**Additional Free Response**
**(These aren't past AP questions)**

1.

A company executive is interested in purchasing printers for his division. He contacts a wholesaler, who shows him two printers comparable in quality and price made by two different manufacturers. Both printers are suitable for the kind of printing generally done in his division. To help him decide between these two printers, the wholesaler offers to loan him a printer of each kind for one day. Since the printers' printing time per page depends on the type of document printed, the executive selects 25 different documents of varying size and complexity for printing. Help this executive design an experiment to compare the mean printing times of the two printers.

2.

It is known that the symptoms of adult depression can be treated effectively with either therapy, antidepressants, or a combination of the two. A pharmaceutical company wants to test a new antidepressant against an older medication that has been on the market for several years. One hundred fifty volunteers who have been diagnosed with depression, and who have not been taking any medication for it, are available for the study. This group contains 72 men and 78 women. Sixty of the volunteers have been in therapy for their depression for at least 3 months.

a. Design a completely randomized experiment to test the new medication. Include a brief explanation of the randomization process.
b. Could the experiment you designed in part (a) be improved by blocking? If so, design an improved study that involves blocking. If not, explain why not.

3.

A sleep researcher wants to know if people get a better quality sleep on expensive mattresses than on economy mattresses. The researcher obtains 125 volunteers for the study. Eighty of the volunteers purchased their mattresses at EconoSleep, a heavily advertised store that caters to working families, and the other 45 bought their mattresses at Night of Luxury, an upscale sleep store. The 125 volunteers were given a questionnaire to determine the quality of sleep on each mattress. The responses were then compared and a report was prepared comparing the two type of mattresses.

a.  Is this an experiment or an observational study? Explain.
b.  Explain what is meant by a confounding variable in the context of this study. Give an example of a possible confounding variable.
c.  Suppose the report concluded that people who bought their mattresses from Night of Luxury slept better than those who bought their mattresses from EconoSleep. Could you conclude that the difference was attributable to the quality of the mattresses in the study? Explain.

4.  An education professor is interested in getting students involved in a tutoring program for area schools. The participating students are paid through a grant from the city. This year, the city has agreed to provide funds to support three students in this program. The professor has found that about 4 out of 5 students that he interviews are not willing to participate in the program due to other commitments.

(a) Describe how you would use a random number table to carry out simulations to determine the number of students the professor needs to interview to fill the three spots in the tutoring program. Describe what each random number represents in your simulation.

(b) Run two trials of your simulation. Use the random number table provided to illustrate your simulation.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 25211 | 75049 | 70678 | 24646 | 96329 | 63547 | 37255 | 51013 | 25211 | 75049 |
| 97077 | 82384 | 33078 | 59574 | 34916 | 09422 | 85700 | 74202 | 97077 | 82384 |
| 82641 | 66179 | 30341 | 40674 | 51778 | 97680 | 84707 | 88808 | 82641 | 66179 |
| 60675 | 60254 | 16308 | 70130 | 29610 | 27658 | 94288 | 88752 | 60675 | 60254 |
| 53860 | 97861 | 34625 | 85190 | 38477 | 60503 | 34561 | 04360 | 53860 | 97861 |

(c) Suppose the professor did 100 simulations to estimate the number of students that he needs to interview to find 3 students willing to work for the tutoring program. The results of the simulations are shown below.
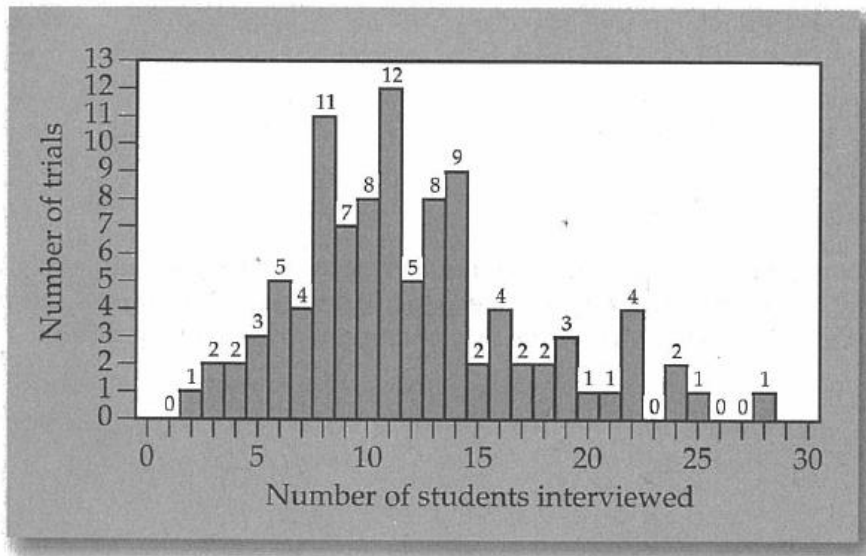


Estimate the probability that the professor has to interview more than 20 students before he finds 3 willing to work for the tutoring program.

