

Chapter 5

5.1 The population is (all) local businesses. The sample is the 73 businesses that return the questionnaire, or the 150 businesses selected. The nonresponse rate is $51.3\% = 77/150$.

Note: *The definition of “sample” makes it somewhat unclear whether the sample includes all the businesses selected, or only those which responded. Many folks lean toward the latter (the smaller group), which is consistent with the idea that the sample is “a part of the population that we actually examine.”*

5.2 (a) An individual is a person; the population is all adult U.S. residents for that week. (b) An individual is a household; the population is all U.S. households in the year 2000. (c) An individual is a voltage regulator; the population is all the regulators in the last shipment.

5.3 This is an experiment: a treatment is imposed. The explanatory variable is the teaching method (computer assisted or standard), and the response variable is the increase in reading ability based on the pre- and post-tests.

5.4 We can never know how much of the change in attitudes was due to the explanatory variable (reading propaganda) and how much to the historical events of that time. The data give no information about the effect of reading propaganda.

5.5 This is an observational study. The researcher did not attempt to change the amount that people drank. The explanatory variable is alcohol consumption. The response variable is survival after 4 years.

5.6 (a) The data were collected after the anesthesia was administered. Hospital records were used to “observe” the death rates, rather than imposing different anesthetics. (b) Some possible confounding variables are type of surgery, location of hospital, training of the doctor, patient allergies to certain anesthetics, and health of the patient before the surgery.

5.7 Only persons with a strong opinion on the subject, strong enough that they are willing to spend the time and money, will respond to this advertisement.

5.8 Letters to legislators are an example of a voluntary response sample—the proportion of letters opposed to the insurance should not be assumed to be a fair representation of the attitudes of the congresswoman’s constituents.

5.9 Put the retail outlets in alphabetical order and label them from 001 to 440. Starting at line 105, the sample includes outlets numbered 400, 077, 172, 417, 350, 131, 211, 273, 208, and 074.

5.10 Entering at line 131 and reading two-digit numbers, the authors will call Beach Castle (05), Sea Castle (19), and Banyan Tree (04). Most statistical software will select a SRS for you, eliminating the need for Table B. The Simple Random Sample applet on the text CD and Web site is a convenient way to automate this task.

5.11 Assign 01 to 30 to the students (in alphabetical order). Starting on line 123 gives 08-Ghosh, 15-Jones, 07-Fisher, and 27-Shaw. Assigning 0–9 to the faculty members gives 1-Besicovitch and 0-Andrews.

5.12 Label the 500 midsize accounts from 001 to 500, and the 4400 small accounts from 0001 to 4400. Starting at line 115, the first five accounts in each strata are 417, 494, 322, 247, and 097 for the midsize group, then 3698, 1452, 2605, 2480, and 3716 for the small group.

5.13 (a) This is a stratified random sample. (b) Label each area code from 01 through 25; beginning at line 111, the SRS includes 12 (559), 04 (209), 11 (805), 19 (562), 02 (707), 06 (925), 08 (650), 25 (619), 17 (626), and 14 (661).

5.14 (a) This is cluster sampling. (b) Answers will vary. Label each block from 01 through 65; beginning at line 142, the 5 blocks are 02, 32, 26, 34, and 08. The statistical applet selected blocks 10, 20, 45, 36, and 60.

5.15 (a) Households without telephones or with unlisted numbers are omitted from this frame. Such households would likely be made up of poor individuals (who cannot afford a phone), those who choose not to have phones, and those who do not wish to have their phone number published. (b) Those with unlisted numbers would be included in the sampling frame when a random-digit dialer is used.

5.16 The higher no-answer rate was probably the second period—when families are likely to be vacationing or spending time outdoors. A high rate of nonresponse makes sample results less reliable because you don't know how these individuals would have responded. It is very risky to assume that they would have responded exactly the same way as those individuals who did respond.

5.17 The first wording would pull respondents toward a tax cut because the second wording mentions several popular alternative uses for tax money.

5.18 Variable: Approval of president's job performance. Population: Adult citizens of the U.S. or perhaps just registered voters. Sample: The 1210 adults interviewed. Possible sources of bias: Only adults with phones were contacted. Alaska and Hawaii were omitted.

5.19 (a) There were 14,484 responses. (Note that we have no guarantee that these came from 14,484 distinct people; some may have voted more than once.) (b) This voluntary response sample collects only the opinions of those who visit this site and feel strongly enough to respond.

5.20 (a) The wording is clear. The question is slanted in favor of warning labels. (b) The question is clear, but it is clearly slanted in favor of national health insurance by asserting it would reduce administrative costs. (c) The wording is too technical for many people to understand—and for those who do understand the question, it is slanted because it suggests reasons why one should support recycling. It could be rewritten to something like: “Do you support economic incentives to promote recycling?”

5.21 (a) The individuals are adults, presumably those who are eligible to vote, in the country.
(b) The individuals are employed women who are members of the local business and professional women's clubs. (c) The individuals are households in the U.S.

5.22 Children from larger families will be overrepresented in such a sample. Student explanations of why will vary; a simple illustration can aid in understanding this effect. Suppose that there are 100 families with children; 60 families have one child, and the other 40 have three. Then there are a total of 180 children (an average of 1.8 children per family), and *two-thirds* of those children come from families with three children. Therefore, if we had a class (a sample) chosen from these 180 children, only one-third of the class would answer "one" to the teacher's question, and the rest would say "three." This would give an average of about 2.3 children per family.

