Question 2

Intent of Question

The primary goals of this question were to assess students' ability to (1) describe a simple random sampling procedure; (2) identify an effective stratification variable; (3) provide a statistical advantage of a stratified random sample over a simple random sample in context.

Solution

Part (a):

The administrators could number an alphabetical list of students from 1 to 2,500. They could then use a random number generator from a calculator or computer to generate 200 unique random integers from 1 to 2,500. The students corresponding to those 200 numbers would be asked to participate in the survey.

Part (b):

One possible stratification variable might be the school level of the student (elementary, middle, high school). The students' perceptions of the importance of good nutrition in food served may differ depending on the students' ages and therefore on school levels. For example, there may be a difference between what elementary students value in food served as opposed to middle school and high school students.

Part (c):

One statistical advantage of using stratified random sampling as opposed to simple random sampling is, for example, if the elementary, middle and high school strata create groups that differ with respect to what they value — and are therefore more homogeneous with respect to opinion on this issue — then for the same overall sample size a more accurate estimate of the overall proportion of students who are satisfied with the food under this contract may result. Another advantage is that stratified random sampling guarantees that each of the school-level strata will have some representation, because it is possible that a simple random sample would miss one or more of the strata completely.

Scoring

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

Part (a) is scored as follows:

Essentially correct (E) if the response describes a sampling procedure for generating a simple random sample and the description of the sampling procedure includes sufficient detail for implementation.

Partially correct (P) if random selection is used correctly for generating a simple random sample, but the description of the sampling procedure does not provide sufficient detail for implementation.

Incorrect (I) if random selection is not used in a correct way for a simple random sample.

Note: A response in which objects are placed into a hat or a box and then drawn out can only earn an "E" if the response explicitly states that the objects are mixed or that they are drawn out at random.

Part (b) is scored as follows:

Essentially correct (E) if the response identifies a reasonable stratification variable and provides a reasonable justification in context (such as stating, "the groups (strata) might differ *with respect to food preferences or nutritional awareness*").

Partially correct (P) if the response identifies a reasonable stratification variable but provides a weak justification (such as stating only, "the groups (strata) differ").

Incorrect (I) if the response identifies an unreasonable stratification variable, or provides an unreasonable justification or no justification.

Part (c) is scored as follows:

Essentially correct (E) if the response provides a reasonable statistical advantage of stratified random sampling that is not also true of random sampling, and that is clearly communicated and in context.

Partially correct (P) if the response provides a reasonable statistical advantage that is either not well communicated or that is not in context.

Incorrect (I) if the response includes only a vague potential statistical advantage, such as "data more accurate" or "stratified random sampling is better."

Note: Responses to part (c) such as "stratified random sampling allows for inferences to be drawn for the three grade levels separately about the feelings of students in those grade levels" should be considered incorrect unless also accompanied by a statistical advantage specific to stratified random sampling.

4   Complete Response

All three parts essentially correct

3   Substantial Response

Two parts essentially correct and one part partially correct

2   Developing Response

Two parts essentially correct and one part incorrect

OR

One part essentially correct and one or two parts partially correct

OR

Three parts partially correct

1   Minimal Response

One part essentially correct and two parts incorrect

OR

Two parts partially correct and one part incorrect

2. In response to nutrition concerns raised last year about food served in school cafeterias, the Smallville School District entered into a one-year contract with the Healthy Alternative Meals (HAM) company. Under this contract, the company plans and prepares meals for 2,500 elementary, middle, and high school students, with a focus on good nutrition. The school administration would like to survey the students in the district to estimate the proportion of students who are satisfied with the food under this contract.

Two sampling plans for selecting the students to be surveyed are under consideration by the administration. One plan is to take a simple random sample of students in the district and then survey those students. The other plan is to take a stratified random sample of students in the district and then survey those students.

(a) Describe a simple random sampling procedure that the administrators could use to select 200 students from the 2,500 students in the district.

Assign a number to each of the 2500 students in the district from 1~2500. Then use a computer to generate 200 random numbers from 1~2500 and find corresponding student who has the same number. This will create a simple random sample of 200 students from the district.

(b) If a stratified random sampling procedure is used, give one example of an effective variable on which to stratify in this survey. Explain your reasoning.

An example of an effective variable to stratify this survey would be by age groups or simply by elementary, middle and high school. This is because people of different age may like different type of food, which would affect how satisfied an individual may be with the food. To eliminate the other variables in food satisfaction such as maturity and level of awareness, group students the survey can with students. similar

(c) Describe one statistical advantage of using a stratified random sample over a simple random sample in the context of this study.

An statistical advantage of using a stratified random sample over simple random sample in this context is the elimination of lurking variable that will effect the outcomes of this survey. Different people of different age group have different awareness of food nutrition, say for a high school student that is important, but for an elementary student that may not be so all they care about is tasting good. This will effect how they answer the question of satisfication where she says nutrition is satification or tasty is satification. The elimination of these variables through grouping people with some knowledge regarding health is useful in making accurate conclusion

GO ON TO THE NEXT PAGE.

