AP® STATISTICS
2006 SCORING GUIDELINES (Form B)

Question 1

Intent of Question

The primary purpose of this question is to assess a student's ability to read, interpret, and explain information contained in a cumulative relative frequency plot for a real estate company.

Solution

Part (a):

This point indicates that 40 percent of the sales agents at this real estate company had sales volume of $300,000 or less in the month shown.

Part (b):

Eighty percent of the sales agents had sales volume of $800,000 or less and 70 percent of the sales agents had sales volume of $700,000 or less. Thus, $0.8 - 0.7 = 0.1$ or 10 percent of the sales agents achieved monthly sales volumes greater than $700,000 and not exceeding $800,000.

Part (c):

There were no agents whose monthly sales volume was between $1,000,000 and $1,100,000.

Part (d):

The 80^{th} percentile for the distribution of monthly sales volume by these agents during the preceding month is $800,000. Therefore, an agent making more than $800,000 will be in the top 20 percent.

Scoring

Parts (a), (c), and (d) 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 both values are correctly identified and interpreted in the appropriate context.

Part (a) is partially correct (P) if incorrect values are read from the plot, but the interpretation is correct OR one of the values is not interpreted correctly in the context of the question.

Part (a) is incorrect (I) if the student fails to recognize the cumulative nature of the graph, for example, the student says 40 percent of the sales agents had a sales volume of $300,000.

Part (b) is essentially correct (E) if 0.1 (or 10 percent) is provided AND work is shown or an appropriate explanation is provided.

Part (b) is incorrect (I) if an answer (0.1, 0.8, or anything else) is provided with no supporting work or explanation.

Question 1 (continued)

Note: Probability statements are OK and work may be provided on the graph.

Alternative solution to Part (b):

Let X represent monthly sales volume (in hundreds of thousands of dollars)

$P(7 < X \leq 8) = P(X \leq 8) - P(X \leq 7) = 0.8 - 0.7 = 0.1$, so 0.1 (or 10 percent) of the sales agents achieved monthly sales volumes greater than \$700,000 and not exceeding \$800,000.

Part (c) is essentially correct (E) if the student indicates that none of the sales agents had a monthly sales volume between \$1 million and \$1.1 million.

Part (c) is partially correct (P) if the student recognizes that no events occurred between 10 and 11 but does not provide a correct description in the context of this problem.

Part (c) is incorrect (I) otherwise, for example, if the student says the number of agents with \$1 million in sales is the same as the number of agents with \$1.1 million in sales, or if the student says that the frequency of sales of \$1 million is the same as the frequency of sales of \$1.1 million.

Part (d) is essentially correct (E) if a minimum monthly sales volume above \$800,000 is identified or the student says anything above \$800,000 will qualify the agent for a bonus AND justification for selecting that value is provided using the complement rule or the graph.

Part (d) is partially correct (P) if the minimum monthly sales volume is specified as \$800,000 with no justification.

Part (d) is incorrect (I) if an incorrect minimum monthly sales volume is specified OR a value is specified without context.

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

4 **Complete Response**

3 **Substantial Response**

2 **Developing Response**

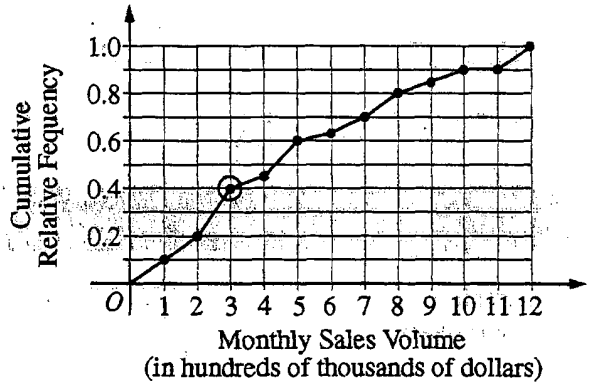
1 **Minimal Response**

If a response 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.

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 and completeness of your results and explanations.

1. A large regional real estate company keeps records of home sales for each of its sales agents. Each month, the company publishes the sales volume for each agent. Monthly sales volume is defined as the total sales price of all homes sold by the agent during a month. The figure below displays the cumulative relative frequency plot of the most recent monthly sales volume (in hundreds of thousands of dollars) for these agents.



