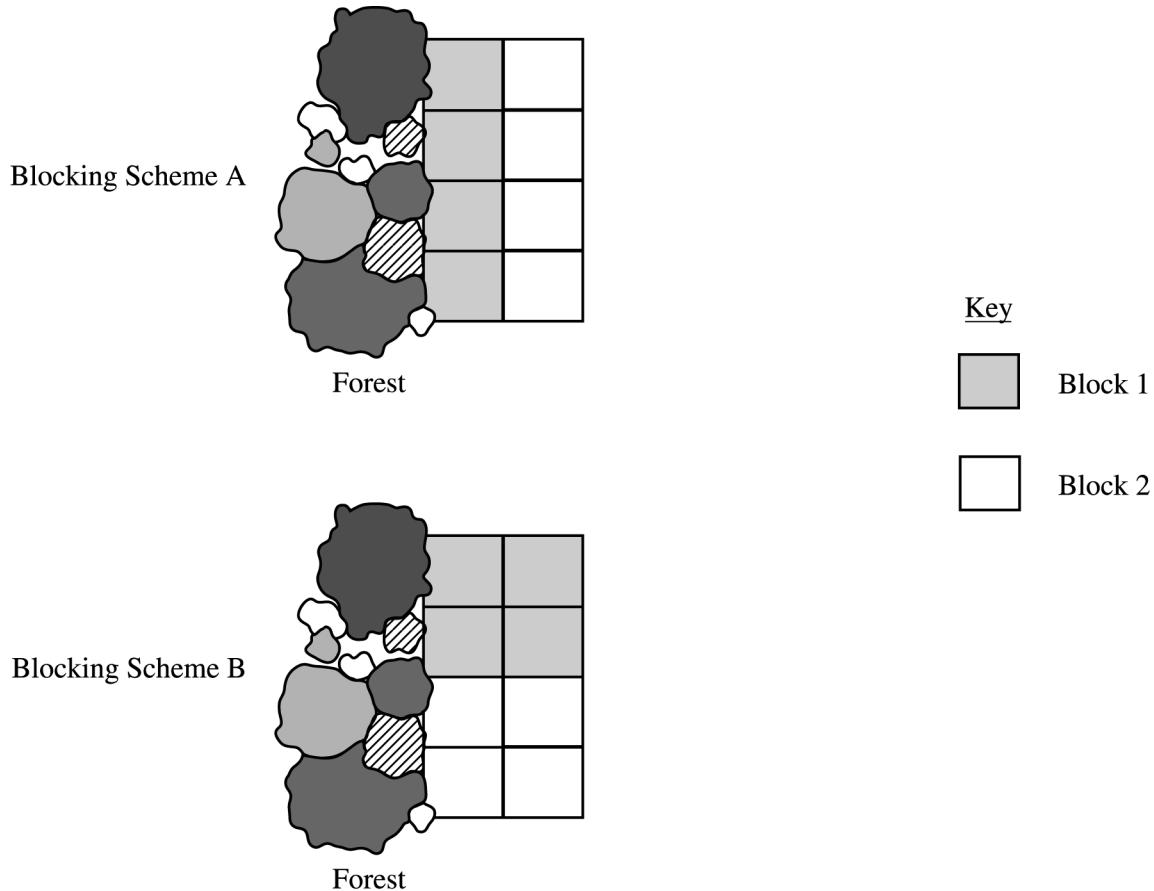


2001 AP® STATISTICS FREE-RESPONSE QUESTIONS

4. Students are designing an experiment to compare the productivity of two varieties of dwarf fruit trees. The site for the experiment is a field that is bordered by a densely forested area on the west (left) side. The field has been divided into eight plots of approximately the same area. The students have decided that the test plots should be blocked. Four trees, two of each of the two varieties, will be assigned at random to the four plots within each block, with one tree planted in each plot.

The two blocking schemes shown below are under consideration. For each scheme, one block is indicated by the white region and the other block is indicated by the gray region in the figures.



- Which of the blocking schemes, A or B, is better for this experiment? Explain your answer.
- Even though the students have decided to block, they must randomly assign the varieties of trees to the plots within each block. What is the purpose of this randomization in the context of this experiment?

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5. A growing number of employers are trying to hold down the costs that they pay for medical insurance for their employees. As part of this effort, many medical insurance companies are now requiring clients to use generic brand medicines when filling prescriptions. An independent consumer advocacy group wanted to determine if there was a difference, in milligrams, in the amount of active ingredient between a certain “name” brand drug and its generic counterpart. Pharmacies may store drugs under different conditions. Therefore, the consumer group randomly selected ten different pharmacies in a large city and filled two prescriptions at each of these pharmacies, one for the “name” brand and the other for the generic brand of the drug. The consumer group's laboratory then tested a randomly selected pill from each prescription to determine the amount of active ingredient in the pill. The results are given in the following table.

ACTIVE INGREDIENT
(in milligrams)

Pharmacy	1	2	3	4	5	6	7	8	9	10
Name brand	245	244	240	250	243	246	246	246	247	250
Generic brand	246	240	235	237	243	239	241	238	238	234

Based on these results, what should the consumer group's laboratory report about the difference in the active ingredient in the two brands of pills? Give appropriate statistical evidence to support your response.

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Question 4 - Solution

Part (a):

Blocking scheme A is preferable because it creates homogeneous blocks with respect to forest exposure. That is, plots in the same block have similar exposure to the forest.

Part (b):

Randomization of varieties of trees to the plots within each block should reduce any possible bias due to confounding variables, such as fertility or moisture, on the productivity of the two types of dwarf trees.

OR

Randomization of varieties of trees to the plots within each block should even out (or equalize) the effect of other characteristics of the plots that might be related to the productivity of the trees.

Scoring

**Part (a) is
Essentially correct if:**

A statement that blocking scheme A is preferable

AND

A good explanation that gets at the notion of wanting homogeneous experimental units (plots, not trees) within blocks

Partially correct if

Blocking scheme A is chosen with weak or no explanation

OR

Blocking scheme B is chosen and the student clearly demonstrates an understanding that trees of both varieties should appear in plots bordering the forest, and similarly, trees of both varieties should appear in plots away from the forest.

Note: If a student chooses blocking scheme B and indicates that s/he will create blocks within the blocks to deal with forest exposure as well as north/south exposure, part (a) should be scored as essentially correct.

Note: If a student attempts to describe analysis techniques, these should be considered extraneous and should be ignored.

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Question 4 (cont'd.)

Part (b) is

Essentially correct if

The student clearly **explains** why randomization is important in the **context** of the problem.

Partially correct if

The student understands that randomization reduces bias and explains it in context, but does not make it clear that a non-random assignment may favor one **variety** of tree.

OR

The student has a correct explanation but contextual interpretation is poor or inappropriate.

Incorrect if

The student uses the word bias, confounding, or other general statistical terms, but does not explain the term(s) in context of the problem.

Note: If the student thinks of blocks as treatment groups (receiving partial credit in part (a)), then part (b) must be **logically consistent**. For example, if a student thinks of the shaded region as one treatment group, it is not sufficient to randomize within the shaded region. The student must address the randomization between the blocks (e.g., flip a coin to assign one variety of tree to one of the blocks and the other variety of tree to the other block).

- 4 Complete Response**
Both parts essentially correct

- 3 Substantial Response**
One part essentially correct and one part partially correct

- 2 Developing Response**
One part essentially correct and one part incorrect

OR

Both parts partially correct

- 1 Minimal Response**
One part partially correct and one part incorrect