AP® STATISTICS
2004 SCORING GUIDELINES

Question 3

Solution

Part (a):

X is not binomial since the trials are not independent and the conditional probabilities of selecting a male change at each trial depending on the previous outcome(s), due to the sampling without replacement.

Part (b):

$$P(X = 4) = \left(\frac{10}{20}\right)\left(\frac{9}{19}\right)\left(\frac{8}{18}\right)\left(\frac{7}{17}\right) = \frac{5040}{116280} = 0.043$$

Part (c):

No. If males and females were equally represented, the probability of observing four males is small (0.043).

Part (d):

No, we can't generalize to the population of all brontosaurs because it is not reasonable to regard this sample as a random sample from the population of all brontosaurs; there is reason to suspect that this sampling method might cause bias.

Scoring

Parts (a), (b), and (c) are scored as essentially correct, partially correct, or incorrect. Part (d) is scored as essentially correct or incorrect.

Part (a): Score as:

Essentially correct if the response indicates that
- (i) trials are not independent, with an explanation that independence means the outcome on any trial will not impact the probability of success on future trials OR
- (ii) the probability of selecting a male on any given trial depends on the results of previous trials.

Partially correct if the response indicates that
- (i) the student is focusing on one of the concepts above, but discussion is weak OR
- (ii) there is sampling without replacement without connection to one of the concepts under Essentially Correct above.

Question 3 (cont'd.)

Part (b): Score as:

Essentially correct if the probability is correctly computed (with minor arithmetic errors being overlooked), with supporting work or rationale. A statement that this is a hypergeometric distribution (either in Part(a) or Part(b)) will suffice. It is OK if the student leaves the answer as the product of fractions. The probability that all four femurs belong to males can also be computed by using the formula $P(X=4)=\dfrac{\binom{10}{4}\binom{10}{0}}{\binom{20}{4}}=.043$.

Partially correct if there is a correct answer (to 3 decimal places) with incomplete justification.

Incorrect if arithmetic errors result in a probability that is negative or greater than one.

Part (c): Score as:

Essentially correct if the probability provided in Part (b) is interpreted correctly.

Partially correct if it is not clear that the student used the probability from Part (b).

Incorrect if just a "Yes" or "No" is given without an explanation.

Part (d): Score as:

Essentially correct if the response indicates that generalization is not possible because this sample

(i) cannot be viewed as a random sample of all brontosaurs OR
(ii) there is reason to suspect that this sample might not be representative of the population at large.

Incorrect if "No" is given without an explanation.

Note: Discussions about conditions for inference are irrelevant.

Each essentially correct response is worth 1 point; each partially correct answer is worth ½ point.

Question 3 (cont'd.)

4 Complete Response

3 Substantial Response

2 Developing Response

1 Minimal Response

IF A PAPER IS BETWEEN TWO SCORES (FOR EXAMPLE, 2½ POINTS) USE A HOLISTIC APPROACH TO DETERMINE WHETHER TO SCORE UP OR DOWN DEPENDING ON THE STRENGTH OF THE RESPONSE AND COMMUNICATION.