, regular granola with no serving label, low-fat granola with 2 servings, low-fat granola with 1 serving, and low-fat granola with no serving label). At 20 subjects per treatment, there were 120 subjects in the experiment. (b) The outline looks as the one in Exercise 9.10, except that each of the 6 groups has 20 subjects, and the treatments are as described in (a).

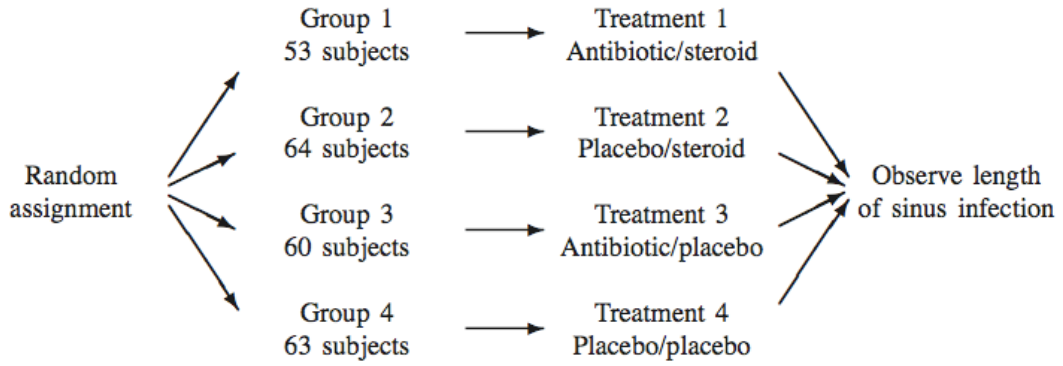
9.37. (a) The outline is given below. There are 40 subjects, so we assign 10 subjects to each of the four treatments. The four treatments are outlined:

	Antidepressant	No drug
Stress management	1	2
None	3	4

(b) Assign labels 01 through 40 (in alphabetical order). The full randomization is easy with the Simple Random Sample applet: each successive sample leaves the population hopper, so that you need only click Sample three times to assign 30 subjects to three groups; the 10 subjects remaining in the hopper are the fourth group. Alternatively, line 125 of Table B gives the following subjects for Group 1: 21 Jiang, 37 Suarez, 18 Hersch, 23 Kim, 19 Hurwitz, 03 Alawi, 39 Wilson 24 Landers, 27 Morgan, and 13 Garrett.



9.38. (a) Diagram below. (b) Assign labels from 001 to 240. (c) Randomly select 53 subjects for Treatment 1, then 64 for Treatment 2, then 60 for Treatment 3. The remaining 63 subjects belong to Treatment 4. If Table B is used, subjects chosen will vary with starting line.



9.39. The factors are pill type and spray type. “Double-blind” means that the treatment assigned to a patient was unknown to both the patient and those responsible for assessing the effectiveness of that treatment. “Placebo-controlled” means that some of the subjects were given placebos. Even though these possess no medical properties, some subjects may show improvement or benefits just as a result of participating in the experiment; the placebos allow those doing the study to observe this effect.

9.40. “No significant difference” does *not* mean the groups are identical. While there almost certainly were *some* differences in these variables between the four groups, those differences were no bigger than we might expect from true random allocation. For example, the proportions of smokers in the four groups were sufficiently similar that the effect of smoking on sinus infections would be nearly the same in each group.

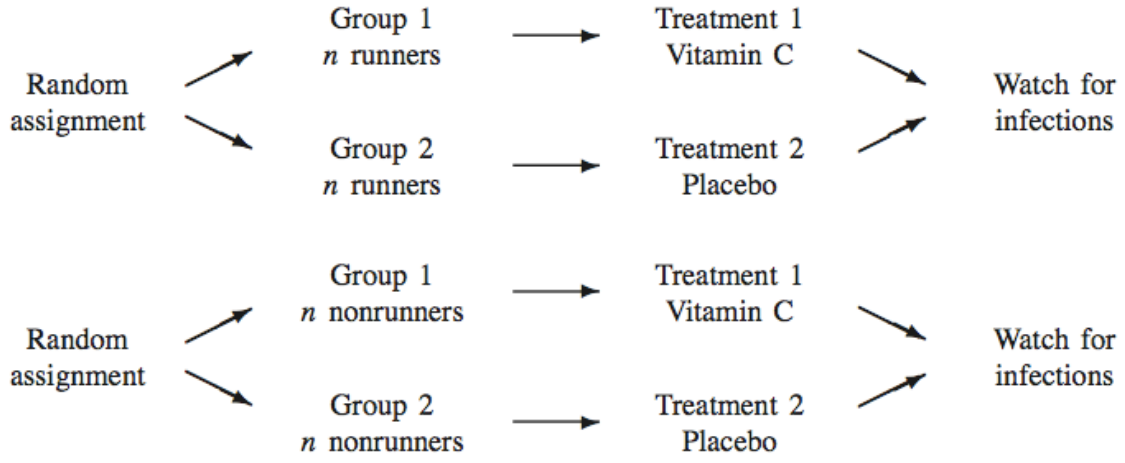
9.41. (a) The subjects are randomly chosen Starbucks customers. Each subject tastes two cups of coffee, in identical unlabeled cups. One contains regular mocha frappuccino, the other the new light version. The cups are presented in random order, half the subjects get regular then light, the other half light then regular. Each subject says which cup he or she prefers. (b) We must assign

10 customers to get regular coffee first. Label the subjects 01 to 20. Starting at line 141, the "regular first" group is: 12, 16, 02, 08, 17, 10, 05, 09, 19, 06.

