Name: Key

STATISTICS

PART 4 PRACTICE EXAM 1

Time – 1 hour and 30 minutes

Number of multiple choice questions – 20

Number of free response questions - 3

1.

Given two events, A and B, if $P(A) = 0.43$, $P(B) = 0.26$, and $P(A \cup B) = 0.68$, then the two events are

(A) mutually exclusive but not independent.

(B) independent but not mutually exclusive.

(C) mutually exclusive and independent.

(D) neither mutually exclusive nor independent.

(E) Not enough information is given to determine whether A and B are mutually exclusive or independent.

2.

The number of T-shirts a school store sells monthly has the following probability distribution:

# of T-shirts, X	0	1	2	3	4	5	6	7	8	9	10
$P(X)$	0.02	0.15	0.18	0.21	0.14	0.08	0.08	0.04	0.03	0.02	0.05

If each T-shirt sells for \$10 but costs the store \$4 to purchase, what is the expected monthly T-shirt *profit*?

(A) \$ 3.78

(B) \$15.12

(C) \$22.68

(D) \$30.00

(E) \$37.80

3.

A young woman works two jobs and receives tips for both jobs. As a hairdresser, her distribution of weekly tips has mean \$65 and standard deviation \$5.75. As a waitress, her distribution of weekly tips has mean \$154 and standard deviation \$8.02. What are the mean and standard deviation of her combined weekly tips? (Assume independence for the two jobs.)

(A) mean \$167.16; standard deviation \$9.87

(B) mean \$167.16; standard deviation \$13.77

(C) mean \$219.00; standard deviation \$2.27

(D) mean \$219.00; standard deviation \$9.87

(E) mean \$219.00; standard deviation \$13.77

4.

Which of the following is not a condition for a geometric setting?

(A) There are only two possible outcomes for each trial.

(B) The probability of success is the same for each trial.

(C) The trials are independent.

(D) There are a fixed number of observations.

(E) The variable of interest is the number of trials required to reach the first success.

5.

In a game of chance, three fair coins are tossed simultaneously. If all three coins show heads, then the player wins \$15. If all three coins show tails, then the player wins \$10. If it costs \$5 to play the game, what is the player's expected net gain or loss at the end of two games?

(A) The player can expect to gain \$15 after two games.

(B) The player can expect to gain \$1.88 after two games.

(C) The player can expect to gain \$3.75 after two games.

(D) The player can expect to lose \$1.88 after two games.

(E) The player can expect to lose \$3.75 after two games.

6.

Senior citizens make up about 12.4% of the American population. If a random sample of 200 Americans is selected, what is the probability that more than 180 of them are *not* senior citizens?

(A) $\binom{200}{180}(0.124)^{180}(0.876)^{20}$

(B) $\binom{200}{180}(0.876)^{180}(0.124)^{20}$

(C) $P\left(z > \dfrac{180 - 175.2}{\dfrac{0.124}{\sqrt{200}}}\right)$

(D) $P\left(z > \dfrac{0.9 - 0.124}{\sqrt{\dfrac{(0.124)(0.876)}{200}}}\right)$

(E) $P\left(z > \dfrac{0.9 - 0.876}{\sqrt{\dfrac{(0.124)(0.876)}{200}}}\right)$

Don't worry about this question. It is probably a question for our next unit.

7.

As a promotional gimmick, a cereal manufacturer packages boxes of cereal with CD-ROMs of popular games. There are five different games distributed equally among the boxes, but the purchasers do not know which game they are receiving when they purchase the cereal. A child would like to receive one game in particular. What is the probability that the child opens three boxes of cereal before receiving the desired game?

(A) $\binom{5}{3}(0.2)^3(0.8)^2$

(B) $\binom{5}{3}(0.2)^2(0.8)^3$

(C) $\binom{5}{1}(0.6)(0.4)^4$

(D) $(0.8)^2(0.2)$

(E) $(0.2)^2(0.8)$

8.

