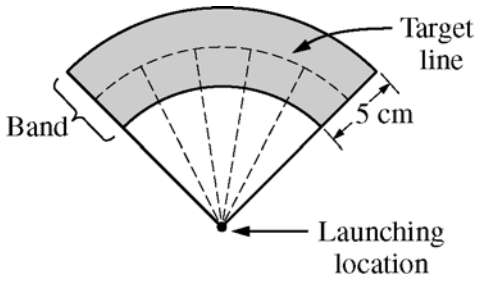
STATISTICS
SECTION II
Part A
Questions 1-5
Spend about 65 minutes on this part of the exam.
Percent of Section II grade—75

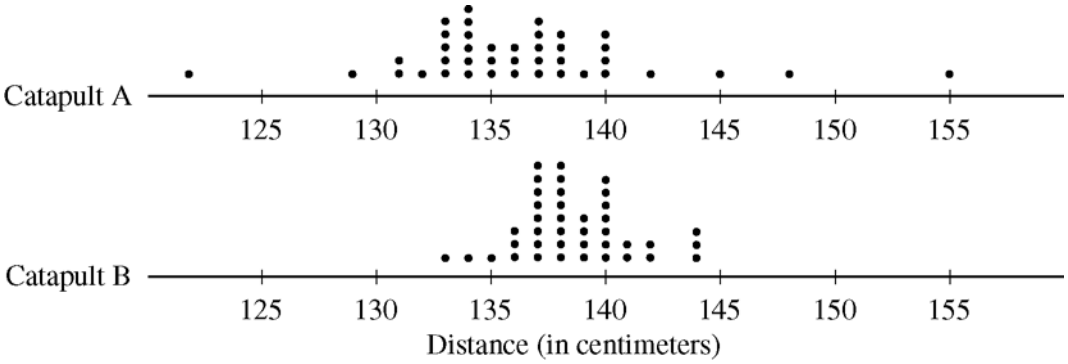
Directions: Show all your work. Indicate clearly the methods you use, because you will be graded on the correctness of your methods as well as on the accuracy and completeness of your results and explanations.

1. Two parents have each built a toy catapult for use in a game at an elementary school fair. To play the game, students will attempt to launch Ping-Pong balls from the catapults so that the balls land within a 5-centimeter band. A target line will be drawn through the middle of the band, as shown in the figure below. All points on the target line are equidistant from the launching location.



If a ball lands within the shaded band, the student will win a prize.

The parents have constructed the two catapults according to slightly different plans. They want to test these catapults before building additional ones. Under identical conditions, the parents launch 40 Ping-Pong balls from each catapult and measure the distance that the ball travels before landing. Distances to the nearest centimeter are graphed in the dotplots below.



(a) Comment on any similarities and any differences in the two distributions of distances traveled by balls launched from catapult A and catapult B.

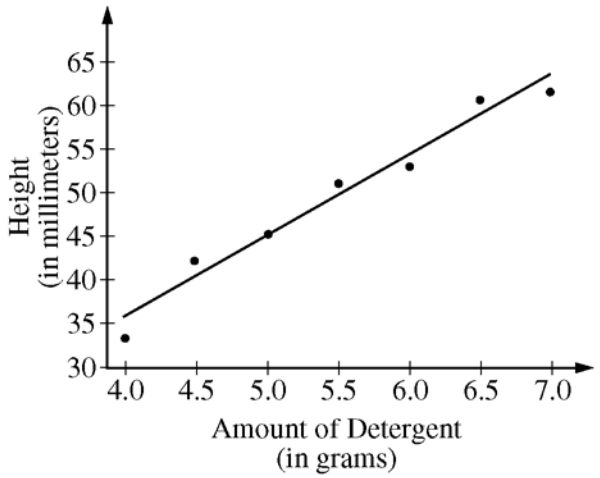
(b) If the parents want to maximize the probability of having the Ping-Pong balls land within the band, which one of the two catapults, A or B, would be better to use than the other? Justify your choice.

(c) Using the catapult that you chose in part (b), how many centimeters from the target line should this catapult be placed? Explain why you chose this distance.

GO ON TO THE NEXT PAGE.

2. A manufacturer of dish detergent believes the height of soapsuds in the dishpan depends on the amount of detergent used. A study of the suds' heights for a new dish detergent was conducted. Seven pans of water were prepared. All pans were of the same size and type and contained the same amount of water. The temperature of the water was the same for each pan. An amount of dish detergent was assigned at random to each pan, and that amount of detergent was added to the pan. Then the water in the dishpan was agitated for a set amount of time, and the height of the resulting suds was measured.

   A plot of the data and the computer output from fitting a least squares regression line to the data are shown below.



