
**THE
QUALITY TECHNICIAN
SOLUTIONS TEXT**

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October, 2011

SECTION IV

BASIC STATISTICS - SAMPLE QUESTIONS

4.1. What is the mean height of five men who have the following heights?

5' 6", 5' 9", 5' 4", 5' 11", 5' 8"

- a. 6' 0"
- b. 5' 5"
- c. 5' 6 1/2"
- d. 5' 7 3/5"

Solution: A determination of average is required. All measurements can be converted into inches and then reconverted into feet and inches to match up with the answers listed. A short-cut is to set aside the five feet common to all data and simply work with the inches.

$$5' + \frac{6'' + 9'' + 4'' + 11'' + 8''}{5} = 5' + 7.6''$$

Answer d is correct.

References: *CQT Primer*, Section IV - 10/11. This question has been modified from a published CQT exam.

4.2. Calculate the standard deviation of the population for the following set of five sample observations:

1.5, 1.2, 1.1, 1.0, 1.6

- a. 1.280
- b. 0.259
- c. 0.231
- d. 0.518

Solution: The question involves determining the sample standard deviation. The classical method may be used but the use of a statistical calculator is faster and necessary to pass a certification exam. Note the wording of the question. An inference is made about a population.

Equation:

$$S = \sqrt{\frac{\sum (X - \bar{X})^2}{n-1}}$$

S must be calculated not σ . The divisor must be $n - 1$. Answer: $S = 0.2588$

Answer b is correct.

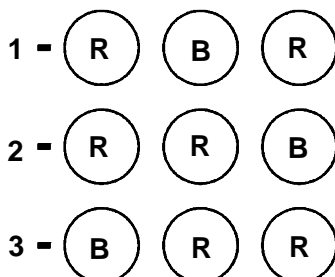
Reference: *CQT Primer*, Section IV - 13/15.

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BASIC STATISTICS - SAMPLE QUESTIONS

- 4.3. A box contains two red balls and two black balls. Given that a black ball has been drawn, what is the probability of drawing two consecutive red balls in the next three draws?
- a. 1/6
 - b. 2/3
 - c. 1/3
 - d. 1/4

Solution: The best way to solve this rather simple probability problem is to diagram the alternatives. The box contains two red balls and one black ball after the removal of one black ball. Only three selection alternatives exist:



In two of the three possibilities (selections 2 and 3 above) two consecutive red balls will be drawn. Therefore, the probability is 2/3 or 0.667.

Answer b is correct.

References: *CQT Primer*, Section IV - 24 and 28 (and logic). This question has been modified from an old published CQT exam.

- 4.4. What is the standard deviation of the following complete set of data? 3.2, 3.1, 3.3, 3.3, 3.1
- a. 3.2
 - b. 0.0894
 - c. 0.1
 - d. 0.0498

Solution: The five values are considered a complete data set which means that N must be used in the denominator for the determination of σ .

Equation:

$$\sigma = \sqrt{\frac{\sum (X - \bar{X})^2}{N}}$$

Using a statistical calculator:

$$\sigma = .0894$$

Answer b is correct.

References: *CQT Primer*, Section IV - 13. This question has been modified from an old published CQE exam.

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BASIC STATISTICS - SAMPLE QUESTIONS

4.5. The expression

$$P(x) = \frac{(\mu^x)(e^{-\mu})}{x!}$$

is called the:

- a. Poisson distribution
- b. Pascal distribution
- c. Hypergeometric distribution
- d. Binomial distribution

Solution: A review of the equations represented by the answers is required.

Equation:

$$P(x) = \frac{(\mu^x)(e^{-\mu})}{x!}$$

Where

$\mu = n\bar{p}$ (the population mean)

X = number of defectives

e = 2.71828 the base of natural logarithms

The equation is one form used for the Poisson distribution.

Answer a is correct.

References: *CQT Primer*, Section IV - 8/9. This question has been modified from an old published CQE exam.