Suppose the probability of encountering an American who practices a particular religion is 0.014. What are the mean and standard deviation for the *number* of Americans in a random sample of 500 who practice this religion?

(A) mean 0.014; standard deviation 0.0006

(B) mean 0.014; standard deviation 0.0053

(C) mean 7; standard deviation 0.0006

(D) mean 7; standard deviation 0.0053

(E) mean 7; standard deviation 2.627

9.

An airline has an on-time probability of 82.4%. What is the probability that, if you travel on this airline, no more than 3 of your next 10 flights will *not* be on time? (Assume that flights are independent.)

(A) $\binom{10}{3}(0.176)^3(0.824)^7$

(B) $\binom{10}{3}(0.824)^3(0.176)^7$

(C) $\binom{10}{0}(0.176)^0(0.824)^{10} + \binom{10}{1}(0.176)^1(0.824)^9 + \binom{10}{2}(0.176)^2(0.824)^8$

(D) $\binom{10}{0}(0.824)^0(0.176)^{10} + \binom{10}{1}(0.824)^1(0.176)^9 + \binom{10}{2}(0.824)^2(0.176)^8$

(E) $\binom{10}{0}(0.176)^0(0.824)^{10} + \binom{10}{1}(0.176)^1(0.824)^9 + \binom{10}{2}(0.176)^2(0.824)^8 + \binom{10}{3}(0.176)^3(0.824)^7$

10.

Owners of a day-care chain wish to determine the proportion of families in need of day care for the town of Bockville. Bockville is estimated to have 1000 families. The owners of the day-care chain randomly sample 50 families and find that 60% of them have a need for day-care services. Which of the following is a condition necessary for constructing a confidence interval for a **proportion** that has *not* been met?

(A) The data constitute a representative random sample from the population of interest.

(B) The sample size is less than 10% of the population size.

(C) The counts of those who need day care and those who don't need day care are 10 or more.

(D) The distribution of sample values is approximately normally distributed.

(E) All conditions necessary for constructing a confidence interval for the proportion seem to be met.

11.

The cause of death and the age of the deceased are recorded for 454 patients from a hospital.

	15–24	25–34	35–44	45–54	55–64	Total
Accident	14	12	15	12	7	60
Homicide	5	4	3	0	0	12
Heart disease	1	3	14	34	63	115
HIV	0	3	6	4	0	13
Cancer	2	4	17	47	89	159
Other	3	7	16	26	43	95
Total	25	33	71	123	202	454

Use these values to estimate the probability that a person at this hospital died as a result of an accident if it is known the person was between the ages of 45 and 54.

(A) 0.0264

(B) 0.0976

(C) 0.1322

(D) 0.2000

(E) 0.4878

12.

The following table shows the preferred exercise for a random sample of 223 men of various ages.

Physical Activity/Age	18–31	32–45	46–59	60–73	Over 74
Jogging	23	14	9	1	0
Cycling	19	19	14	11	8
Swimming	10	8	5	3	1
Weight Lifting	34	21	12	6	5

If the type of exercise is independent of age, how many men over the age of 74 would we expect to prefer cycling?

(A) 3
(B) 4
(C) 8
(D) 11
(E) 14

13.

A baseball recruiter visits a high school where a player has a batting average of 0.450. (This means that he gets a hit in 45% of his at-bats.) What is the probability that the recruiter won't see the player get a hit until his third at-bat?

(A) $(0.450)^2(0.550)$
(B) $(0.550)^2(0.450)$
(C) $\binom{3}{1}(0.450)(0.550)^2$
(D) $\binom{3}{1}(0.550)(0.450)^2$
(E) $\binom{3}{2}(0.450)(0.550)^2$

14.

If two events, A and B, are mutually exclusive, then the probability that both A and B occur simultaneously is

(A) 0.
(B) 1.
(C) $P(A) + P(B)$.
(D) $P(A) + P(B) - P(A \cap B)$.
(E) $P(A)\,P(B)$.

