

## **2005 AP® STATISTICS FREE-RESPONSE QUESTIONS**

### **STATISTICS SECTION II Part A Questions 1-5**

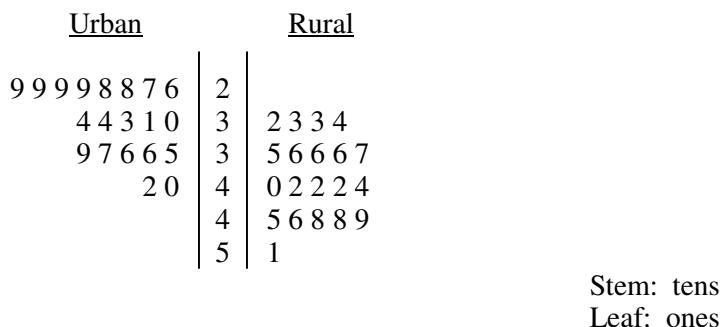
**Spend about 65 minutes on this part of the exam.**

**Percent of Section II grade—75**

**Directions:** Show all your work. Indicate clearly the methods you use, because you will be graded on the correctness of your methods as well as on the accuracy of your results and explanation.

1. The goal of a nutritional study was to compare the caloric intake of adolescents living in rural areas of the United States with the caloric intake of adolescents living in urban areas of the United States. A random sample of ninth-grade students from one high school in a rural area was selected. Another random sample of ninth graders from one high school in an urban area was also selected. Each student in each sample kept records of all the food he or she consumed in one day.

The back-to-back stemplot below displays the number of calories of food consumed per kilogram of body weight for each student on that day.



- (a) Write a few sentences comparing the distribution of the daily caloric intake of ninth-grade students in the rural high school with the distribution of the daily caloric intake of ninth-grade students in the urban high school.
- (b) Is it reasonable to generalize the findings of this study to all rural and urban ninth-grade students in the United States? Explain.
- (c) Researchers who want to conduct a similar study are debating which of the following two plans to use.

Plan I: Have each student in the study record all the food he or she consumed in one day. Then researchers would compute the number of calories of food consumed per kilogram of body weight for each student for that day.

Plan II: Have each student in the study record all the food he or she consumed over the same 7-day period. Then researchers would compute the average daily number of calories of food consumed per kilogram of body weight for each student during that 7-day period.

Assuming that the students keep accurate records, which plan, I or II, would better meet the goal of the study? Justify your answer.

## **2005 AP<sup>®</sup> STATISTICS FREE-RESPONSE QUESTIONS**

2. Let the random variable  $X$  represent the number of telephone lines in use by the technical support center of a software manufacturer at noon each day. The probability distribution of  $X$  is shown in the table below.

$x$	0	1	2	3	4	5
$p(x)$	0.35	0.20	0.15	0.15	0.10	0.05

- (a) Calculate the expected value (the mean) of  $X$ .
- (b) Using past records, the staff at the technical support center randomly selected 20 days and found that an average of 1.25 telephone lines were in use at noon on those days. The staff proposes to select another random sample of 1,000 days and compute the average number of telephone lines that were in use at noon on those days. How do you expect the average from this new sample to compare to that of the first sample? Justify your response.
- (c) The median of a random variable is defined as any value  $x$  such that  $P(X \leq x) \geq 0.5$  and  $P(X \geq x) \geq 0.5$ . For the probability distribution shown in the table above, determine the median of  $X$ .
- (d) In a sentence or two, comment on the relationship between the mean and the median relative to the shape of this distribution.

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**Question 1**

**Solution**

**Part (a):**

The mean (40.45 cal/kg) and median (41 cal/kg) daily caloric intake of ninth-grade students in the rural school are higher than the corresponding measures of center, mean (32.6 cal/kg) and median (32 cal/kg), for ninth-graders in the urban school. There is also more variability or spread in the daily caloric intake for students in the rural school (Range=19, SD=6.04, IQR=10) than in the daily caloric intake for students in the urban school (Range=16, SD=4.67, IQR=7). The shapes of the two distributions are also different. The distribution of daily caloric intake for rural students is more uniformly distributed (symmetric) between 32 cal/kg and 51 cal/kg while the distribution of daily caloric intake for urban students appears to be skewed toward the larger values.

**Part (b):**

No, the samples include students from only one rural and one urban high school so it is not reasonable to generalize the findings from these two schools to all rural and urban ninth-grade students in the United States.

**Part (c):**

Since we are assuming that students keep accurate records, Plan II will do a better job of comparing the daily caloric intake of adolescents living in rural areas with the daily caloric intake of adolescents living in urban areas. Both plans take body weight into account by converting to food consumed per kilogram of body weight. Plan II includes a 7-day period (possibly days in school and days at home on the weekend), and there are differences in caloric intake among days. It would therefore be better to average over the 7-day period rather than considering only the food consumed in one day, as is the case with Plan I. Plan II would provide a more precise estimate of the average daily intake.

**Scoring**

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

**Part (a)** is essentially correct (E) if the student correctly compares center, shape, and spread of the two distributions. Specific numerical values are not required.

Part (a) is partially correct (P) if the student correctly compares any two of the three characteristics (center, shape, or spread) of the two distributions.

Part (a) is incorrect (I) if the student correctly compares no more than one characteristic.