5.  A resident at a medical college was interested in showing that exercising regularly helps reduce cholesterol levels. Over a period of one month, he selected a random sample of 50 patients who came to his clinic for their annual physical examination. He asked the patients if they exercised regularly, and noted down the answers as "Exercises regularly" or "Does not exercise regularly." He also recorded their current cholesterol levels and their cholesterol levels from the previous year's physical examination, as noted in their medical records. He summarized the data on their cholesterol levels as shown in the table below.

| | Excercises regularly | | Does not excercise regularly | |
|---|---|---|---|---|
| | Last year | This year | Last year | This year |
| Number of patients | 18 | 18 | 32 | 32 |
| Mean | 223.80 | 189.75 | 268.35 | 265.53 |
| Standard deviation | 15.88 | 18.77 | 32.81 | 28.17 |
| Difference in mean cholesterol levels (Last year – this year) | 34.05 | | 2.82 | |

(a) The resident included the following in his report:

"On the average, the group that exercises regularly has experienced a larger decrease in cholesterol level as compared to the group that does not exercise regularly. Since the observed difference is considerably large, we can conclude that exercising regularly reduces cholesterol level."

Why is such a causal conclusion not warranted by this data? Explain your answer.

(b) Design an experiment that will allow the resident to draw such a conclusion.

6. About 48% of U.S. women of all ages engage in walking for physical activity.

   a. Explain *how* you would conduct a simulation using the random-number table displayed in part (b) to estimate the number of walkers from a sample of 10 women.

   b. Perform your simulation 20 times. Start at the leftmost digit in the first row and move across. By marking directly on or above the table, make your procedure clear enough that someone else can follow what you did. Record the number of walkers for each of your trials.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 69165 | 01210 | 02156 | 38425 | 02216 | 90078 | 41061 | 02463 | 40374 | 13298 | 80188 | 21906 |
| 44494 | 01096 | 29950 | 16306 | 92255 | 75170 | 57400 | 09191 | 80522 | 09235 | 86386 | 78007 |
| 47007 | 72848 | 02846 | 46633 | 41906 | 59357 | 03933 | 19473 | 37483 | 01769 | 76267 | 78340 |
| 52435 | 85822 | 33415 | 94602 | 99499 | 42195 | 24360 | 06706 | 10948 | 34268 | 66144 | 10375 |
| 39832 | 85409 | 14239 | 61405 | 40866 | 17083 | 53189 | 10901 | 62926 | 85304 | 64067 | 56177 |
| 69221 | 41200 | 84407 | 48185 | 96361 | 09404 | 60255 | 56996 | 41696 | 84481 | 27388 | 82125 |
| 64091 | 81760 | 78188 | 76031 | 43483 | 81928 | 05945 | 93758 | 49307 | 66038 | 23405 | 10343 |
| 94975 | 14597 | 66416 | 01014 | 05406 | 65230 | 00456 | 62101 | 94834 | 35086 | 99930 | 75912 |

c. From your results, create a frequency table showing the number of women who walk.

d. Another researcher collected 20 random samples of size 10 and recorded the number of women who walk for physical activity.

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

Create an appropriate graphical display of the researcher's data *and* the data from *your* simulation so that the two data sets can be compared.

e. Write a few sentences comparing the two data sets. Use your display from part (d).

7.

A manufacturer has created a pole from a new material and believes that pole-vaulters can improve the heights of their vaults by using this new type of pole.

a.  In order to test this hypothesis, the manufacturer visits Kennett High School. He selects a student who is new to vaulting. He records a sample of 25 vaults where the student uses a pole made from the customary material. Then he records a sample of 25 vaults where the student uses a pole constructed from the new material. He analyzes the data and finds a significant improvement in heights with the new pole. Comment on the design of this experiment.

b.  Could you improve upon the design of the experiment in part (a)? If you answer yes, describe *your* design.

c.  As pole-vaulters improve their performances, longer poles become a necessity. Describe an experiment to test the new material that takes different pole lengths into account.

8.

A high school administrator wants to determine whether positive reinforcement improves student performance. A group of students is randomly selected from the high school population. Their last year's records are examined for their GPAs. Beginning the first day of the school year and continuing through the first semester, the selected students receive a reward (free movie tickets) whenever they pass a major test. At the end of the first semester, their GPAs for the semester are calculated and compared with the last year's GPAs.

a. Comment on this design.

b. Suggest an improved design.

9.

A tennis racquet manufacturer has designed a new racquet. The manufacturer claims the new racquet will allow the user to return more serves than any racquet currently sold. A group of male volunteers who currently play tennis and own their own racquets agree to participate in the study.

a. Design an experiment that would test the manufacturer's claim.

b. Suppose the volunteer group had included both men and women. Would you adjust the design of your experiment? If so, provide the new design.