15.

Pearson High School students have cumulative grade point averages as shown in the table.

Class \ GPA	≥ 4.0	3.0–4.0	2.0–3.0	1.0–2.0	< 1.0	Total
Sophomores	43	121	114	22	10	310
Juniors	26	102	84	16	5	233
Seniors	15	87	100	10	7	219
Total	84	310	298	48	22	762

Which of the following statements is *not* true?

(A) About 39% of sophomores have *at least* a 3.0 GPA.

(B) Sophomores represent 39% of GPAs from 3.0 to 4.0.

(C) Seniors represent about 29% of the reported GPAs at Pearson High School.

(D) Only about 3% of seniors have GPAs *less than* 1.0.

(E) About 11% of the reported GPAs are juniors with GPAs from 2.0 to 3.0.

16.

Given the information below, which of the statements is true?

X	2	4	6	8	10
$P(X)$	0.3	0.2	0	0.4	0.1

(A) The expected value of the random variable is 6.

(B) The expected value of the random variable is 0.

(C) The variance of the random variable is 1.

(D) The expected value of the random variable is 11.6.

(E) The variance of the random variable is 8.64.

17.

Two random variables, X and Y, are independent. X has expected value 2.5 and standard deviation 0.3, while Y has expected value 4.7 and standard deviation 0.4. Which of the following is true?

(A) The mean of $X + Y$ is 6.2.

(B) The standard deviation of $X + Y$ is 0.7.

(C) The variance of $X + Y$ is 0.7.

(D) The mean of $X + Y$ is 11.75.

(E) The standard deviation of $X + Y$ is 0.5.

18.

Which of the following is true?

(A) The value of a random variable must always be positive.

(B) The expected value of a random variable must always be positive.

(C) The variance of a random variable must always be positive.

(D) The expected value of a random variable must be nonzero.

(E) The variance of a random variable must be nonnegative (0 or positive).

19.

Home pregnancy test kits have grown in popularity. Research shows that only 30% of those using a particular kit are actually pregnant. When a pregnant woman uses this kit, it correctly indicates pregnancy 96% of the time. A woman who is not pregnant gets a correct indication 90% of the time. What is the probability that a woman is pregnant given that this test gives a positive result?

(A) About 96%

(B) About 86%

(C) About 80%

(D) About 36%

(E) About 21%

20.

Two friends, Tom and Janice, have cars in desperate need of repair. On any given day, the probability that Tom's car will break down is 0.5, the probability that Janice's car will break down is 0.5, and the probability that both of their cars will break down is 0.3. What is the probability that Tom or Janice's car will break down?

(A) 1.3

(B) 1.0

(C) 0.7

(D) 0.4

(E) 0.2

Practice Exam 1

1

AP® STATISTICS
2008 SCORING GUIDELINES (Form B)

Question 5

Intent of Question

The primary goals of this question were to assess a student's ability to (1) describe the distribution of the difference of two normal random variables and (2) use this distribution to find a probability and to find a value given its location in the distribution.

Solution

Part (a):

X is normally distributed with $\mu = 170$ and $\sigma = 20$, and Y is normally distributed with $\mu = 200$ and $\sigma = 10$. The distribution of $Y - X$ has mean and standard deviation:

$$\mu_{Y-X} = \mu_Y - \mu_X = 200 - 170 = 30$$
$$\sigma_{Y-X} = \sqrt{\sigma_Y^2 + \sigma_X^2} = \sqrt{10^2 + 20^2} = \sqrt{500} = 22.36$$

The distribution of $Y - X$ is normal with mean 30 and standard deviation 22.36 (or, variance 500).

Part (b):

The train from Bullsnake will have to wait when $Y - X$ is positive:

$$P(Y - X > 0) = P\left(z > \frac{0-30}{22.36}\right) = P(z > -1.34) = 0.9099$$

(Calculator: 0.9082408019 or 0.9078172963, if z is not rounded.)
The proportion of days that the train will have to wait is about 0.91.