5.23 Number the bottles across the rows from 01 to 25, then select 12–B0986, 04–A1101, and 11–A2220. (If numbering is done down columns instead, the sample will be A1117, B1102, and A1098.)

5.24 In order to increase the accuracy of its poll results. Larger samples give less variable results than smaller samples.

5.25 One could use the labels already assigned to the blocks, but that would mean skipping a lot of four-digit combinations that do not correspond to any block. An alternative would be to drop the second digit and use labels 100, 101, 102,...,105; 200,...,211; 300,...,325. But by far the simplest approach is to assign labels 01,..., 44 (in numerical order by the four-digit numbers already assigned), enter the table at line 125, and select: 21 (#3002), 37 (#3018), 18 (#2011), 44 (#3025), and 23 (#3004).

5.26 (a) False—if it were true, then after looking at 39 digits, we would know whether or not the 40th digit was a 0. (b) True—there are 100 pairs of digits 00 through 99, and all are equally likely. (c) False—0000 is just as likely as any other string of four digits.

5.27 It is not an SRS, because some samples of size 250 have no chance of being selected (e.g., a sample containing 250 women).

5.28 (a) The two options presented are too extreme; no middle position on gun control is allowed. Many students may suggest that this question is likely to elicit more responses against gun control (that is, more people will choose 2). (b) The phrasing of this question will tend to make people respond in favor of a nuclear freeze. Only one side of the issue is presented.

5.29 A sample from a smaller subgroup gives less information about the population. "Men" constituted only about one-third of our sample, so we know less about that group than we know about all adults.

5.30 The chance of being interviewed is 3/30 for students over age 21 and 2/20 for students under age 21. This is 1/10 in both cases. It is not an SRS because not all combinations of

students have an equal chance of being interviewed. For instance, groups of 5 students all over age 21 have no chance of being interviewed.

5.31 Answers will vary. One possible approach: Obtain a list of schools, stratified by size or location (rural, suburban, urban). Choose SRSs (not necessarily all the same size) of schools from each strata. Then choose SRSs (again, not necessarily the same size) of students from the selected schools.

5.32 (a) Split the 200 addresses into 5 groups of 40 each. Looking for 2-digit numbers from 01 to 40, the table gives 35 so the systematic random sample consists of 35, 75, 115, 155, and 195. (b) Every address has a 1-in-40 chance of being selected, but not every subset has an equal chance of being picked—for example, 01, 02, 03, 04, and 05 cannot be selected by this method.

5.33 Experimental units: pine seedlings. Factor: Light intensity. Treatments: full light, 25% light and 5% light. Response variable: dry weight at the end of the study.

5.34 Subjects: The students living in the selected dormitory. Factor: The rate structure. Treatments: Paying one flat rate, or paying peak/off-peak rates. Response variables: The amount and time of use and total network use.

5.35 Experimental units: the individuals who were called. Factors: 1. type of call; 2. offered survey results. Treatments: (1) giving name/no survey results, (2) identifying university/no survey results, (3) giving name and university/no survey results, (4) giving name/offer to send survey results, (5) identifying university/offer to send survey results, (6) giving name and university/offer to send survey results. Response variable: whether or not the interview was completed.

5.36 Subjects: 300 sickle cell patients. Factor: type of medication. Treatments: hydroxyurea and placebo. Response variable: number of pain episodes.

5.37 (a) The response variable is the amount of chest pain. (b) This phenomenon is known as the placebo effect. (c) Well-designed experiments should use a control. The ligation study illustrates the importance of using a control group.

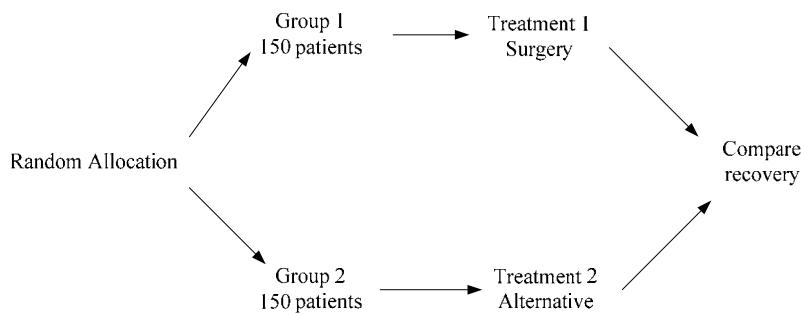
5.38 (a) The experimental units are the middle schools. The response variables are physical activity and lunchtime consumption of fat. (b) There are two factors, physical activity program and nutrition program, and four treatments, activity intervention, nutrition intervention, both interventions, and neither intervention.

		Factor B:	
		Nutritional Program	
		Yes	No
Factor A:	Physical Activity	Yes	1
	Program	No	3
			2
			4

(c) At least 4 experimental units are required for the experiment, but as we will see in the next section, using only 4 experimental units is not a good idea. We want at least one replicate on

each treatment combination so that systematic differences due to the treatments can be separated from natural variability in the experimental units.

