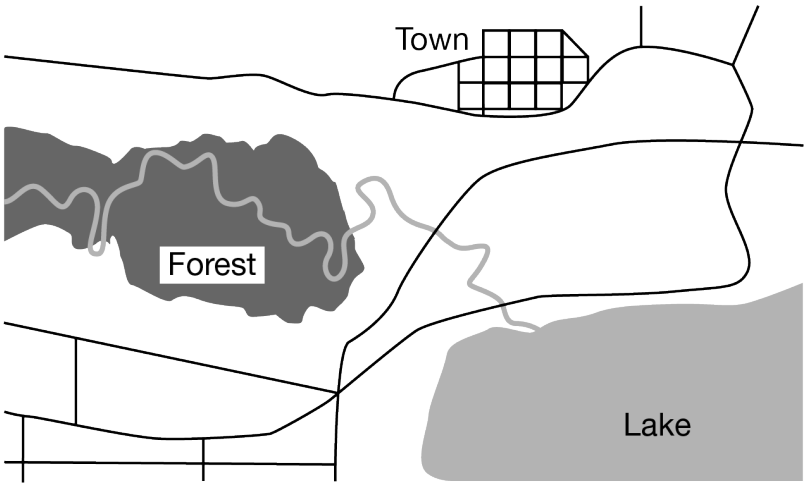
Random Sampling and Data Collection Quiz

1. Show all your work. Indicate clearly the methods you use, because you will be scored on the correctness of your methods as well as on the accuracy and completeness of your results and explanations.

Biologists want to estimate the number of deer living in a certain region. They will use a method known as a hair snare. A hair snare is a length of barbed wire set up near a salt lick, where deer can lick minerals and nutrients from salt deposits. The wire snares hair from the neck of the deer. The hair is collected and sent for analysis.

The biologists will randomly place 90 salt licks throughout the region. The region consists of 3 areas: the town, the forest, and the lake, as shown in the following diagram.



(a) Two methods have been proposed for choosing where to place the salt licks: a simple random sample or a stratified random sample, with area as strata. Give one reason why the stratified random sample might be the better method for choosing where to place the salt licks.

(b) By using the hair snare method, deer are sampled with replacement. Why is sampling with replacement a problem in this context, and how would the problem impact the estimate of the number of deer living in the region?

Part A and B

The primary goals of this question are to assess a student's ability to (1) describe an advantage to selecting a stratified sample and (2) identify the distinction between sampling with/without replacement.

Scoring

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

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0	1	2	3	4 ✓

Both parts essentially correct

- [ ] Part (a) essentially correct
- [ ] Part (a) partially correct
- [ ] Part (a) incorrect
- [ ] Part (b) essentially correct
- [ ] Part (b) partially correct
- [ ] Part (b) incorrect

Solution

Part (a):

Deer might prefer forested areas where they feel safe, or prefer to be near water where they can drink. Deer might also avoid populated areas, such as a town. Due to these factors, the deer population could be very different in the three areas of the region. Stratifying by area ensures that all three regions will be represented in the placement of the salt licks. A simple random sample of location does not ensure adequate representation of the three areas.

Scoring

Part (a) is scored as follows:

Essentially correct (E) if the response acknowledges that there could be differences in the deer population among the three areas AND that stratifying will allow for a better representation of the deer in the three areas.

Partially correct (P) if the response provides only one of the two components for E.

Incorrect (I) if the response does not meet the criteria for E or P.

Solution

Part (b):

If the same deer are repeatedly recorded but counted as different deer, the estimate of the deer population would be greater than the actual deer population.

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Scoring

Part (b) is scored as follows:

Essentially correct (E) if the response satisfies the following three components:

· Provides a reasonable problem with the same deer being represented multiple times in the sample

· Indicates the estimate of the deer population would differ from the actual population

· Provides a direction for the difference in the estimate (e.g. estimate would be greater)

Partially correct (P) if the response satisfies only 2 of the three components:

Incorrect (I) if the response does not meet the criteria for E or P.

2. A certain county school district has 15 high schools. The high school seniors' plans after graduation in each school vary greatly from one school to the next. The county superintendent will select a sample of high school seniors from the district to survey about their plans after graduation. The superintendent will use a cluster sample with the high schools as clusters. A random sample of 5 high schools will be selected, and all seniors at those high schools will complete the survey. What is one disadvantage to selecting a cluster sample to investigate the superintendent's goal?

(A) Cluster sampling is usually very expensive to implement and could cost the district too much money.

(B) Because every senior in the selected clusters will complete the survey, the sample will be too large to yield accurate results.

(C) The schools in the cluster sample might not be representative of the population of seniors. ✓

(D) There could be seniors absent from school on the day the survey is given, which could affect the results.

(E) There is no disadvantage to using a cluster sample.

Answer C

Correct. Because of the known difference between schools in terms of plans after graduation, the schools not chosen may have seniors that differ in some way from the seniors in schools that are chosen. Therefore, the plans of the students surveyed may not accurately represent the population in the district.

3. To estimate the percent of red marbles in a large bag of marbles, Margo will use the following sampling method. She will randomly select a marble, record its color, put it back into the bag, shake the bag to thoroughly mix the marbles, and then repeat those steps. She will perform the procedure many times. What type of sampling method is Margo using?

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(A) Cluster sampling
(B) Stratified random sampling
(C) Systematic random sampling
(D) Random sampling with replacement ✓
(E) Random sampling without replacement

Answer D

Correct. Each marble selected is randomly selected, so the sampling is random. Since the chosen marble is placed back into the bag before the next selection of a marble, the sampling is done with replacement. Margo is using random sampling with replacement.

4. At a certain clothing store, the clothes are displayed on racks. The clothes on each rack have similar prices, but the prices among the racks are very different. To estimate the typical price of a single piece of clothing, a consumer will randomly select four pieces of clothing from each rack. What type of sample is the consumer selecting?

(A) A census
(B) A cluster sample
(C) A simple random sample
(D) A stratified random sample ✓
(E) A systematic random sample

Answer D

Correct. The pieces of clothing in the store are divided into strata, where each stratum is a rack of clothes having similar prices. The mean price calculated using the randomly selected pieces of clothing from the strata is an example of using a stratified random sample.