Question 5 (continued)

Part (c):

Let D denote the delay that will be needed for the train leaving Bullsnake. With the additional constant delay,

$X + D$ is normally distributed with $\mu_{X+D} = 170 + D$ and $\sigma_{X+D} = \sigma_X = 20$

Y is normally distributed with $\mu_Y = 200$ and $\sigma_Y = 10$

Thus, the difference $Y - (X + D)$ is normally distributed with

$$\mu_{Y-(X+D)} = \mu_Y - \mu_{(X+D)} = 200 - (D + 170) = 30 - D$$
$$\sigma_{Y-(X+D)} = \sigma_{Y-X} = 22.36$$

The combined delay and travel time $(X + D)$ for the Bullsnake train must be *less than* the travel time for the Diamondback train (Y) with probability 0.01. That is, $P(Y - (X + D) > 0) = 0.01$, so we need

$$\frac{0 - \mu_{Y-(X+D)}}{\sigma_{Y-(X+D)}} = \frac{0 - (30 - D)}{22.36} = 2.33$$

Solving for D, the train from Bullsnake should be delayed by 82.099 minutes.

<u>*OR*, with alternative notation</u>:

Let X' denote the combined delay and travel time from Bullsnake to Copperhead, and let Y represent the travel time to Copperhead for the Diamondback train. The distribution of $Y - X'$ also is normal (because D is constant), with mean $\mu_{Y-X'} = \mu_Y - \mu_{X'}$ and standard deviation $\sigma_{Y-X'} = \sigma_{Y-X} = 22.36$.

The combined delay and travel time for the Bullsnake train (X') must be *less than* the time for the Diamondback train (Y) with probability 0.01. That is, $P(Y - X' > 0) = 0.01$, and we need

$$z = \frac{0 - \mu_{Y-X'}}{\sigma_{Y-X'}} = \frac{0 - \mu_{Y-X'}}{22.36} = 2.33$$

Solving, $\mu_{Y-X'} = \mu_Y - \mu_{X'} = -52.099$, so the mean travel time for the Diamondback train (Y) should be 52.099 minutes less than the mean combined travel and delay time for the Bullsnake train X'. The mean travel time for the Diamondback train is now 30 minutes more than the mean travel time for the Bullsnake train, so the train from Bullsnake should be delayed by 52.099 + 30 = 82.099 minutes.

Question 5 (continued)

Scoring

Part (a) is divided into two sections: section 1 and section 2. Section 1 is scored as essentially correct (E) or incorrect (I). Section 2 is scored as essentially correct (E), partially correct (P), or incorrect (I).

Section 1 is scored as follows:

Essentially correct (E) if the response states that the distribution of $Y - X$ is normal.

Incorrect (I) otherwise.

Section 2 is scored as follows:

Essentially correct (E) if the response correctly computes the mean and standard deviation *AND* shows some work for the calculation of the standard deviation. May contain a minor arithmetic error.

Partially correct (P) if the response correctly states the values of the mean and standard deviation.

Incorrect (I) if the formula for the mean or standard deviation contains a conceptual error (such as not squaring the original standard deviations or subtracting the variances).

Part (b) constitutes section 3 and is scored as essentially correct (E), partially correct (P), or incorrect (I).

Section 3 is scored as follows:

Essentially correct (E) if the response uses the distribution information from part (a) to correctly compute the desired probability. If the mean or standard deviation is computed incorrectly in part (a), those values should be used in part (b). (*Note:* If variances are incorrectly subtracted instead of added, $\sigma = 17.32$, $z = -1.73$, and the probability is $1 - 0.0418 = 0.9582$.)

Partially correct (P) if the response computes $P(Y - X < 0)$ instead of $P(Y - X > 0)$ and gets $P(Y - X < 0) = 1.0 - 0.9099 = 0.0901$.

Incorrect (I) otherwise.

Part (c) constitutes section 4 and it is scored as essentially correct (E), partially correct (P), or incorrect (I).