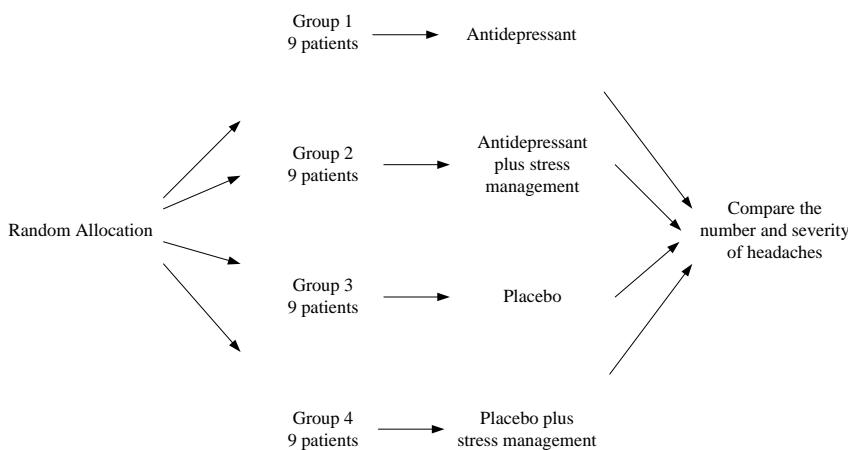
- 5.39 (a) Expense, condition of the patient, etc. In a serious case, when the patient has little chance of surviving, a doctor might choose not to recommend surgery; it might be seen as an unnecessary measure, bringing expense and a hospital stay with little benefit to the patient.
 (b)



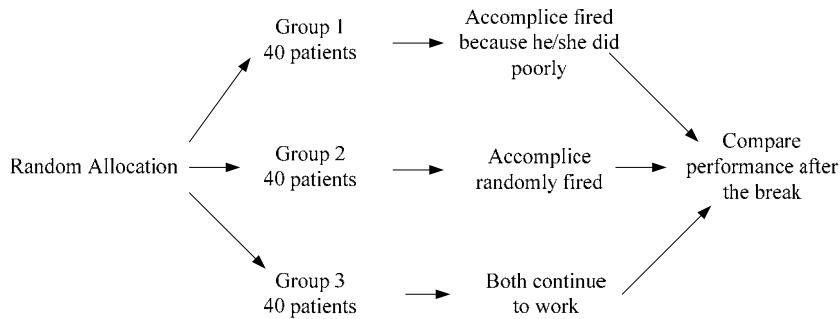
- 5.40 Assign nine subjects to each treatment. A diagram is below; if we assign labels 01 through 36, then line 130 gives:

Group 1		Group 2		Group 3	
05 Chen	32 Vaughn	31 Valasco	02 Asihiro	35 Willis	11 Fleming
16 Imrani	04 Bikalis	18 Kaplan	36 Zhang	21 Marsden	15 Hruska
17 James	25 Padilla	07 Duncan	23 O'Brian	26 Plochman	12 George
20 Maldonado	29 Trujillo	13 Han	27 Rosen	08 Durr	14 Howard
19 Liang		33 Wei		10 Farouk	

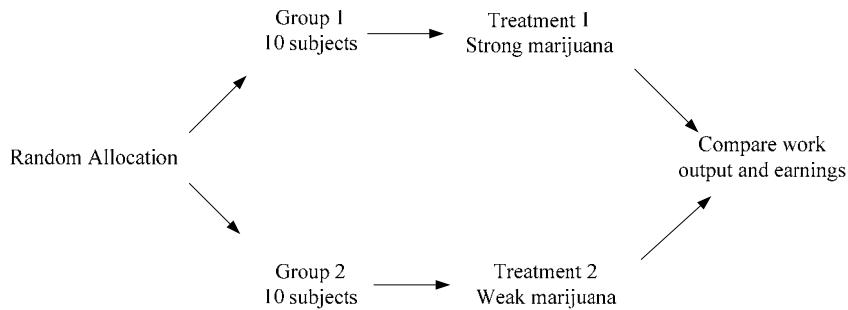
The other nine subjects are in Group 4.



5.41 (a) A diagram is shown below. (b) Assigning the students numbers from 001 to 120, using line 123 from Table B, the first four subjects are 102, 063, 035, and 090.

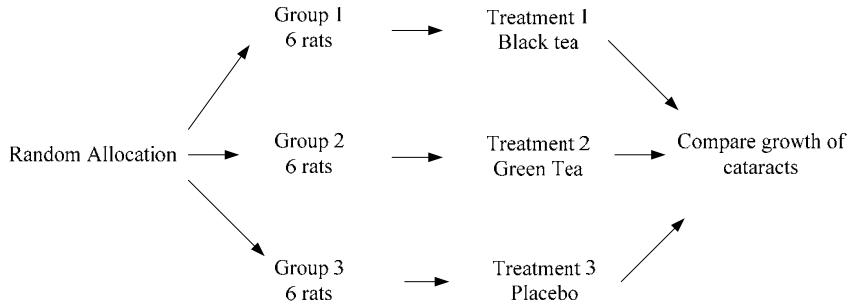


5.42 (a) A diagram is shown below. (b) Label the subjects from 01 through 20. From line 131, we choose 05, 19, 04, 20, 16, 18, 07, 13, 02, and 08; that is, Frankum, Wenk, Edwards, Zillgitt, Valenzuela, Waespe, Hankinson, Shenk, Colton, and Mathis for one group, and the rest for the other.