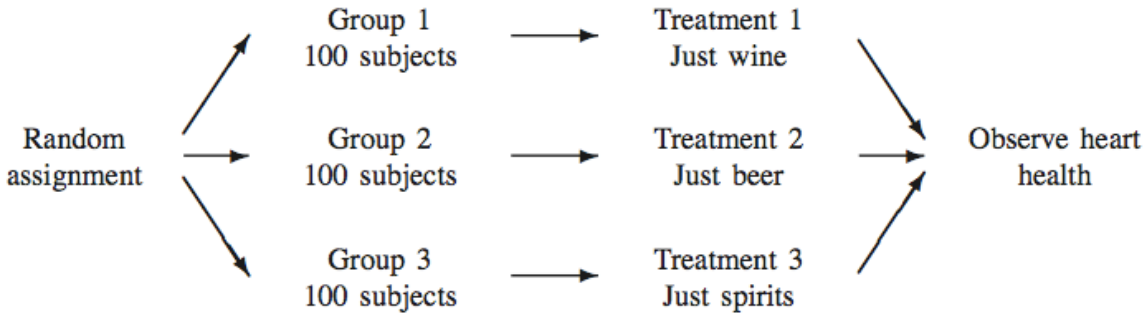
9.42. The sketches requested in the problem are not shown here; random assignments will vary among students. (a) Label the circles 1 to 6, then randomly select three (using Table B, or simply by rolling a die) to receive the extra CO_2. Observe the growth in all six regions, and compare the mean growth within the three treated circles with the mean growth in the other three (control) circles. (b) Select pairs of circles in each of three different areas of the forest. For each pair, randomly select one circle to receive the extra CO_2 (using Table B or by flipping a coin). For each pair, compute the difference in growth (treated minus control).

9.43. Each player will be put through the sequence (100 yards, four times) twice—once with oxygen and once without. For each player, randomly determine whether to use oxygen on the first or second trial. Allow ample time (perhaps a day or two) between trials for full recovery.

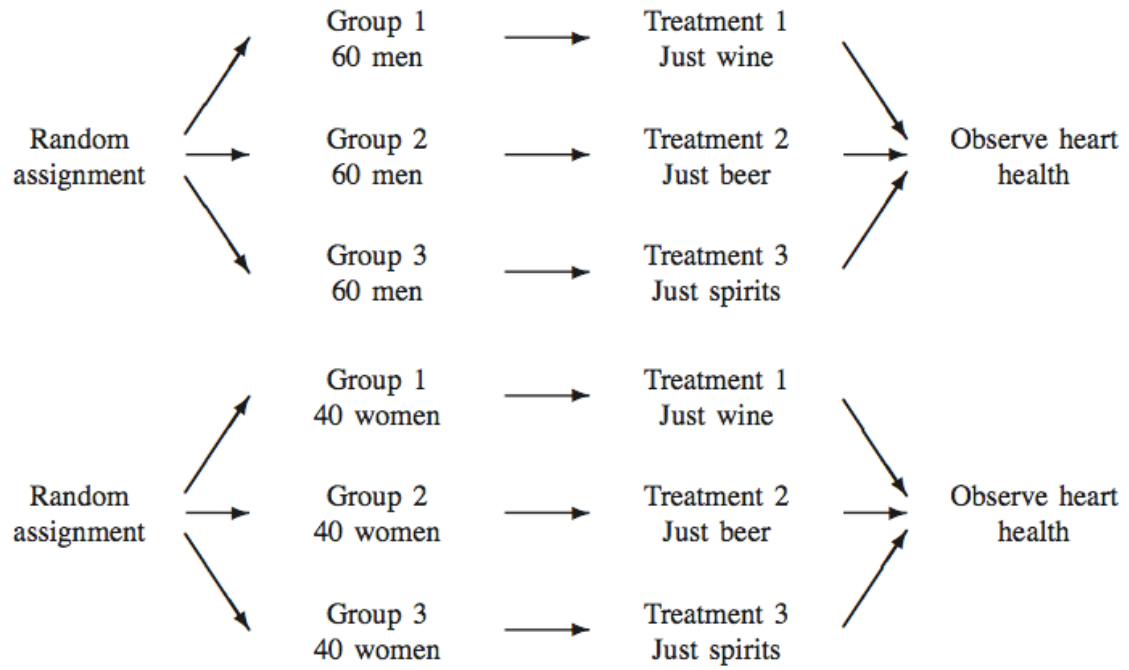
9.44. (a) This is a block design. (b) The diagram might be similar to the one below (which assumes equal numbers of subjects in each group).