Section 4 is scored as follows:

Essentially correct (E) if the response correctly concludes that the train from Bullsnake should be delayed by about 82 minutes. If the mean or standard deviation is computed incorrectly in part (a), those values should be used in part (c). (*Note:* If variances are subtracted instead of added, the delay time will be (2.33)(17.32) + 30 = 70.36.)

Partially correct (P) if a correct line of reasoning is explored but the student fails to reach the correct answer.

Incorrect (I) otherwise.

Question 5 (continued)

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

#2

AP® STATISTICS
2008 SCORING GUIDELINES

Question 3

Intent of Question

The primary goals for this question were to assess a student's ability to (1) recognize and calculate the mean as the expected value of a probability distribution; (2) demonstrate how to use two distributions to form all possible ways a specific difference may occur; (3) calculate a probability for this specific difference occurring; and (4) calculate a probability from the probability distribution of all possible differences.

Solution

Part (a):

The expected scores are as follows:

Josephine

$\mu_J = 16(0.1) + 17(0.3) + 18(0.4) + 19(0.2) = 17.7$

Crystal

$\mu_C = 17(0.45) + 18(0.4) + 19(0.15) = 17.7$

Part (b):

J	C	Probability
16	17	(0.1)(0.45) = 0.045
17	18	(0.3)(0.40) = 0.12
18	19	(0.4)(0.15) = 0.06

Part (c):

The probability is

$0.045 + 0.12 + 0.06 = 0.225$

Part (d):

P(difference = –1) = 0.225 (from part c)

P(difference = –2) = 1 – 0.015 – 0.225 – 0.325 – 0.260 – 0.90 = 0.085

Distribution of Josephine – Crystal

Differences	–3	–2	–1	0	1	2
Probability	0.015	**0.085**	**0.225**	0.325	0.260	0.090

The probability that Crystal's score is higher than Josephine's score is

P(difference < 0) = 0.015 + 0.085 + 0.225 = 0.325

Scoring

This problem is scored in three sections. Section 1 consists of part (a). Section 2 consists of parts (b) and (c). Section 3 consists of part (d). Each section is scored as essentially correct (E), partially correct (P), or incorrect (I).

Question 3 (continued)

Section 1 [part (a)] is scored as follows:

Essentially correct (E) if correct expected scores (means) are calculated for both Josephine and Crystal with appropriate calculations or formulas shown for at least one of the players.

Partially correct (P) if the student makes one of the following errors:

- Rounds both expected values to integers (e.g., approximately 18 or 17–18)
- Calculates only one player's score correctly with appropriate calculations or formula
- Uses nonuniversal calculator syntax with linkage to the values in the table to describe how the correct expected values for both players are calculated
- Shows correct work for the expected values but gives answers of 17.5 and 18 (the unweighted averages)
- Gives correct expected values but does not show the multiplications or does not show the additions

Incorrect (I) if two or more of the errors above are made *OR* if no justification is given for correct answers *OR* if both expected scores are calculated using an incorrect method *OR* if the expected values are not calculated.

Note: If the student shows correct work but has at most one minor arithmetic error and/or copies at most one probability incorrectly from the table, the student should not be penalized for these types of errors.

Section 2 [parts (b) and (c)] is scored as follows:

Essentially correct (E) if all five of the components below are correctly completed by the student:

- Lists all the score combinations that result in a difference of -1 in part (b)
- Calculates the probabilities correctly in part (b)
- Shows appropriate work or formula in part (b)
- Calculates the correct probability for the difference of -1 in part (c)
- Shows appropriate work or formula in part (c)

Partially correct (P) if three or four of the previous components are correct.

Incorrect (I) if at most two of the previous components are correct.

Notes:

- If a student gets incorrect answers for the three combinations that result in a difference of -1 but uses them correctly in part (c), the student can still get credit for the last two components if the resulting probability is between 0 and 1.
- If the student shows correct work but has at most one minor arithmetic error and/or copies at most one probability incorrectly from the table, the student should not be penalized for these types of errors.