5.43 The second design is an experiment—a treatment is imposed on the subjects. The first is an observational study; it may be confounded by the types of men in each group. In spite of the researcher's attempt to match "similar" men from each group, those in the first group (who exercise) could somehow be different from men in the non-exercising group.

5.44 (a) A diagram is shown below. (b) If we assign labels 01, ..., 18 and begin on line 142, then we select: 02, 08, 17, 10, 05, and 09 for Group 1; 06, 16, 01, 07, 18, and 15 for Group 2. The remaining rats are assigned to the placebo group.

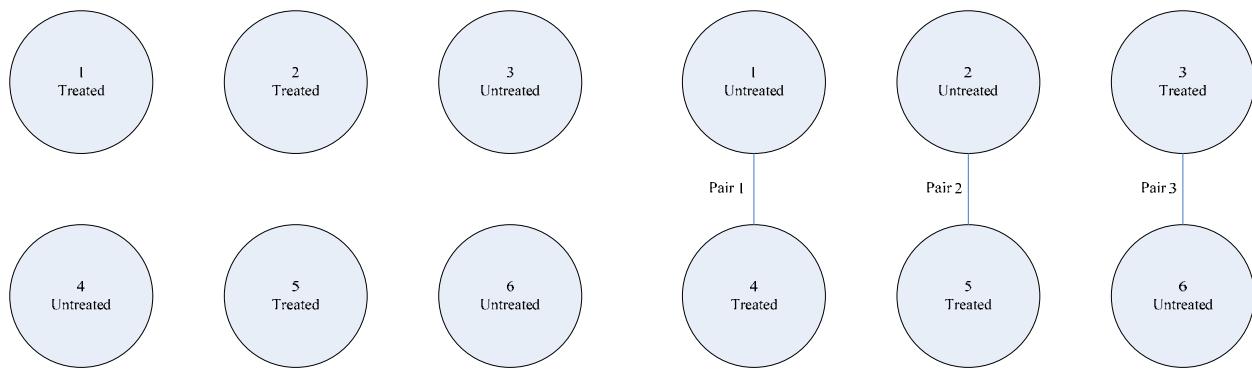


5.45 Because the experimenter knew which subjects had learned the meditation techniques, he (or she) may have had some expectations about the outcome of the experiment: if the experimenter believed that meditation was beneficial, he may subconsciously rate that group as being less anxious.

5.46 (a) If only the new drug is administered, and the subjects are then interviewed, their responses will not be useful, because there will be nothing to compare them to: How much “pain relief” does one expect to experience? (b) Randomly assign 20 patients to each of three groups: Group 1, the placebo group; Group 2, the aspirin group; and Group 3, which will receive the new medication. After treating the patients, ask them how much pain relief they experienced, and then compare the average pain relief experienced by each group. (c) The subjects should certainly not know what drug they are getting—a patient told that she is receiving a placebo, for example, will probably not experience any pain relief. (d) Yes—presumably, the researchers would like to conclude that the new medication is better than aspirin. If it is not double-blind, the interviewers may subtly influence the responses of the subjects.

5.47 (a) Ordered by increasing weight, the five blocks are (1) Williams-22, Deng-24, Hernandez-25, and Moses-25; (2) Santiago-27, Kendall-28, Mann-28, and Smith-29; (3) Brunk-30, Obrach-30, Rodriguez-30, and Loren-32; (4) Jackson-33, Stall-33, Brown-34, and Cruz-34; (5) Birnbaum-35, Tran-35, Nevesky-39, and Wilansky-42. (b) The exact randomization will vary with the starting line in Table B. Different methods are possible; perhaps the simplest is to number the subjects from 1 to 4 within each block, then assign the members of block 1 to a weight-loss treatment, then assign block 2, etc. For example, starting on line 133, we assign 4-Moses to treatment A, 1-Williams to B, and 3-Hernandez to C (so that 2-Deng gets treatment D), then carry on for block 2, etc.

5.48 (a) A figure with 6 circular areas is shown below. Table B was used to select 3 for the treatment, starting at line 104. The first 4 digits are: 5 2 7 1. We cannot use the 7 because it is more than 6. Therefore, we would treat areas 5, 2 and 1. (b) A figure with 3 pairs of circular areas is shown below. For each pair, we randomly pick one of the two to receive the treatment. A random number was generated for each pair. If the random number was less than 0.5 then the top area was treated and the bottom area was untreated. If the random number is greater than or equal to 0.5, then the top area is untreated and the bottom area is treated.

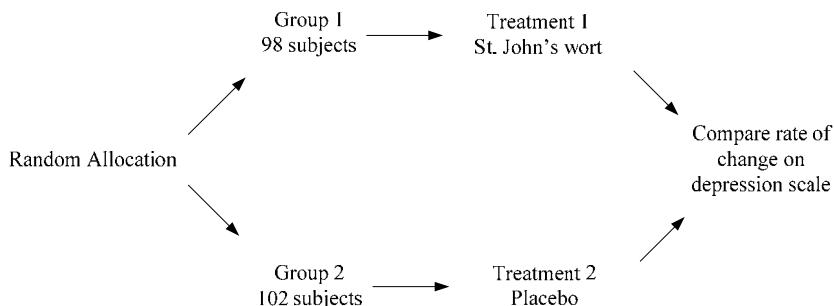


5.49 (a) Randomly assign 10 subjects to Group 1 (the 70° group) and the other 10 to Group 2 (which will perform the task in the 90° condition). Record the number of correct insertions in each group. (b) All subjects will perform the task twice; once in each temperature condition. Randomly choose which temperature each subject works in first by flipping a coin.