4.6. A number derived from sample data, which describes the data in some useful way, is called a:

- a. Constant
- b. Statistic
- c. Parameter
- d. Critical value

Solution: A constant is a fixed value: π , e, A_2 , etc. A parameter is a number derived from population data. A critical value is a table value with which a test statistic is compared to derive a population inference. A statistic is derived from sample data.

Answer b is correct.

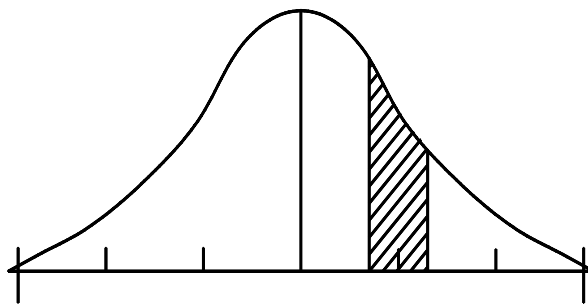
References: *CQT Primer*, Section IV - 3. This question has been modified from an old published CQE exam.

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BASIC STATISTICS - SAMPLE QUESTIONS

- 4.7. In a normal distribution, what is the area under the curve between +0.7 and +1.3 standard deviation units?
- a. 0.2903
 - b. 0.7580
 - c. 0.2580
 - d. 0.1452

Solution: The question asks for the area as shown in the normal distribution curve below:



The standard normal table lists the area of the curve beyond a given Z value. The value for +0.7 must be looked up and the value for +1.3 must be subtracted from it.

$$0.2420 - 0.0968 = 0.1452$$

Answer d is correct.

References: *CQT Primer*, Section IV - 33/37 and the Standard Normal Table in Section XII.

- 4.8. The grades of a student on six examinations were 84, 91, 72, 68, 87, and 78. Find the median of the grades:
- a. 84
 - b. 78
 - c. 80
 - d. 81

Solution: The median is the middle value when the data is arranged in ascending or descending order. In this instance there is an even number of readings and the middle two readings differ. For this problem:

$$\frac{84 + 78}{2} = \frac{162}{2} = 81$$

Answer d is correct.

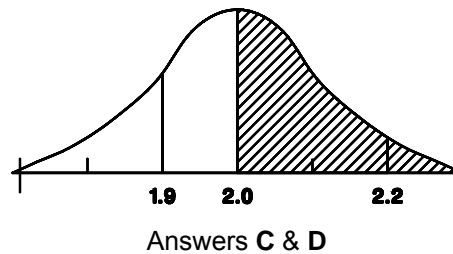
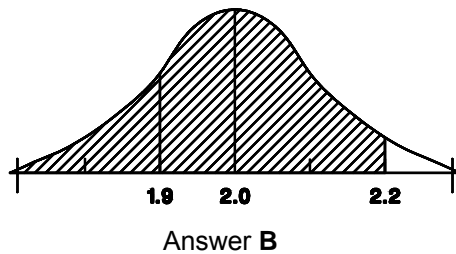
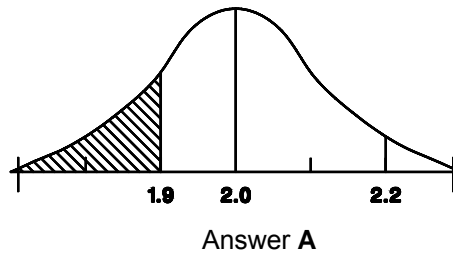
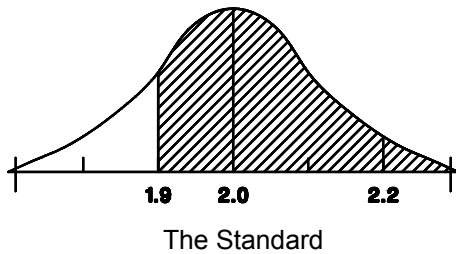
Reference: *CQT Primer*, Section IV - 12.

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- 4.9. If the ODs of a certain bushing are normally distributed with mean 2.00 inches, then the proportion of bushings with ODs greater than 1.90 inches is:
- Less than the proportion with ODs less than 1.90 inches
 - Greater than the proportion with ODs less than 2.20 inches
 - Less than 50%
 - Greater than the proportion with ODs greater than the median

Solution: This question requires a basic understanding of the normal distribution curve and a review of the answers. Consider the following arbitrary normal distributions.