Section 3 [part (d)] is scored as follows:

Essentially correct (E) if both of the components below are successfully done by the student:

- Completes the table correctly
- Calculates the correct probability that Crystal's score is higher than Josephine's score *AND* shows appropriate work or formula

Question 3 (continued)

Partially correct (P) if only one of the components is correct.

Incorrect (I) if both components are incorrect.

Notes:

- It is possible to calculate P(difference = –2) = 0.085 by listing the two combinations that result in a difference of –2.

J	C	Probability
16	18	(0.1)(0.4) = 0.04
17	19	(0.3)(0.15) = 0.045

- If a student has an incorrect answer in part (c) but uses it correctly in part (d), then the P(difference = –2) must be 0.085 *OR* the probabilities in the table must add up to 1 to get credit for the first component.
- If any of the values in the table are less than 0 or greater than 1, then no credit will be given for the first component.
- If the student shows correct work but has at most one minor arithmetic error and/or copies at most one probability incorrectly from the table, the student should not be penalized for these types of errors.

4 Complete Response

All three sections essentially correct

3 Substantial Response

Two sections essentially correct and one section partially correct

2 Developing Response

Two sections essentially correct and no sections partially correct

OR

One section essentially correct and one or two sections partially correct

OR

Three sections partially correct

1 Minimal Response

One section essentially correct and no parts partially correct

OR

No sections essentially correct and two sections partially correct

Question 3

Intent of Question

The primary goals of this question are to assess a student's ability to: (1) recognize the random variable of interest, identify its probability distribution, and calculate a probability; (2) use basic probability rules to find a different probability; and (3) use the sampling distribution of the sample mean to identify a characteristic of the manufacturing process that will meet a given specification.

Solution

Part (a):

Let D represent the distance a randomly selected ball travels. Since D is normally distributed with a mean of 288 yards and a standard deviation of 2.8 yards, we find

$$P(D > 291.2) = P\left(Z > \frac{291.2 - 288}{2.8}\right) > P(Z > 1.14) = 1 - 0.8729 = 0.1271.$$

Part (b):

$$\begin{aligned} P(\text{at least one distance} > 291.2) &= 1 - P(\text{all five distances} \le 291.2) \\ &= 1 - (1 - 0.1271)^5 \\ &= 1 - (0.8729)^5 \\ &= 1 - 0.5068 \\ &= 0.4932 \end{aligned}$$

Part (c):

Since the 99th percentile for a standard normal distribution is 2.33, we can set the appropriate z-score equal to 2.33 and solve for the desired mean, say M. Thus,

$\frac{291.2 - M}{2.8} = 2.33$ or $M = 291.2 - 2.33 \times 2.8 = 284.676$. In order to be 99 percent certain that a randomly selected ball does not exceed the maximum distance of 291.2 yards, the mean should be set to 284.676 yards.

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 clearly shows ALL three of the following:

Indicates the distribution is normal.

Specifies BOTH the mean, μ, and the standard deviation, σ.

Calculates the correct probability.

Question 3 (continued)

Part (a) is partially correct (P) if the student:

Calculates the correct probability but fails to specify BOTH μ and σ in the identification of the normal the distribution.

OR

Completely identifies the distribution as normal with BOTH μ and σ correctly specified but fails to calculate the correct probability, e.g., calculates the probability that the ball travels less than 291.2 yards.

OR

Completely identifies the distribution as normal with BOTH μ and σ correctly specified but uses the empirical rule to provide an approximate answer.

Part (a) is incorrect (I) if the student:

Reports a correct probability without showing any work.

OR

Calculates and incorrect probability using an inappropriate distribution.

Notes:

Calculator solution is 0.1265. If this is the only information provided, the response is scored as incorrect (I).

If only the calculator command Normalcdf ($-\infty$, 291.2, 288, 2.8) is provided along with 0.1265, then the response should be scored as partially correct (P).