5.50 (a) Randomly assign half the girls to get high-calcium punch, and the other half get low-calcium punch. The response variable is not clearly described in this exercise; the best we can say is “observe how the calcium is processed.” (b) Randomly select half of the girls to receive high-calcium punch first, while the other half gets low-calcium punch first, then for each subject, compute the difference in the response variable for each treatment. This is a better design because it deals with person-to-person variation; the differences in responses for 60 individuals gives more precise results than the difference in the average responses for two groups of 30 subjects. (c) The first five subjects are 16, 34, 59, 44, and 21. In the completely randomized design, the first group receives high-calcium punch all summer; in the matched pairs design, they receive high-calcium punch for the first part of the summer, and then low-calcium punch in the second half.

5.51 (a) “Randomized” means that patients were randomly assigned either St. John’s-wort extract or the placebo. “Placebo controlled” means that the results for the group using St. John’s-wort extract were compared to the group that received the placebo. “Double-blind” means that neither the subjects nor the researchers interacting with them (including those who measured depression levels) know who is receiving which treatment.

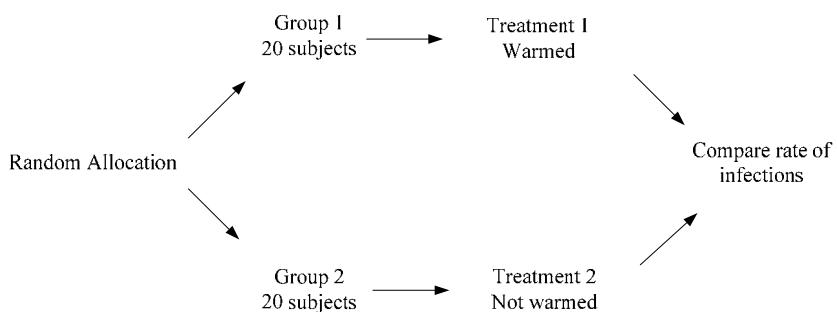
(b)



5.52 (a) The subjects are the 210 children. (b) The factor is the “choice set”; there are three levels (2 milk/2 fruit drink, 4 milk/2 fruit drink, and 2 milk/4 fruit drink). (c) The response variable is the choice made by each child. (d) Arrange the names of the children in alphabetical order and assign numbers from 001 to 210. Use Table B, the statistical applet, or a random number generator to select 70 children for Group 1 (2 milk/2 fruit drink) and 70 children for Group 2 (4 milk/2 fruit drink). The remaining 70 children would be placed in Group 3 (2 milk/4 fruit drink). Starting at line 125, the first five children in Group 1 are 119, 33, 199, 192, and 148.

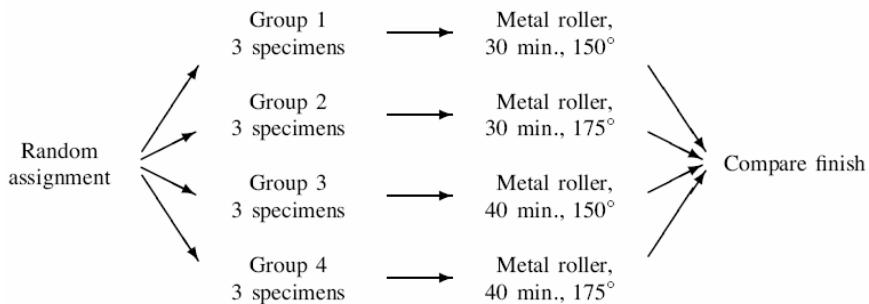
5.53 (a) The subjects are patients. The factor is temperature with 2 levels, warmed and not warmed. The response variable is the presence of infection (yes or no) after surgery.

(b)



(c) Assign each subject a number, 01 to 40, by alphabetical order. Starting at line 121 in Table B, the first twenty different subjects are: 29-Ng, 07-Cordoba, 34-Sugiyara, 22-Kaplan, 10-Devlin, 25-Lucero, 13-Garcia, 38-Ullmann, 15-Green, 05-Cansico, 09-Decker, 08-Curzakis, 27-McNeill, 23-Kim, 30-Quinones, 28-Morse, 18-Howard, 03-Afifi, 01-Abbott, 36-Travers. These subjects will be assigned to Treatment Group 1; the remaining subjects go into Group 2. (d) We want the treatment groups to be as alike as possible. If the same operating team was used to operate on “warmed” and “unwarmed” patients, then the effect of the “warming” on the occurrence of infection might be confounded with the effect of the surgical team (e.g., how skillful the team was in performing the necessary preventive measures). (e) Double-blinding. We would prefer a double-blind experiment here to ensure that the patients would not be treated differently with regard to preventing and monitoring infections due to prior knowledge of how they were treated.

5.54 (a) There are three factors (roller type, dyeing cycle time, and temperature), each with two levels, for a total of $2^3 = 8$ treatments. The experiment therefore requires 24 fabric specimens. (b) In the interest of space, only the top half of the diagram is shown below. The other half consists of Groups 5 to 8, for which the treatments have natural bristle rollers instead of metal rollers.

