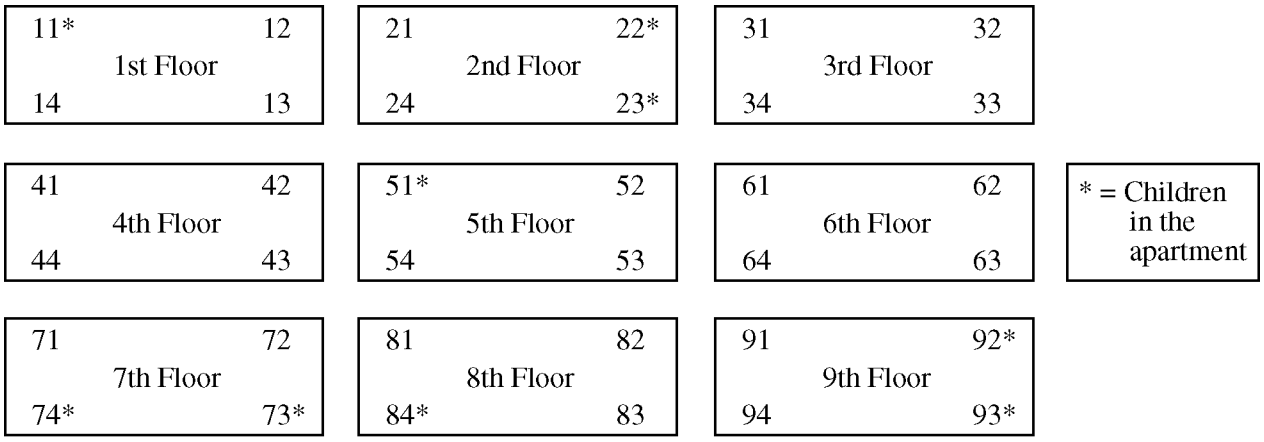
3. An apartment building has nine floors and each floor has four apartments. The building owner wants to install new carpeting in eight apartments to see how well it wears before she decides whether to replace the carpet in the entire building.

   The figure below shows the floors of apartments in the building with their apartment numbers. Only the nine apartments indicated with an asterisk (*) have children in the apartment.



   (a) For convenience, the apartment building owner wants to use a cluster sampling method, in which the floors are clusters, to select the eight apartments. Describe a process for randomly selecting eight different apartments using this method.

   (b) An alternative sampling method would be to select a stratified random sample of eight apartments, where the strata are apartments with children and apartments with no children. A stratified random sample of size eight might include two randomly selected apartments with children and six randomly selected apartments with no children. In the context of this situation, give one statistical advantage of selecting such a stratified sample as opposed to a cluster sample of eight apartments using the floors as clusters.

4. High cholesterol levels in people can be reduced by exercise, diet, and medication. Twenty middle-aged males with cholesterol readings between 220 and 240 milligrams per deciliter (mg/dL) of blood were randomly selected from the population of such male patients at a large local hospital. Ten of the 20 males were randomly assigned to group A, advised on appropriate exercise and diet, and also received a placebo. The other 10 males were assigned to group B, received the same advice on appropriate exercise and diet, but received a drug intended to reduce cholesterol instead of a placebo. After three months, posttreatment cholesterol readings were taken for all 20 males and compared to pretreatment cholesterol readings. The tables below give the reduction in cholesterol level (pretreatment reading minus posttreatment reading) for each male in the study.

Group A (placebo)

Reduction (in mg/dL)	2	19	8	4	12	8	17	7	24	1

Mean Reduction: 10.20 Standard Deviation of Reductions: 7.66

Group B (cholesterol drug)

Reduction (in mg/dL)	30	19	18	17	20	−4	23	10	9	22

Mean Reduction: 16.40 Standard Deviation of Reductions: 9.40

Do the data provide convincing evidence, at the $\alpha = 0.01$ level, that the cholesterol drug is effective in producing a reduction in mean cholesterol level beyond that produced by exercise and diet?

AP® STATISTICS
2011 SCORING GUIDELINES

Question 3

Intent of Question

The primary goals of this question were to assess students' ability to (1) describe a process for implementing cluster sampling; (2) describe a statistical advantage of stratified sampling over cluster sampling in a particular situation.

Solution

Part (a):

The following two-step process can be used to select the eight apartments.

Step 1: Generate a random integer between 1 and 9, inclusive, using a calculator, a computer program, or a table of random digits. Select all four apartments on the floor corresponding to the selected integer.
Step 2: Generate another random integer between 1 and 9, inclusive. If the generated integer is the same as the integer generated in step 1, continue generating random integers between 1 and 9 until a different integer appears. Again select all four apartments on the floor corresponding to the second selected integer.

The cluster sample consists of the eight apartments on the two randomly selected floors.

Part (b):

Because the amount of wear on the carpets in apartments with children could be different from the wear on the carpets in apartments without children, it would be advantageous to have apartments with children represented in the sample. The cluster sampling procedure in part (a) could produce a sample with no children in the selected apartments; for example, a cluster sample of the apartments on the third and sixth floors would consist entirely of apartments with no children. Stratified random sampling, where the two strata are apartments with children and apartments without children, guarantees a sample that includes apartments with and without children, which, in turn, would yield sample data that are representative of both types of apartments.

Scoring

Parts (a) and (b) are scored as essentially correct (E), partially correct (P) or incorrect (I).

Part (a) is scored as follows:

Essentially correct (E) if the response correctly addresses the following two components:
1. Indication that two floors are randomly selected, with all four apartments on each of the selected floors forming the sample (or that the entire floors should be carpeted).
2. Description of a valid random sampling procedure for selecting two floors that could be implemented after reading the response (so that two knowledgeable statistics users would use the same method to select the floors).

Partially correct (P) if the response includes exactly one of the two components listed above.

Question 3 (continued)

Incorrect (I) if the response includes neither of the two components listed above *OR* the response does not involve taking a random sample of two floors out of the nine.

Note: Some possible errors in component 2 include the following:
- Using 10 random digits rather than nine
- Failing to explicitly deal with the issue of potentially repeated random numbers

Part (b) is scored as follows:

Essentially correct (E) if the response indicates the following two components:

1. The amount of carpet wear could be different for apartments with and without children.
2. The stratified random sample ensures that some apartments with children will be selected.

Partially correct (P) if the response includes exactly one of the two components listed above.

Incorrect (I) if the response fails to meet the criteria for E or P.

Notes
- If the response in part (b) says that this stratified sampling method guarantees proportional representation of apartments with and without children, then the second component is satisfied.
- If the sampling procedure in part (a) divides the floors into two groups — those that have apartments with children and those that do not ("prestratification") — and then selects one floor from each group, score part (b) based on the degree to which a statistical advantage of the stratified sampling in part (b) is addressed.

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

Two parts partially correct

1 Minimal Response

One part partially correct and one part incorrect