Answers **A**, **B**, and **C** are not correct. ODs measuring less than 2.1" would be the same as ODs measuring greater than 1.9". Therefore, ODs less than 2.2" is greater than ODs greater than 1.9". The median represents the midpoint of the bell shaped curve.

Answer d is correct.

References: *CQT Primer*, Section IV - 12 and 32/37. This question has been modified from an old published CQE exam.

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BASIC STATISTICS - SAMPLE QUESTIONS

4.10. The average number of flaws in large plate glass is 0.25 per pane. The standard deviation of this Poisson distribution is:

- a. 0.25
- b. 0.05
- c. 0.75
- d. 0.50

Solution: This question requires a review of the relationship between the mean and sigma for a c chart and a comparison with the answers.

Equation: Poisson sigma = $\sqrt{\bar{c}}$

Where,

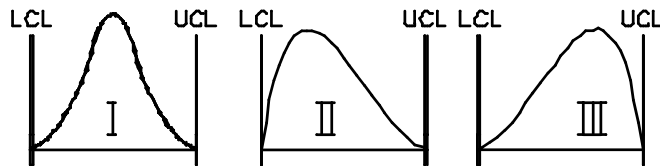
\bar{c} = The Poisson average

$$\text{Poisson sigma} = \sqrt{0.25} = 0.50$$

Answer d is correct.

References: *CQT Primer*, Section IV - 5 and 8/9. This question has been modified from an old published CQE exam.

4.11. Which of the following statements is most applicable to the 3 curves below?



- a. Curve II is skewed to the left
- b. The mode, median, and average are all the same in curves II and III
- c. Curve III indicates an out of control condition
- d. Curve I represents good control

Solution: Curve II is skewed to the right. The mode, median, and average are different in curves II and III. Curve III may or may not have assignable cause variation, but it is shown to be in control. Curve I represents good control.

Answer d is correct.

Reference: *CQT Primer*, Section IV - 12 (and logic).

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BASIC STATISTICS - SAMPLE QUESTIONS

- 4.12. Given 6 books, how many sets can be arranged in lots of 3 but always in a different order?
- a. 18 sets
 - b. 54 sets
 - c. 108 sets
 - d. 120 sets

Solution: This problem does not imply distinct combinations therefore, a permutation calculation, not a combination calculation, is required:

$$P_r^n \frac{n!}{(n-r)!} = P_r^n \frac{6!}{(6-3)!} = (4)(5)(6) = 120$$

If the question asked for distinct combinations the answer would be:

$$C_r^n \frac{n!}{r!(n-r)!} = \frac{6!}{(3!)(3!)} = 20$$

Combination
(ABC)

Permutation
(ABC) + (ACB) + (BAC) + (BCA) + (CAB) + (CBA)

Answer d is correct.

References: *CQT Primer*, Section IV - 30/31. This question has been modified from an old published CQE exam.

- 4.13. The probability of observing at least one defective in a random sample size of ten drawn from a population that has been producing on the average, ten percent defective units is:
- a. $(0.10)_{10}^{10}$
 - b. $(0.90)_{10}^{10}$
 - c. $1 - (0.10)_{10}^{10}$
 - d. $1 - (0.90)_{10}^{10}$

Solution: This question can be answered using a binomial probability calculation. Please note that the question asks for the probability of at least one. The best approach is to calculate the probability for 0 and subtract the answer from one.

Equation

$$P(r) = C_r^n p^r (1-p)^{n-r}$$

for $n = 10$, $r = 0$, $p = .1$

$$\begin{aligned} P(r) &= \frac{10!}{0!(10-0)!} (0.1)^0 (1-0.1)^{10-0} \\ &= (1)(1)(.9)^{10} = (0.9)^{10} \end{aligned}$$

Therefore, the probability of one or more = $1 - (.9)^{10}$

Answer d is correct.

References: *CQT Primer*, Section IV - 7/8. This question has been modified from an old published CQE exam.