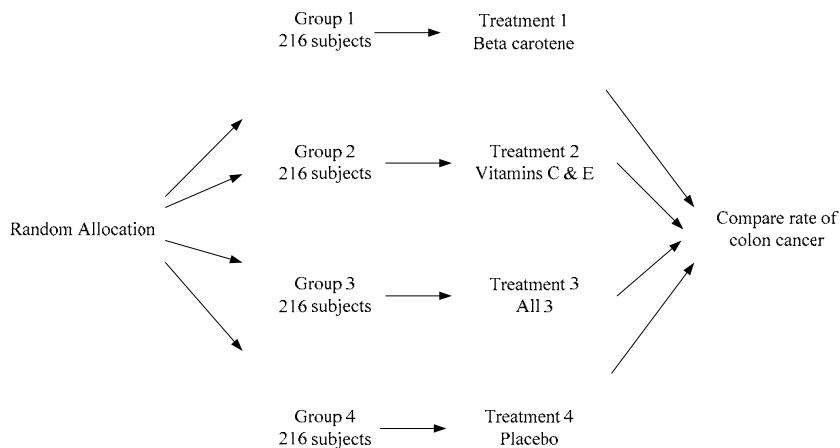


5.55 (a) Randomly assign 20 men to each of two groups. Record each subject's blood pressure, then apply the treatments: a calcium supplement for Group 1, and a placebo for Group 2. After sufficient time has passed, measure blood pressure again and observe any change. (b) Number from 01 to 40 down the columns. Group 1 is 18-Howard, 20-Imrani, 26-Maldonado, 35-Tompkins, 39-Willis, 16-Guillen, 04-Bikalis, 21-James, 19-Hruska, 37-Tullock, 29-O'Brian, 07-Cranston, 34-Solomon, 22-Kaplan, 10-Durr, 25-Liang, 13-Fratianna, 38-Underwood, 15-Green, and 05-Chen. (c) Block on race (make 2 groups, one of black men and one of white men) and then apply the design in (a) to each block. Observe the change of blood pressure for each block.

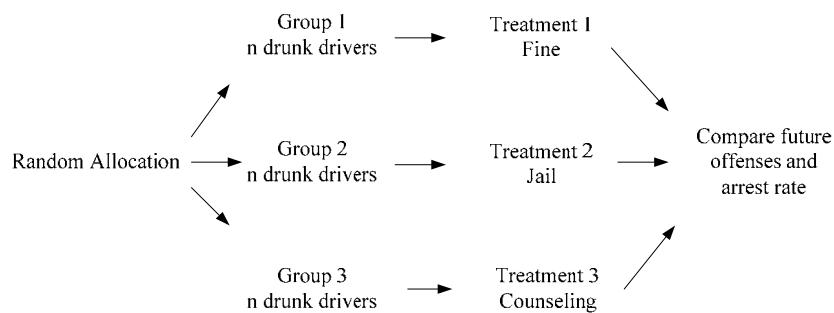
5.56 The simplest design would be a completely randomized design, assigning half of the women to take strontium renelate and half to take the placebo. A better design would block according to the medical center (and country); that is, randomly select for the strontium renelate group half the women from country A, half of those from country B, and so on. This blocking would take care of differences from one country to another.

5.57 Responding to a placebo does not imply that the complaint was not "real"—38% of the placebo group in the gastric freezing experiment improved, and those patients really had ulcers. The placebo effect is a psychological response, but it may make an actual physical improvement in the patient's health.

5.58 (a) The explanatory variable is the vitamin(s) taken each day; the response variable is the colon cancer rate. (b) Diagram below; equal group sizes are convenient but not necessary. (c) Using labels 001 through 864 (or 000 through 863), we choose 731, 253, 304, 470, and 296. (d) "Double-blind" means that both the subjects and those who work with the subjects do not know who is getting what treatment. This prevents the expectations of those involved from affecting the way in which the subjects' conditions are diagnosed. (e) The observed differences were no more than what might reasonably occur by chance even if there is no effect due to the treatments. (f) Some possible lurking variables are amount of exercise, fiber intake, cholesterol level, fat intake, amount of sleep, etc.



5.59 Three possible treatments are (1) fine, (2) jail time, and (3) attending counseling classes. The response variable would be the rate at which people in the three groups are rearrested.



5.60 (a) Each subject takes both tests; the order in which the tests are taken is randomly chosen.
 (b) Take 22 digits, one for each subject, from Table B. If the digit is even, the subject takes the BI first; if it is odd, he or she takes the ARSMA first. Answers will vary, but approximately 11 subjects should take each BI first. Using line 107 of Table B, subjects 1, 2, 8, 10, 11, 12, 13, 14, 16, and 21 would take ARSMA first and the other 12 subjects would take BI first.

CASE CLOSED!