9.45. Diagram is shown below. The last stage ("Observe heart health") might be described in more detail.

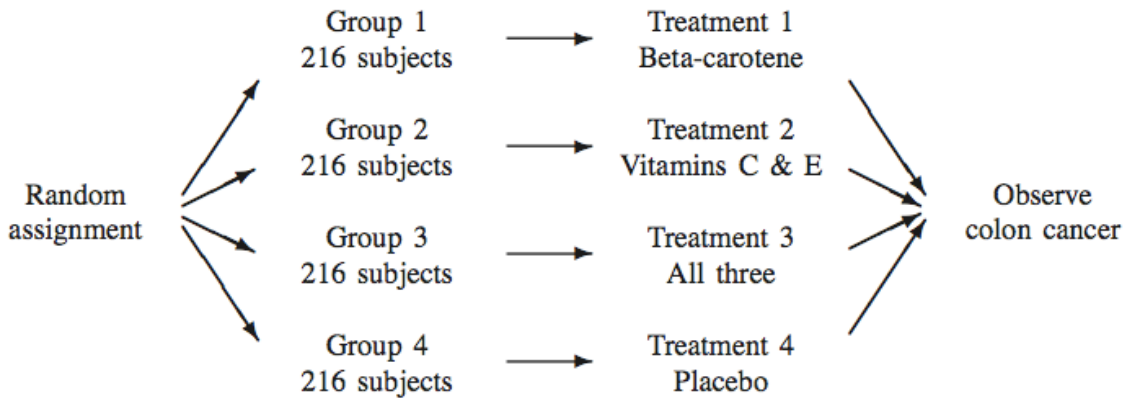


9.46. Divide the men and women into three groups of equal size. Diagram below.

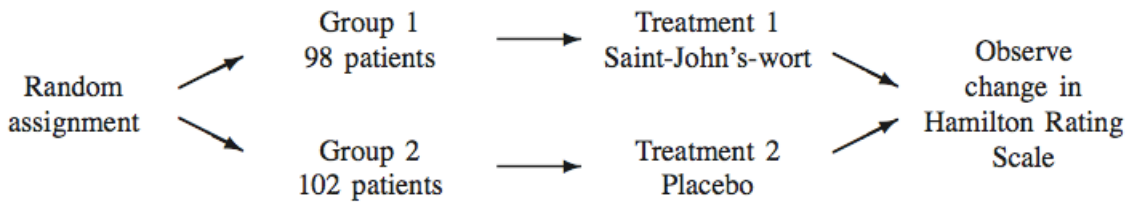


9.47. Any experiment randomized in this way assigns all the women to one treatment and all the men to the other. That is, sex is completely confounded with treatment. If women and men respond differently to the treatment, the experiment will be strongly biased. The direction of the bias is random, depending on the coin toss.

9.48. (a) The explanatory variable is the beta-carotene/vitamin(s) taken each day; the response variable is whether or not colon cancer develops. (b) Diagram is shown below; equal group sizes are convenient but not necessary. (c) Neither the subjects nor the researchers who examined them knew who was getting which treatment. (d) The observed differences were no more than what might reasonably occur by chance even if there is no effect due to the treatments. (e) Fruits and vegetables contain fiber; this could account for the benefits of those foods. Also, people who eat lots of fruits and vegetables may have healthier diets overall (e.g., less red meat).



9.49. (a) "Randomized" means that patients were randomly assigned to receive either Saint-John's-wort or a placebo. "Double-blind" means that the treatment assigned to a patient was unknown to both the patient and those responsible for assessing the effectiveness of that treatment. "Placebo-controlled" means that some of the subjects were given placebos. Even though these possess no medical properties, some subjects may show improvement or benefits just as a result of participating in the experiment; the placebos allow those doing the study to observe this effect. (b) Diagram below.



9.50. (a) We expect half of the sample to be made up of older students, so we expect 12.5 (half of 25) older students in the sample. (b) Results will vary, but probability computations reveal that more than 97.7% of samples will have 9 to 16 older employed subjects (and 99.6% of samples have 8 to 17 older employed subjects). Additionally, if students average their 20 samples, nearly all students (more than 99%) should find that the average number of older employed subjects is between 11.3 and 13.7.

Note: X, *the number of older employed subjects in the sample, has a hypergeometric distribution with parameters* N = *50,* r = *25,* n = *25, so that* $P(9 \le X \le 16) = 0.977$. *The theoretical average number of older employed subjects in the sample is 12.5.*

9.51 and 9.52 are Web-based exercises.