Predictor	Coef	SE Coef	T	P
Constant	−2.679	4.222	−0.63	0.554
Amount	9.5000	0.7553	12.58	0.000

S = 1.99821 R–Sq = 96.9% R–Sq(adj) = 96.3%

(a) Write the equation of the fitted regression line. Define any variables used in this equation.

(b) Note that $s = 1.99821$ in the computer output. Interpret this value in the context of this study.

(c) Identify and interpret the standard error of the slope.

GO ON TO THE NEXT PAGE.

AP® STATISTICS
2006 SCORING GUIDELINES

Question 1

Intent of Question

The primary goals of this question are: (1) to assess a student's ability to use simple graphical displays (dotplots in this case) to compare and contrast two distributions; and (2) to evaluate a student's ability to recognize what statistical information is most useful in making different practical decisions.

Solution

Part (a):

Both distributions of distances are roughly symmetric and somewhat mound-shaped. The center of the distances for catapult A (median A = 136 cm) is slightly lower than the center of the distances for catapult B (median B = 138 cm). There is more variability in the distances traveled by the Ping-Pong balls launched with catapult A. There are distances that are extreme enough to be called (potential) outliers in the catapult A distribution, but there are no outliers among the catapult B distances.

Part (b):

Catapult B would be best because the distances vary less about the center of the distribution for catapult B. If catapult B is properly placed, the balls launched will have a higher probability of landing in the narrow (only 5 cm wide) target band.

Part (c):

The catapult should be placed 138 cm from the target line. Since the distribution of distances for catapult B seems to be fairly symmetric and somewhat mound-shaped, the median (138 cm) is a good representation of the center of the distribution. Placing catapult B at this location would have resulted in a high proportion (30/40 = 0.75) of Ping-Pong balls from this sample of launches landing in the target band.

Scoring

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

Part (a) is essentially correct (E) if the student correctly identifies similarities and differences in center, spread, and shape for the two distributions.

Part (a) is partially correct (P) if the student correctly identifies similarities and differences in two of the three characteristics (center, shape, and spread) for the two distributions.

Part (a) is incorrect (I) if the student correctly identifies no more than one similarity or difference of the three characteristics (center, shape, and spread) for the two distributions.

Notes:

- Correct comments regarding outliers should be viewed as a positive. However, comments about outliers do not count as one of the three required characteristics.

Question 1 (continued)

- Describing catapult A's distribution as "normal" or "skewed left" or "uniform" is not acceptable for the shape characteristic. Describing either distribution as "approximately normal" is acceptable.

- Giving separate lists of measures of center and/or spread for the two distributions with no linkage between them is not an acceptable discussion of similarities and differences for these characteristics.

Part (b) is essentially correct (E) if catapult B is chosen using a rationale based on the variability in the distances.

Part (b) is partially correct (P) if catapult B is chosen, but the explanation does not refer to the variability in the distances.

Part (b) is incorrect (I) if catapult B is chosen and no explanation is provided OR catapult A is chosen.

Part (c) is essentially correct (E) if:
the catapult is placed at the median (or mean) of the distances traveled by the Ping-Pong balls, and the explanation addresses why the median (or mean) was selected based on a property of the chosen statistic that relates to the context of the problem;
OR
the catapult is placed at a distance of 137.5-139.5 cm from the target line, and the explanation indicates that the chosen distance resulted in a high proportion of the balls in the sample landing in the target band.

Part (c) is partially correct (P) if the catapult is placed at an acceptable distance from the target line, but the explanation is incomplete or incorrect.

Part (c) is incorrect (I) if the catapult is placed less than 137.5 centimeters or more than 139.5 centimeters from the target line.

Notes:
- Simply saying "because it's the median (or mean)" is an incomplete explanation.
- Some students may confuse the 5 cm band as meaning 5 cm on either side of the target line. If the student chooses the median (or mean) and satisfactorily addresses why the median (or mean) was selected OR chooses a value of 137-140 cm and the explanation indicates that the chosen distance resulted in a high proportion of the balls in the sample landing in the target band, score the response as partially correct.
- If a student gives the distance from the catapult to the front or back of the shaded band rather than the distance to the target line, but gives an otherwise correct response, score part (c) as partially correct.
- If a student picks catapult A in part (b) and follows through correctly in part (c), then part (c) should be scored as essentially correct.

Question 1 (continued)

4 Complete Response

All three parts essentially correct

3 Substantial Response

Two parts essentially correct and one part partially correct

2 Developing Response

Two parts essentially correct and no parts partially correct

OR

One part essentially correct and two parts partially correct

OR

Three parts partially correct

1 Minimal Response

One part essentially correct and either zero or one part partially correct

OR

No parts essentially correct and two parts partially correct