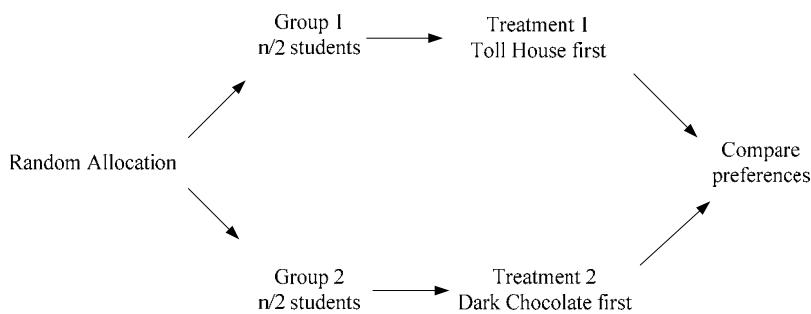
1. (a) Researchers simply asked 305 pregnant women to rate their stress levels and chocolate consumption, so this is an observational study. (b) Since this is an observational study, the researchers should not suggest a cause and effect relationship. Suggesting that chocolate “produced” these feelings is going too far.
2. (a) Both of the studies simply observed the impact of a treatment on a group of patients. The major difference is that Dr. Hollenberg measured blood flow on two separate days (day 1 and day 5). Thus, each subject has a baseline measurement and a measurement after consuming flavonols for a week. (b) Dr. Hollenberg’s study is a matched pairs design. The measurements on day 1 and day 5 are not independent since they are obtained on the same subjects. (c) Randomly assign the patients into two groups, one group is treated using the protocol from Dr. Hollenberg’s study and the other group is treated the same way except the fluid they drink each

day does not contain 900 milligrams of flavonols. The differences in blood flow (day 5 – day 1) are compared for the two groups.

3. (a) The researchers did not use a completely randomized design because they wanted to control the subject-to-subject variability. Blood flow differs for different individuals. (b) The investigators used a randomized block design. (c) The researchers were able to control a major source of variation.

5.61 (a) Explanatory variable: type of cookie (Toll house or Dark Chocolate); Response variable: cookie preference. (b) The population is all cookies manufactured of each type. We can assume that the cookies used were not systematically different from the population and so hopefully a representative sample was used, but not a SRS because not all sets of cookies in the population had an equal chance of being used.

(c)



(d) Variability was controlled by the students being randomly assigned to the two groups, the cookies being tasted in different orders, the cookies being as similar as possible and given to the student in the same way. (e) Half of the students were assigned to each treatment group which provides sufficient student-to-student variability to show that any difference is due to the cookies and not the subject variability. (f) The experiment was blind (the students don't know which cookie they are eating – it has nothing to do with their blindfold!) but not double blind (the person handing them the cookie would know—by the appearance—which cookie the student was being given. (g) Answers will vary but some examples are: Can they tell the difference at all? You could add 2 more treatments: Toll house followed by another Toll House and a Dark Chocolate followed by another Dark Chocolate. They may think there is a strong preference for one cookie when, in fact, they are both the same! You might want to block by gender or if you wanted to reach a conclusion using the whole school, you could take a stratified sample using grade.

5.62 (a) The population is Ontario residents; the sample is the 61,239 people interviewed. (b) The sample size is very large, so if there were large numbers of both sexes in the sample—this is a safe assumption since we are told this is a “random sample”—these two numbers should be fairly accurate reflections of the values for the whole population.

5.63 (a) A matched pairs design (two halves of the same board would have similar properties). (b) A sample survey (with a stratified sample: smokers and nonsmokers). (c) A block design (blocked by sex).

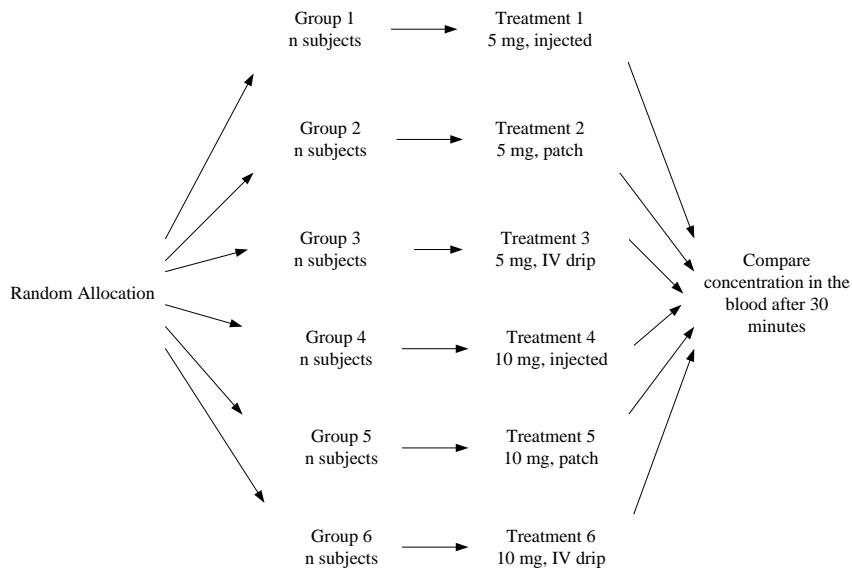
5.64 (a) Possible response variables are: whether or not a subject has a job within some period of time, number of hours worked during some period, length of time before subject became employed. For the design, randomly assign about one-third of the group (3,355 subjects) to each treatment, and observe the chosen response variables after a suitable amount of time.
(b) The simplest approach is to label from 00001 through 10065, and then take five digits at a time from the table. (This means we have to skip about 90% of the five-digit sets, as only those beginning with 0 [and a few beginning with 1] are useful.) With this approach, we choose 00850, 02182, and 00681 (the last of these is on line 172). More efficient labellings are possible and will lead to different samples.