2B

2. In response to nutrition concerns raised last year about food served in school cafeterias, the Smallville School District entered into a one-year contract with the Healthy Alternative Meals (HAM) company. Under this contract, the company plans and prepares meals for 2,500 elementary, middle, and high school students, with a focus on good nutrition. The school administration would like to survey the students in the district to estimate the proportion of students who are satisfied with the food under this contract.

Two sampling plans for selecting the students to be surveyed are under consideration by the administration. One plan is to take a simple random sample of students in the district and then survey those students. The other plan is to take a stratified random sample of students in the district and then survey those students.

(a) Describe a simple random sampling procedure that the administrators could use to select 200 students from the 2,500 students in the district.

The administrators could use random number table. Each student would have each numbe from 0001 to 2500, excluding repeats of numbers they choose first 200 ~~numbers~~ ~~students~~ out of that are the numbers of the students.

(b) If a stratified random sampling procedure is used, give one example of an effective variable on which to stratify in this survey. Explain your reasoning.

Students can be stratified by the elementary, middle and high school student. This can help to divide students by more or less equal groups with equal physical situation, age or other factors that differ children.

(c) Describe one statistical advantage of using a stratified random sample over a simple random sample in the context of this study.

Stratified random sample helps the administrators to make ~~equal~~ more or less homogeneous blocks of students and choose the equal number of representatives from each group. So the ~~conclusion will be~~ whereas simple random sample could allow as ease where there was not any students from high school for example, so the conclusion would be distorted.

GO ON TO THE NEXT PAGE.

-8-

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2. In response to nutrition concerns raised last year about food served in school cafeterias, the Smallville School District entered into a one-year contract with the Healthy Alternative Meals (HAM) company. Under this contract, the company plans and prepares meals for 2,500 elementary, middle, and high school students, with a focus on good nutrition. The school administration would like to survey the students in the district to estimate the proportion of students who are satisfied with the food under this contract.

Two sampling plans for selecting the students to be surveyed are under consideration by the administration. One plan is to take a simple random sample of students in the district and then survey those students. The other plan is to take a stratified random sample of students in the district and then survey those students.

(a) Describe a simple random sampling procedure that the administrators could use to select 200 students from the 2,500 students in the district.

Number all 2500 students from 1 to 2500.
Using a random number generator, generate 200 numbers ranging from 1 to 2500.
Students whose assigned numbers are generated from the random number generator are selected to take the survey.

(b) If a stratified random sampling procedure is used, give one example of an effective variable on which to stratify in this survey. Explain your reasoning.

Age group. The students can be stratified into elementary school, middle school and high school students, which can be significant as students from different age groups may like to eat different kinds of food.

(c) Describe one statistical advantage of using a stratified random sample over a simple random sample in the context of this study.

By using a stratified random sample, the school can find out how the students from the different strata respond to the food, and see if the students' responses differ according to the strata, or example age group. The school can find out if students from elementary, middle and high school differ in their satisfaction with the food.

GO ON TO THE NEXT PAGE.

Question 2

Sample: 2A
Score: 4

In part (a) the student assigns a number to each of the 2,500 students in the district, then proposes to use a computer to generate 200 random numbers to identify the students to be selected in the simple random sample. This proposed procedure can be implemented given access to the random number generator on a computer. The student identifies school level as an effective variable on which to stratify in part (b) and then explains that the students at different levels may vary in food satisfaction owing to maturity and level of awareness. In part (c) the student states that the "lurking variable" of school level would be eliminated by stratifying, when in fact differences in food satisfaction according to school level are modeled, not eliminated. The student recognizes that grouping students into strata according to knowledge regarding health can help to provide accurate conclusions. Parts (a), (b) and (c) were all scored as essentially correct. The entire answer, based on all three parts, was judged a complete response and earned a score of 4.

Sample: 2B
Score: 3

In part (a) the student proposes to use a random number table to identify which of the 2,500 students in the school district will be selected for the simple random sample. The student carefully numbers each member of the population, using four digits to ensure that they are equally likely to be selected. It is true that school level is an example of an effective variable on which to stratify, as requested in part (b), but the response fails to link the variable to students' opinions about satisfaction with the food under this contract. The response in part (c) describes the possibility of missing all of the students from one of the three school buildings. Parts (a) and (c) were scored as essentially correct, but part (b) was scored as only partially correct. The entire answer, based on all three parts, was judged a substantial response and earned a score of 3.

Sample: 2C
Score: 2

In the solution to part (a) the student proposes to number the 2,500 students in the school district and then to use a random number generator to select 200 students at random. This procedure will yield a simple random sample of the students in the district. In part (b) the student identifies an effective variable on which to stratify and notes that students in the different school levels may like to eat different kinds of food. In part (c) the student fails to notice that a simple random sample is also likely to provide information about how students in the different strata differ in their satisfaction with the food. Parts (a) and (b) were scored as essentially correct, but part (c) was scored as incorrect. The entire answer, based on all three parts, was judged a developing response and earned a score of 2.