



## AP<sup>®</sup> Statistics 2000 Scoring Commentary

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**Question 1**

**Sample 1 – Score 4**

The student's answer is complete, in context, and the information is communicated clearly.

**Sample 2 – Score 3**

The student described drug A and selected the proper dosage, but did not justify the selection of drug A over drug B. The communication is well done.

**Sample 3 – Score 3**

The student described drug B as being more effective with increasing dosage, but failed to point out the lack of effect at the lower dosage. The communication is clear.

**Question 2**

**Sample 1 – Score 4**

The student clearly states the population of interest and the normality assumption. In a check of the normality assumption using the five-number summary, the student concludes that the distribution of the sampled footprints is not symmetric. An alternative sampling scheme is suggested to resolve the problem with this sample.

**Sample 2 – Score 4**

The student clearly identifies the population and states the normality assumption. A problem with the sample is identified in the statement that footprints from the same individual might appear more than once. The student further explains that the normality assumption is not reasonable since the mean is greater than the median, indicating a distribution that is skewed to the right. (Although the justification for the normality assumption is weak, this complete response still earns a score of 4.)

**Sample 3 – Score 3**

The student identifies the population, states both assumptions correctly, provides a boxplot, and suggests that the distribution of foot lengths is skewed to the right and not normal. However, a clear rationale of why the boxplot indicates skewness is not provided. While problems with the sample are addressed, the student never clearly states that the sample is not reasonable for this situation.

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**Question 3**

**Sample 1 – Score 4**

In part (a), an appropriate graph is clearly drawn with sufficient labels and a scale that is easy to read, making it easy to compare the two distributions. In part (b), the spreads and centers of the two distributions are compared by examining the interquartile ranges and medians, respectively. A succinct concluding statement about relative flexibility is linked to the graph by the word "suggesting".

**Sample 2 – Score 4**

Part (a) shows an appropriate choice of graphs that are clearly labeled and can be easily compared. Part (b) presents a good discussion of shape and center (supported by the graphical display). A summary sentence clearly uses the graphs to differentiate between the central tendency ("on average") of the two groups.

**Sample 3 – Score 3**

This response earned a score of 3, rather than 4, because it did not compare the shapes of the two distributions by noting the approximate symmetry of the distribution of middle-age mens' flexibilities and the left-skewness of the distribution for younger men.

**Question 4**

**Sample 1 – Score 4**

This is an excellent example of a 4 conveying excellent statistical understanding and methodology. Note, in particular, the complete, coherent communication of methods, assumptions, decisions, and conclusions.

**Sample 2 – Score 4**

This response contains two important features: (1) The student uses a rejection region to complete the test in part (a), and (2) the student conveys an understanding that parental choice is the problem with the design of this study. While the student does not explicitly identify the study design as an observational study, the response does focus on the major design issue in the study.

**Sample 3 – Score 3**

This response earned a score of 3 because the student listed appropriate assumptions but gave no indication of verifying that the assumptions were met. Merely "checking" an assumption does not convey sufficient evidence of verifying an assumption.

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**Question 5**

**Sample 1 – Score 4**

In part (a), the student correctly describes a completely randomized design, randomly assigning volunteers to two treatment groups corresponding to the currently used drug and the new drug, and then states that differences in cholesterol levels will be measured. In the following parts, an improved design using blocking is presented and an understanding of double blind is demonstrated. The weakest part of this response is the randomization procedure described in part (a), since it does not guarantee equal numbers of volunteers in each treatment group. However, a detailed description of the randomization procedure was not required.

**Sample 2 – Score 3**

The student uses diagrams to indicate a correct design in both parts (a) and (b). While sufficient detail is provided in part (a), the student incorrectly equates a simple random allocation to the groups. In part (b), the student fails to give a brief explanation of why gender was chosen as a blocking variable. However, random allocation is correctly illustrated in the diagram.

**Sample 3 – Score 3**

The student correctly describes a completely randomized design in part (a) and the describes a reasonable block design using pre-study cholesterol level to create blocks. However, in part (c), the student confuses the concept of of a double-blind experiment with randomization.

**Question 6**

**Sample 1 – Score 4**

Through part (a) is lacking a check of the appropriate assumptions, the remaining work is well done, including a particularly good interpretation of the confidence interval. In part (b) the mean and standard deviation of the random variable  $W - M$  are explicitly given, and the steps to obtain the probability are indicated. The contrast between the probability and confidence interval is well stated in part (c), and the response in part (d) is outstanding, showing a complete understanding of all relationships present in this study.

**Sample 2 – Score 3**

In part (a), while the assumptions and work are carefully presented, the interpretation of the confidence interval is incorrect. Although the probability was not computed as envisioned in part (b), the response represents a creative solution. A differentiation is made between randomly selecting a man and a woman and randomly selecting a couple in part (c), and, in part (d), although the essential characteristics of the ellipse are present, more detail is recommended.

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**Question 6 (cont.)**

**Sample 3 – Score 3**

All of the work in part (a), including the assumptions, is clearly shown. In part (b), although nonstandard notation ( $s$  for the population standard deviation of the derived random variable) was defined, it was used consistently. The dissonance between the confidence interval from part (a) and the probability from part (b) was well stated in part (c). In part (d), two key characteristics of the ellipse are drawn inconsistent with the available information: (1) The range of wives' height is greater than that observed, and (2) the overlap of the line  $y = x$  indicating the proportion of the couples for which the wives are taller than their husbands is too great.