(a) In the context of this question, explain what information is conveyed by the circled point.

The circled point is conveying 40th percentile of the most recent monthly sales volume. This 40th percentile means that the agent who earned $300,000 dollars (horizontal coordinate for the point) has higher monthly sales volume than about 40% of all the agents of the company. At the same time, it means that about 60% of the agents had monthly sales volume greater than the agent

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(b) What proportion of sales agents achieved monthly sales volumes between $700,000 and $800,000 ?

There was 0.1 of sales agents or 10% who achieved monthly sales volume between $700,000 and $800,000.

0.8 − 0.7 = 0.1 ← proportion of agents between

↑ Y coordinate for 700,000 ... for 800,000

(c) For values between 10 and 11 on the horizontal axis, the cumulative relative frequency plot is flat. In the context of this question, explain what this means.

In the context of this question, ither flat line means there was no one who earned monthly sales volume between $ 1,000,000 and $11,000,000. Since this is cumulative frequency graph, an increase in frequency for a given interval signifies that there were agents who made sales of between this range. However, as there is no difference in frequency, (0.9 − 0.9 = 0), close to 0 % of sales agents achieved monthly sales volume between $ 1000,000 and $ 11,000,000.

↑ for 10 on horizontal axis ↑ for 11 ← Proportion of agents

(d) A bonus is to be given to 20 percent of the sales agents. Those who achieved the highest monthly sales volume during the preceding month will receive a bonus. What is the minimum monthly sales volume an agent must have achieved to qualify for the bonus?

To find answer for this problem, I had to find 80th percentile or top 20 % of sales agent. 80th Percentile, or 0.8 on Cumulative Relative Frequency (y axis) corresponds with $ 800,000 (8 on horizontal axis). That is an agent must have achieved at least $ 800,000 monthly sales volume to qualify for the bonus.

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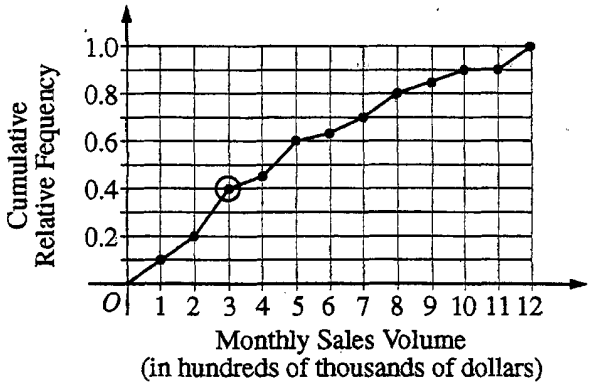

(a) In the context of this question, explain what information is conveyed by the circled point.

The circled point shows that the proportion of sales agents who achieved monthly sales volumes of $300,000 or less is 0.4

(b) What proportion of sales agents achieved monthly sales volumes between \$700,000 and \$800,000 ?

0.8-0.7 = 0.1

The proportion of sales agents who achieved monthly sales between \$700,000 and \$800,000 is 0.1

(c) For values between 10 and 11 on the horizontal axis, the cumulative relative frequency plot is flat. In the context of this question, explain what this means.

The proportion of agents who sold a volume of \$1,000,000 and those agents who sold a volume of \$1,100,000 is the same.

(d) A bonus is to be given to 20 percent of the sales agents. Those who achieved the highest monthly sales volume during the preceding month will receive a bonus. What is the minimum monthly sales volume an agent must have achieved to qualify for the bonus?

Since the bonus is going to be given to 20% of sales agents who achieved the highest sales volume during the preceding month, it should be given to sales agents who achieved more \$800,000 or more because 80% of the people made below \$800,000.

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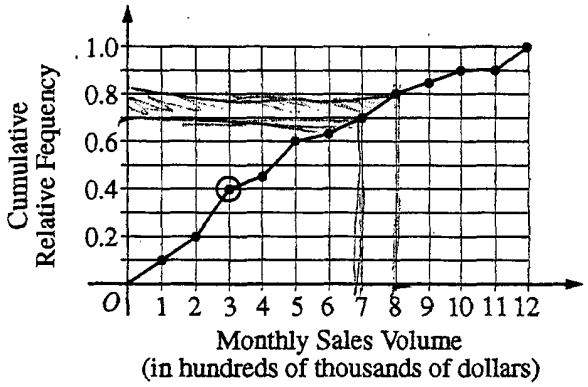

(a) In the context of this question, explain what information is conveyed by the circled point.