If the calculator command Normalcdf ($-\infty$, 291.2, 288, 2.8) is provided along with 0.1265 AND the mean and standard deviation are clearly identified, then the response should be scored as essentially correct (E).

If the calculator command Normalcdf ($-\infty$, 291.2, 288, 2.8) AND a shaded/labeled sketch of an appropriate normal distribution are provided along with 0.1265, then the response should be scored as essentially correct (E).

Minor arithmetic or transcription errors will not necessarily lower the score.

Part (b) is essentially correct (E) if the student calculates the correct probability and:

Clearly indicates the distribution is binomial AND specifies both n and p using the value obtained in part (a)

OR

Correctly applies complement and probability rules using the value obtained in part (a).

Part (b) is partially correct (P) if the student:

Clearly indicates the distribution is binomial AND specifies both n and p using the value obtained in part (a), but does not calculate the probability correctly.

OR

Calculates the correct probability using the value obtained in part (a) but fails to completely identify the distribution as binomial with both n and p specified.

OR

Indicates a correct procedure for computing the probability but uses a value of p that is different from the value obtained in part (a).

Question 3 (continued)

Part (b) is incorrect (I) if the student

Provides a probability, but no work is shown.

OR

Obtains a probability with an incorrect solution strategy, e.g., $P(\text{at least one distance} > 291.2) = 1 - p^5$ or $P(\text{at least one distance} > 291.2) = 1 - 5p$, where p is the solution to part (a).

Notes:

Calculator solution is 0.4916. If the student uses calculator syntax, BOTH n and p AND the binomial distribution must be identified to be scored essentially correct.

If only the calculator command $1 - \text{binomcdf}(5, 0.1265, 0)$ is provided along with the probability 0.4915, then the response should be scored as partially correct.

Alternative solutions using the binomial distribution with $p = 0.1265$ are:

$$\begin{aligned}
P(\text{at least one measurement} > 291.2) &= P(B = 1) + P(B = 2) + P(B = 3) + P(B = 4) + P(B = 5) \\
&= \binom{5}{1}0.1265^1(1 - 0.1265)^4 + \binom{5}{2}0.1265^2(1 - 0.1265)^3 + \\
&\quad \binom{5}{3}0.1265^3(1 - 0.1265)^2 + \binom{5}{4}0.1265^4(1 - 0.1265)^1 + 0.1265^5 \\
&= 0.368224 + 0.106652 + 0.015445 + 0.001118 + +0.00032 \\
&= 0.491472
\end{aligned}$$

$$\begin{aligned}
P(\text{at least one measurement} > 291.2) &= 1 - P(\text{all five distances} > 291.2) \\
&= 1 - \binom{5}{0}0.1265^0(1 - 0.1265)^5 \\
&= 1 - (1 - 0.1265)^5 \\
&= 1 - (0.8735)^5 \\
&= 1 - 0.5085 \\
&= 0.4915
\end{aligned}$$

Part (c) is essentially correct (E) if the student clearly shows ALL three of the following:

Identifies the 99th percentile for the standard normal distribution

Sets up an appropriate equation

Solves for the desired mean

Part (c) is partially correct (P) if the student:

Recognizes that the 99th percentile for the standard normal distribution must be used and sets up the appropriate equation but does not solve the equation for the desired mean.

Question 3 (continued)

OR

Sets up an appropriate equation using the correct minimum distance but provides an incorrect mean because an incorrect upper tail percentile (say the 99.5^{th} percentile) was used.

OR

Sets up an appropriate equation using the correct percentile of the standard normal distribution but provides an incorrect mean because an incorrect minimum distance was used (say 288 yards) was used.

Part (c) is incorrect (I) if the student

Provides the correct mean, 284.676 yards, but no work is shown

OR

A lower tail percentile is used.

OR

An incorrect mean is calculated with an incorrect solution strategy.

Note: Calculator solution is 284.686 yards.

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