5.65 Each player will complete the experiment twice, once with oxygen during the rest period and once without oxygen. The order for each player will be determined by the flip of a coin. If the coin lands heads up, then the player will receive oxygen during the first set of sprints. If the coin lands tails up, then the player will not receive oxygen during the first set of sprints. After a suitable amount of time, the players will run the sprints again with the different “treatment” during the second set of sprints. The differences for each player (final time with oxygen – final time without oxygen) will be used to check for an oxygen effect.

5.66 A stratified random sample would be useful here; one could select 50 faculty members from each type of institution. If a large proportion of faculty in your state work at a particular class of institution, it may be useful to stratify unevenly. If, for example, about 50% teach at Class I institutions, you may want half your sample to come from Class I institutions.

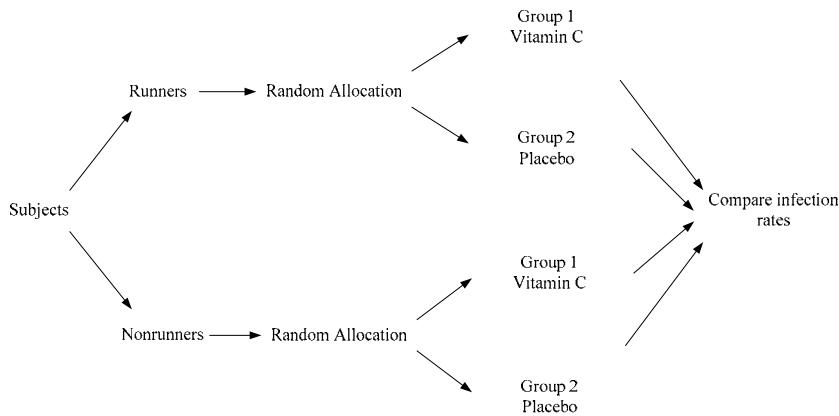
5.67 (a) The treatment combinations are shown in the table below, and the design is also diagrammed below.

		Factor B		
		Administration method		
		Injection	Skin Patch	IV drip
Factor A	5 mg	Treatment 1	Treatment 2	Treatment 3
	10 mg	Treatment 4	Treatment 5	Treatment 6



- (b) Larger samples give more information; in particular, with large samples, the variability in the observed mean concentrations is reduced, so that we can have more confidence that the differences we might observe are due to the treatment applied rather than random fluctuation.
 (c) Use a block design. Separate men and women and randomly allocate the 6 treatments to each gender.

5.68 (a) This is a randomized block design. The blocks here are “runners” and “nonrunners.”
 (b)

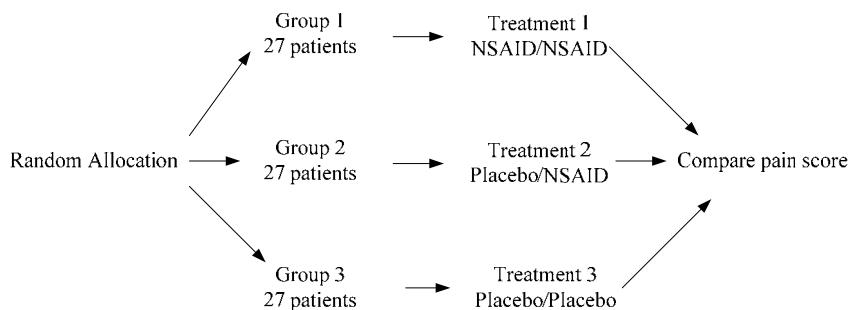


- (c) A difference in rate of infection may have been due to the effects of the treatments, or it may simply have been due to random chance. Saying that the placebo rate of 68% is “significantly more” than the Vitamin C rate of 33% means that the observed difference is too large to have occurred by chance alone. In other words, Vitamin C appears to have played a role in lowering the infection rate of runners.

5.69 As described, there are two factors: ZIP code (three levels: none, 5-digit, 9-digit) and the day on which the letter is mailed (three levels: Monday, Thursday, or Saturday) for a total of 9 treatments. To control confounding variables, aside from mailing all letters to the same address, all letters should be the same size, and either printed in the same handwriting or typed. The design should also specify how many letters will be in each treatment group. Also, the letters should be sent randomly over many weeks.

5.70 Each subject should taste both kinds of cheeseburger, in a randomly selected order, and then be asked about their preference. Both burgers should have the same “fixings” (ketchup, mustard, etc.). Since some subjects might be able to identify the cheeseburgers by appearance, one might need to take additional steps (such as blindfolding, or serving only the center part of the burger) in order to make this a truly “blind” experiment.

5.71 (a)



The two extra patients can be randomly assigned to two of the three groups. (b) The patients, physicians, and physical therapists did not know which subjects were in which group. (c) If the pain scores for Group A were significantly lower than that of Group C, it suggests that NSAID was successful in reducing pain. However, because the pain score for Group A was not significantly lower than Group B, this suggests that it was the application of NSAID *before* the surgery that made the drug effective.

5.72 (a) It appears to be an observational study. Taking blood samples from the subjects and measuring their lung function do not qualify as treatments. (b) No. While a large sample does reduce variability, it does not imply causation. (c) No. This is not an experiment. Association is not the same as causation.