Name: _____ AP Statistics

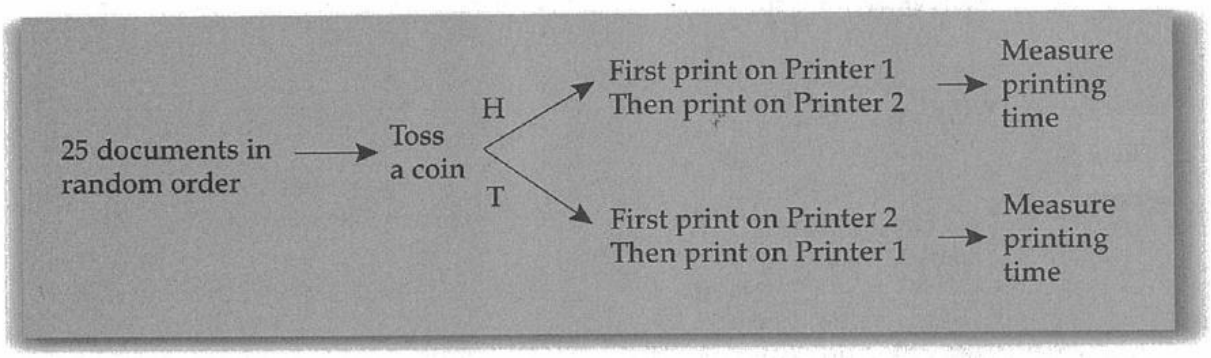
Additional Free Response
Answers

1.

Let's label the two printers Printer 1 and Printer 2. Then we should list the 25 selected documents in a random order. The order can be determined using a random number table. Then for each document in the list, toss a coin, and use the following rule to decide in which order to print the document on the two printers.

Heads: Print on Printer 1 first and then on Printer 2.
Tails: Print on Printer 2 first and then on Printer 1.

For each document, measure the printing time, and compare.



2.

a. Randomly divide your 150 volunteers into two groups. One way to do this would be to put each volunteer's name on a slip of paper, put the papers into a box, and begin drawing them out. The first 75 names selected would be in group A, and the other 75 would be in group B. Alternatively, you could flip a coin for each volunteer. If it came up heads, the volunteer goes into group A; if tails, the volunteer goes into group B. The second method would likely result in unequal size groups.

Administer one group the new medication (treatment group), and administer the old medication to the other group (control) for a period of time. After enough time has passed, have each volunteer evaluated for reduction in the symptoms of depression. Compare the two groups.

b. Because we know that being in therapy can affect the symptoms of depression, block by having the 60 people who have been in therapy be in one block and the 90 who have not been in therapy be in the other block. Then, within each block, conduct an experiment as described in part (a).

3.

a. It is an observational study. The researcher is not controlling the treatments to the two different groups in the study. Rather, the groups are self-selected based on where they bought their mattresses. The researcher has simply observed and recorded outcomes. In an experiment, the researcher would have had control over which volunteers slept on which mattress.

b. A confounding variable would be a variable that differentially affects one group of buyers more than the other. For example, a possible confounding variable might be that people who buy their mattresses at an upscale location are better off financially than those who buy for economy. They might be more content and less stressed as a group, and this could affect the quality of their sleep.

c. No. You cannot infer a cause-and-effect relationship from an observational study because of the possible presence of confounding variables as described in (b). All you know is that the groups experienced different qualities of sleep. You do not know why.

4. Approximately 4 out of 5 students that the professor interviews are not able to participate in the program. This means,

P(Student is not able to participate) = 4/5 = 0.80
P(Student is able to participate) = 1/5 = 0.20

(a) To simulate the situation, consider ten 1-digit random numbers 0, 1, 2, 3, 4, 5, 6, 7, 8, 9.

Designate them as follows:

- Assign "0, 1" to "Student is able to participate."
- Assign "2, 3, ..., 9" to "Student is not able to participate."

Start at the beginning of the table and read random numbers consecutively, one number for each student contacted. Numbers 0 or 1 mean that the student contacted is able to participate in the program, while numbers 2 through 9 mean the student contacted is not able to participate in the program. Continue until 3 students who are able to participate in the program are found.

(b) Suppose we start the first simulation at the beginning of the table.

25211	75049	70678	24646	96329	63547	37255	51013	25211	75049

Our first simulation results in interviewing 8 students before finding 3 students who are able to participate in the program.

Suppose we start the second simulation at the beginning of the second line.

97077	82384	33078	59574	34916	09422	85700

Our second simulation results in interviewing 24 students before identifying 3 students who are willing to participate in the program.

Note that the answer to this question depends on how the simulation is designed as well as where in the table one starts the simulation.

(c) From the chart, we can see 9 simulations that resulted in interviewing more than 20 students before 3 students were found.

P(Interviewing more than 20 students) = 9/100 = 0.09.

There is a 9 percent chance that the professor will have to interview more than 20 students before he can recruit 3.

5.

