

Directions: *Work on these sheets.*

**Part 1: Multiple Choice.** *Circle the letter corresponding to the best answer.*

A chemical engineer is designing the production process for a new product. The chemical reaction that produces the product may have a higher or lower yield depending on the temperature and the stirring rate in the vessel in which the reaction takes place. The engineer decides to investigate the effects of combinations of two temperatures (50°C and 60°C) and three stirring rates (60 rpm, 90 rpm, and 120 rpm) on the yield of the process. Ten batches of feedstock will be processed at each combination of temperature and stirring rate.

1. What are the experimental units?
  - (a) The two temperatures (50°C and 60°C)
  - (b) The three stirring rates (60 rpm, 90 rpm, and 120 rpm)
  - (c) The two temperatures and the three stirring rates
  - (d) The batches of feedstock
  - (e) None of the above. The answer is \_\_\_\_\_.
  
2. Identify all factors (explanatory variables).
  - (a) The two temperatures (50°C and 60°C)
  - (b) The three stirring rates (60 rpm, 90 rpm, and 120 rpm)
  - (c) The two temperatures and the three stirring rates
  - (d) The batches of feedstock
  - (e) None of the above. The answer is \_\_\_\_\_.
  
3. What is the response variable?
  - (a) The two temperatures (50°C and 60°C)
  - (b) The three stirring rates (60 rpm, 90 rpm, and 120 rpm)
  - (c) The two temperatures and the three stirring rates
  - (d) The batches of feedstock
  - (e) None of the above. The answer is \_\_\_\_\_.
  
4. How many treatments are there?
  - (a) 2
  - (b) 3
  - (c) 5
  - (d) 6
  - (e) None of the above. The answer is \_\_\_\_\_.
  
5. How many experimental units are needed?
  - (a) 2
  - (b) 3
  - (c) 5
  - (d) 6
  - (e) None of the above. The answer is \_\_\_\_\_.

## Part 2: Free Response

Answer completely, but be concise. Write sequentially and show all steps.

Read the article about the connection between vitamin E and heart bypass surgery.

### Vitamin E may have special health benefits

Large doses of vitamin E apparently can reduce harmful side effects of bypass surgery in heart patients. A study involving 28 bypass patients found that the 14 patients who took vitamin E for two weeks before their operations had significantly better heart function after the procedure than the 14 patients who took placebos.

The vitamins apparently prevent damage to the heart muscle by destroying the toxic chemicals, called free radicals, that form when blood is cut off during the surgery, said Dr. Terrance Yau of the University of Toronto.

6. Describe the experimental units/subjects in the experiment. How many were there?
7. Identify the explanatory variable(s).
8. How many treatments were there? \_\_\_\_ List them.
9. How many subjects were in each treatment group?
10. What was the response variable?

Suppose there are 500 students in your school.

11. Using Line 125 of the ~~attached~~ Random Numbers Table(RNT), select the *first* 5 students in a simple random sample (SRS) of 20 students.

Turkeys raised commercially for food are often fed the antibiotic salinomycin to prevent infections from spreading among the birds. However, salinomycin can damage the birds' internal organs, especially the pancreas. A researcher believes that a combination of selenium and vitamin E in the birds' diet may prevent injury. He wants to explore the effects of two different dosages of selenium (call them S1, S2) in combination with any of three different dosages of vitamin E (call them E1, E2, E3) added to the turkeys' diets. There are 48 turkeys available for the study. At the end of the study, the birds will be killed and the condition of their pancreas examined with a microscope.

12. What is the response variable?
13. Outline in diagram form an appropriate design for this experiment. In your diagram, indicate how many turkeys are assigned to each treatment group.

14. Use the random-digit table starting at line 128 to select the turkeys that will be assigned to the first treatment group. Be sure to indicate how you labeled the turkeys.

15. What kind of bias is Calvin introducing into the survey he's taking?

**CALVIN AND HOBBS** / BY BILL WATTERSON



Used with permission from University Press Syndicate

16. Several years ago, the Veterans Administration decided to conduct a work performance study involving claims department employees at field offices around the country. Reading from a list, provided by VA headquarters, of randomly selected times during the work day, a designated person would blow a referee's whistle. Employees would immediately stop what they were doing and jot down their activity at that moment. A newspaper reporter observing the experiment in the Salt Lake City office wrote that one day the whistle blew 17 times, and that another day, the whistle sounded barely 59 seconds into the workday. Briefly comment on the appropriateness of the experimental design. Specifically, do you see any weaknesses in this design?

Bias is present in each of the following sample designs. In each case, identify the type of bias involved and state whether you think the sample proportion obtained is higher or lower than the true population proportion.

17. A political pollster is seeking information on public attitudes toward funding of pornographic art by the National Endowment for the Arts (NEA). He asks a SRS of 2000 U. S. adults, "Rather than support government censorship of artistic expression, are you in favor of continuing federal funding of artists whose work may be controversial?" 85% of those surveyed answer "yes".
18. A church group interested in promoting volunteerism in a community chooses a SRS of 200 community addresses and sends members to visit these addresses during weekday working hours and inquire about the residents' attitude toward volunteer work. 60% of all respondents say that they would be willing to donate at least an hour a week to some volunteer organization.
19. What would be the effect on the results of the survey of increasing the sample size in the opinion poll in the previous problem to a SRS of 500?