The agents who had a monthly sales volume of $300,000 had greater or equal sales to 40% of the real estate company's agents.

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(b) What proportion of sales agents achieved monthly sales volumes between $700,000 and $800,000 ?

0.05 proportion of sales agents had monthly sales volumes between $700,000 and $800,000.

(c) For values between 10 and 11 on the horizontal axis, the cumulative relative frequency plot is flat. In the context of this question, explain what this means.

Monthly sales volumes of ~~[illegible]~~ $1,000,000 and $1,100,000 both indicate the sales agent has had greater or equal sales to 90% of their peers.

(d) A bonus is to be given to 20 percent of the sales agents. Those who achieved the highest monthly sales volume during the preceding month will receive a bonus. What is the minimum monthly sales volume an agent must have achieved to qualify for the bonus?

The top 20% of sales agents (in terms of monthly sales volume) is indicated by a cumulative relative frequency of 0.8. The cumulative relative frequency of 0.8's correspond monthly sales volume is $800,000 indicating that the minimum monthly sales volume an agent must have to qualify for a bonus is $800,000.

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AP® STATISTICS
2006 SCORING COMMENTARY (Form B)

Question 1

Sample: 1A
Score: 4

This is a complete essay in which values on the horizontal axis of the graph are correctly interpreted as sales volumes for agents, and values on the vertical axis are interpreted as cumulative relative frequencies. In part (a) the circled point is interpreted as the 40th percentile of the most recent monthly sales volumes for the agents who work for the real estate company; the essay goes on to say that this means that 40 percent of all agents had monthly sales volumes at or below $300,000, and about 60 percent of sales agents had monthly sales volumes above $300,000. In part (b) the essay correctly reports that 10 percent of the agents had monthly sales volumes between $700,000 and $800,000, and it shows how the solution is obtained. Although part (c) explains that the flat line between 10 and 11 on the graph indicates that no agent had monthly sales between $1,000,000 and $11,000,000, instead of between $1,000,000 and $1,100,000, this was considered a minor error; this part was scored as essentially correct because correct units are used in the other parts of the response. In part (d) the connection between the sales agents with the top 20 percent of sales and the 80th percentile (or 0.8 relative frequency) on the vertical axis of the graph is clearly developed, and the corresponding value of $800,000 on the horizontal axis as the monthly sales volume that must be exceeded to qualify for the bonus is then identified.

Sample: 1B
Score: 3

This essay demonstrates a substantial understanding of the concepts of cumulative relative frequency and percentiles and the ability to use those concepts in the context of a practical application. The circled point on the plot is correctly interpreted as indicating that 40 percent of the agents achieved monthly sales of $300,000 or less. The plot is also used correctly in parts (b) and (d). The explanation in part (b) could have been improved by including a statement that 70 percent of the agents had monthly sales of $700,000 or less, and 80 percent of agents had monthly sales of $800,000 or less. The equal probability response to part (c) is incorrect. If 5 percent of the agents have monthly sales of $1,000,000, and 5 percent have monthly sales of $1,100,000, for example, the response that is provided in part (c) would be true, but the cumulative frequency plot would increase between 10 and 11.

Sample: 1C
Score: 2

This essay displays some understanding of cumulative relative frequencies and how to use the graph to find percentiles of the distribution of monthly sales volumes for the real estate sales agents in parts (a) and (d), but the responses to the parts that require an interpretation of the relationship between two points on the graph, parts (b) and (c), are incorrect. Although the lines that are drawn on the graph correspond to the correct solution to part (b), this does not provide a clear explanation of how the incorrect value of 0.05 for the proportion is obtained. While the response to part (c) is a correct statement, it does not completely describe the information provided by the flat line between 10 and 11 on the cumulative frequency plot. It is true that sales agents with monthly sales of $1,000,000 had sales greater than or equal to 90 percent of the population of agents, but an agent with sales of $1,150,000 also exceeded the sales of 90 percent of the agents. The response that is provided to part (c) is not equivalent to the statement that no agents had sales between $1,000,000 and $1,100,000 during the month.