(a) This is an observational study, not an experiment. Therefore, causal conclusions are not appropriate from this data.

(b) Recruit a group of patients with high cholesterol levels. Randomly assign the selected patients to two groups. Instruct patients in Group 1 to do specifically assigned exercises regularly. Monitor their exercising activities closely. Instruct patients in Group 2 not to do regular exercises. After one year, measure the cholesterol levels of both groups and compare. In order to avoid confounding factors, make sure that none of the patients are on a cholesterol-reducing diet or medicine.

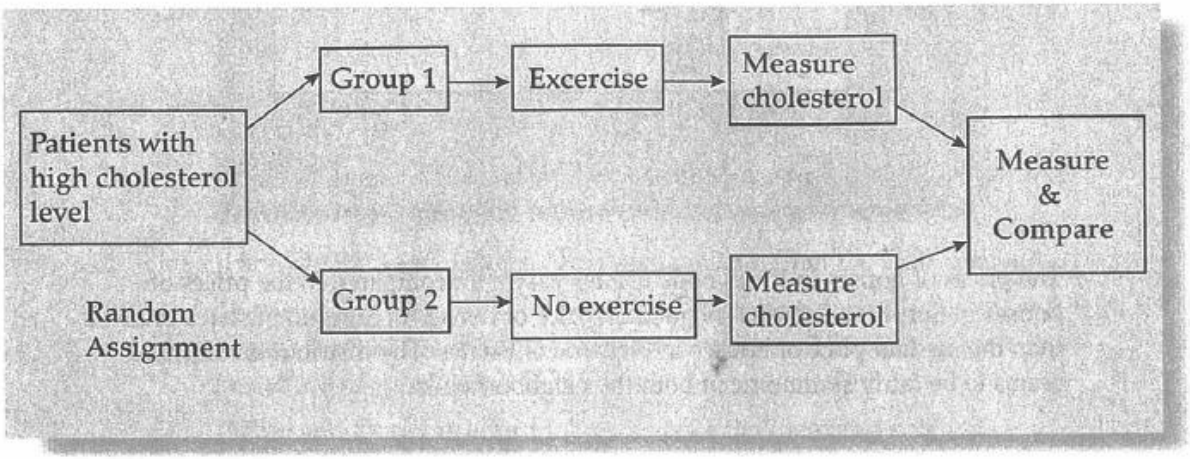


Figure 3: Schematic diagram showing the design of this experiment

6. a. Assign the numbers 00–47 to represent women who walk (W). The numbers 48–99 will represent women who do not walk (N). Start in the upper-left-hand corner of the table, examine every two digits, and record the category of the two-digit number. Move across the table until ten distinct two-digit numbers are examined and record your results. Ignore repeats. This constitutes one trial. Repeat many times and obtain an average.

b.

Trial 1: 6 walkers
N W N W W W W N N W
69|16|5 0|12|10| 02|15|6 3|84|25

Trial 2: 7 walkers
02|21|6 9|00|78| 41|06|1 0|24|63

Trial 3: 7 walkers
40|37|4 1|32|98| 80|18|8 2|19|06

Trial 4: 6 walkers
44|49|4 0|10|96| 29|95|0 1|63|06

Trial 5: 3 walkers
92|25|5 7|51|70| 57|40|0 0|91|91

Trial 6: 4 walkers
80|52|2 0|92|35| 86|38|6 7|80|07

Trial 7: 5 walkers
47|00|7 7|28|48| 02|84|6 4|66|33

Trial 8: 3 walkers
41|90|6 5|93|57| 03|93|3 1|94|73

Trial 9: 5 walkers
37|48|3 0|17|69| 76|26|7 7|83|40

Trial 10: 6 walkers
52|43|5 8|58|22| 33|41|5 9|46|02

Trial 11: 5 walkers
99|49|9 4|21|95| 24|36|0 0|67|06

Trial 12: 5 walkers
10|94|8 3|42|68| 66|14|4 1|03|75

Trial 13: 7 walkers
39|83|2 8|54|09| 14|23|9 6|14|05

Trial 14: 4 walkers
40|86|6 1|70|83| 53|18|9 1|09|01

Trial 15: 2 walkers
62|92|6 8|53|04| 64|06|7 5|61|77

Trial 16: 5 walkers
69|22|1 4|12|00| 84|40|7 4|81|85

Trial 17: 4 walkers
96|36|1 0|94|04| 60|25|5 5|69|96

Trial 18: 6 walkers
41|69|6 8|44|81| 27|38|8 8|21|25

Trial 19: 5 walkers
64|09|1 8|17|60| 78|18|8 7|60|31

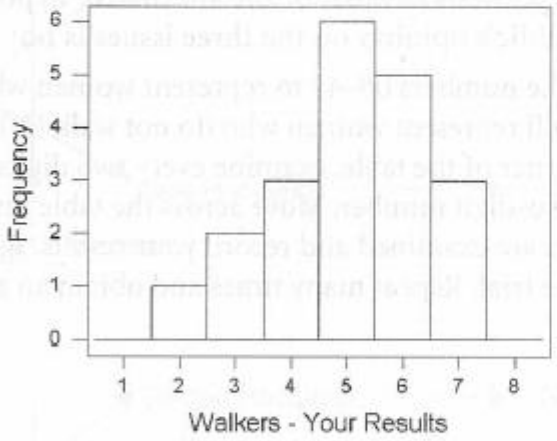
Trial 20: 6 walkers
43|48|3 8|19|28| 05|94|5 9|37|58