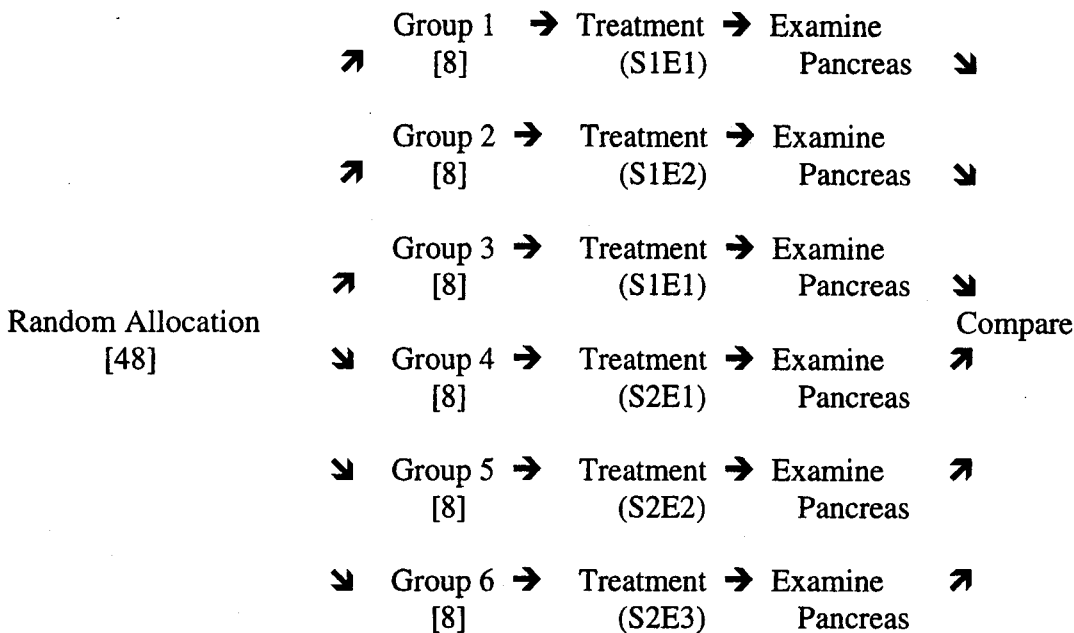
20. Consider an experiment to investigate the efficacy of different insecticides in controlling pests and their effects on subsequent yield. What is the best reason for randomly assigning treatment levels (spraying or not spraying) to the experimental units (farms)?
- (a) Randomization makes the experiment easier to conduct since we can apply the insecticide in any pattern rather than in a systematic fashion.
  - (b) Randomization will tend to average out all other uncontrolled factors such as soil fertility so that they are not confounded with the treatment effects.
  - (c) Randomization makes the analysis easier since the data can be collected and entered into the computer in any order.
  - (d) Randomization is required by statistical consultants before they will help you analyze the experiment.
  - (e) Randomization implies that it is not necessary to be careful during the experiment, during data collection, and during data analysis.

21. In a 1995 Corporation for Public Broadcasting poll of TV viewership, one question was, "A recent study by a psychology professor at a leading university concluded that the amount of violence children see on television has an effect on their likelihood of being aggressive and committing crimes. From what you have seen or heard about this subject, do you agree strongly with that conclusion, agree somewhat, or disagree strongly?" Is this question appropriate, or is it flawed in some way? Comment briefly.

22. A large forest near an industrial area suffers from the effects of acid rain. It is estimated that 30% of all trees in the forest display some signs of acid rain damage.
- (a) Describe how you would use a random digit table to simulate a SRS of 10 trees from the forest.
  - (b) Use the random digit table starting at line 120 to simulate a SRS of 10 trees. What is the proportion of trees in the sample that display some signs of acid rain damage?

# Ch 5 Review

(1) d (2) Technically, (e): temperature and stirring rates. But I accept (c) (3) e: yield (4) d (5) e  
 10 batches • 6 treatments = 60 experimental units. (6) heart bypass surgery patients; 28 (7) vitamin  
 E (8) two: treatment (vitamin E) and control (placebo) (9) 14 (10) heart function after the surgery.  
 (11) 461, 214, 235, 119, and 033. (12) condition of the turkeys' pancreas (13) Algorithm form:  
 There will be 6 treatment groups: S1E1, S1E2, S1E3, S2E1, S2E2, and S2E3. Randomly select 8  
 turkeys to be assigned to the first treatment group. Randomly select the next 8 turkeys to go into the  
 2nd group, and so forth until there are 8 turkeys in each of the 6 groups. Administer the salinomycin  
 and at the end of the study, sacrifice the birds and study the conditions of their pancreas. Compare the  
 results from the 6 groups. The diagram would look like this:



(14) Tag the turkeys with numbers 01 to 48. Using line 128 in the random digit table, these 8 turkeys:  
 #15, 42, 27, 06, 43, 13, 35, and 24 will be assigned to group 1. (15) Response bias. (16) This design  
 depends on the honesty of the workers to accurately record their activity. Some workers, wanting to  
 paint the best face on their personal work habits, may be inclined to record a legitimate work activity  
 when in fact they were engaged in non-work activity. This design is open to response bias (i.e., lying).  
 (17) The wording of the question is poor. Reference to government censorship will result in more  
 respondents in favor of the other position (continuing federal funding for artists whose work is  
 controversial). The sample proportion is higher than the population proportion. (18) There will be  
 undercoverage of people who work outside the home during the day. Respondents will be at home  
 during the workday, and they will be more inclined to donate time to a volunteer organization. The  
 sample proportion is higher than the population proportion. (19) There would be less variability in the  
 results.

(20) b. (21) Flawed because the wording of the question

includes a position and leads the participant toward a certain response. This introduces bias. (22) a) Let  
 the digits 0 to 9 represent a tree, and let the digits 1, 2, and 3 represent a tree damaged by acid rain.

(22) b) Line 120: 3 5 4 7 6    5 5 9 7 2 is my simulated sample. The underlined trees are those  
 damaged by acid rain. The proportion of damaged trees in my sample is  $2/10 = 0.2$  (20%).