49307 66038 23405 10343

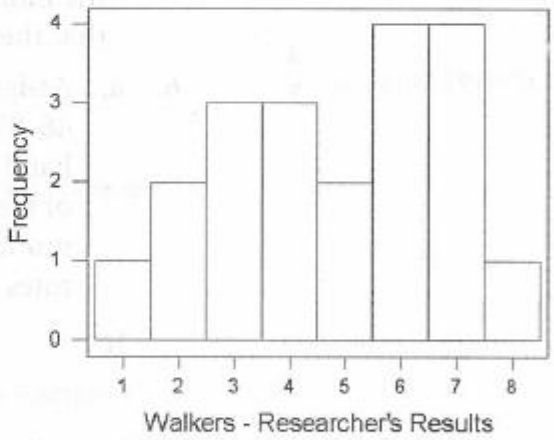
c.

Number of Walkers	Frequency
1	0
2	1
3	2
4	3
5	6
6	5
7	3
8	0

d. Your Results



Researcher's Results



e. Both distributions are somewhat skewed left. The distribution of the simulation results is unimodal, with a high peak at the value of 5. Both distributions have a median value of 5. The spread from the simulation is less than that from the researcher. The range of values from the simulation is 5, while the range from the researcher's results is 7.

Note: Other comparative displays like parallel boxplots and comparative dotplots would be acceptable solutions to part (d); however, a scatterplot is NOT appropriate for these data sets since the data involve only one variable.

7.

a. This experiment lacks randomization. There will most likely be a confounding variable of the learning curve of the vaulter. Since the student is only beginning to learn how to vault, his first vaults will most likely be for much lower heights than his later vaults. Therefore, the manufacturer cannot truly attribute the increased height to the pole. It may instead be due to experience.

b. To improve upon the design, for the 50 vaults, the student uses a random method to choose the type of pole to use. In this manner, randomization is introduced into the experiment, and the experience factor is most likely removed.

c. We should use a block design, with the blocks defined by pole length. Within each group of vaulter(s), the vaulter should use a random method to choose which type of pole to use for each vault. Heights should be recorded, and after the vaults are completed, the results between the new type of pole and the old should be compared.

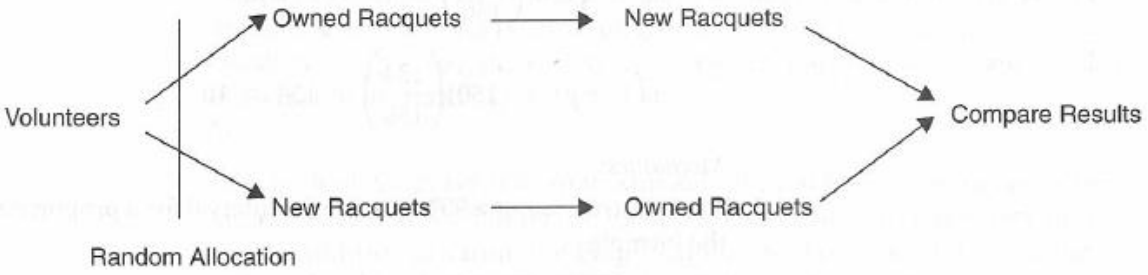
8.

a. This design is part observational study and part experiment. There are many possible confounding and lurking variables. Confounding variables may include that students not receiving the rewards may work harder as a form of protest; movie tickets may be a social stressor for those without dates and may actually not be a reward at all if someone does not like movies; courses taken in two different years may have differing degrees of difficulty and result in different GPAs. Lurking variables include the intrinsic motivation of students who simply enjoy getting good grades as well as other rewards that may be provided by the classroom teacher as the normal course of action in the class.

b. Randomly allocate the students to two groups: one to receive the reward and the other not. Allow students in the reward group to choose from a wide selection of rewards. At the end of the first semester, compare the mean GPAs from both groups. Because the students were randomly assigned to the groups, we expect the groups to have similar GPA distributions. This design is now a true comparative experiment; it does not rely on last year's GPAs and the design will remove most of the confounding variables.

9.

a. The best design is matched-pairs. Randomly choose whether each volunteer should start with his/her own racquet or the new racquet. Serve balls to the volunteers, recording how many balls are returned. Then, have the volunteers switch racquet types. Serve balls again, and again record how many balls are returned.



b. A matched-pairs design is still appropriate. Since men and women may respond differently to exercise equipment, first block by gender.