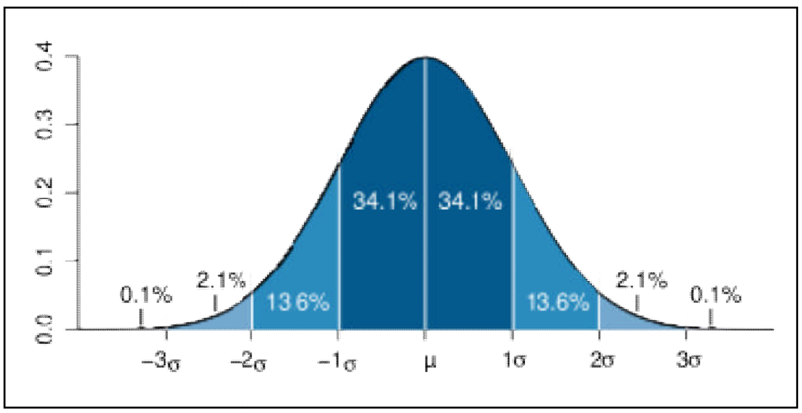
Cut Score Study Report

The CLCP examination utilizes standard scores for determining pass/fail statuses of the respective CLCP examinees. Standard scores express the examinee's score's distance from the mean in terms of the standard deviation of the distribution (Anastasi, 1976). The score is based upon the measures of central tendency, more specifically; the mean of group scores and where these scores fall within a normal distribution of scores and within how many standard deviations these respective scores are from the mean. The normal distribution is illustrated in Figure 1.

Figure 1 – Normal Distribution



These scores are referred to as Type II A scores since they focus on inter-individual comparisons that are expressed as the number of standard deviations between any specified score and the mean (Lyman, 1978). Thus, a change in norm group influences the level of score, which is noted during each individual administration of the CLCP exam. The cut score seems to fluctuate after several test administrations due to the tendency for the group mean to fluctuate.

<u>Standard Deviation</u>: The standard deviation represents the variability of a test score from the mean, and as a group of scores is reviewed, the variability, or the variance of individual scores from the mean, provides a good indicator of test stability, or test score reliability. The simplest indicator of variance among test scores is the range, whereby the lowest achieved score and the highest achieved score are identified and the total units between the two extreme scores are calculated as the range (Anastasi, 1976). Glass and Stanley (1970) documented two levels of score variance as applied to range; 1) inclusive range and 2) exclusive range. The exclusive range is the difference between the largest and smallest scores of a group. For example, a group of 10 persons took the CLCP exam and achieved scores of 72, 68, 82, 79, 75, 76, 83, 89, 62, and 86. The mean score is 77.2 and the range is 89 – 62 =

27. Another set of scores included 71, 66, 90, 88, 89, 72, 65, 67, 80, and 95. The mean score for this set is 78.3, with a range of 30. However, does the range of 30 suggest a set of scores with greater variances than the set of scores with a 27 point range? Actually, Shertzer and Linden (1979) noted that the range is the difference between the lowest score and the highest score plus 1. Reviewing the second set of scores and applying Shertzer and Linden's plus 1 model, the range between the lowest score and the highest score is 30 + 1 = 31, which is referred to as the *exact* range of scores on the test. Given that there is a maximum score of 100 and a minimum range of 0 on the CLCP exam, the *absolute* range of scores is 100 + 1 = 101. The variability of the test scores is determined by the ratio of the exact range to that of the absolute range (Shertzer & Linden, 1979). Thus, given the *exact* range of 31 on the second set of scores, divided by the *absolute* range of 101 reveals a dispersion ratio of .31. When considering the first set of scores, the exact range of scores is 27 + 1 = 28 and the absolute range is 101, which reveals a dispersion ratio of .27. These scores are close and suggest minimal variability. The closer the ratio between the exact range and the absolute range the greater the variability of the scores (Shertzer & Linden, 1979).

The inclusive range is the difference between the upper real limit of the set of scores and the lower real limit of the lowest score (Glass & Stanley, 1970). This range-type involves scores that may be rounded to the highest integer if the scoring allows for fractional scoring, which the LCP exam does not. Therefore, this range type is not applicable to the CLCP exam.

Anastasi (1976) and Lyman (1978) concluded that the range is the crudest and least of the stable methods for determining variance, and suggest that measuring variability among scores should be based on the difference between each individual's score and the mean of the group. Therefore, the most dependable measure of variability is the ***standard deviation*** (Lyman, 1978).

Huck, Courmier, and Bounds (1974) noted that the best measures of variability include the variance and the standard deviation. The standard deviation is based upon the variance, and both are based on all of the scores in the group, or in terms of the CLCP examination, all scores that have accumulated since the first administration of the exam. Huck et al. (1974) noted that the variance is determined by calculating how much each score deviates from the mean and placing these deviation scores into a computational formula. From this formula, the variance is derived and the standard deviation is derived from square root of the variance. The variance formula is noted as follows:

$$\sigma = \frac{\Sigma x^2}{N}$$

Where σ = Symbol for Variance

x^2= Scores squared

Σx^2= sum of squared scores

N = Total number of scores

Using the following scores from the earlier example, the variance is determined as follows:

Table 1 – Illustration of Variance Calculation

Score and Mean Calculation (X and $\bar{X}$)	Score – Mean ($X - \bar{X}$)	Sum of Score/Mean Differences Squared
71	71 – 78.3	53.29
66	66 – 78.3	24.60
90	90 – 78.3	136.89
88	88 – 78.3	94.09
89	89 – 78.3	114.49
72	72 – 78.3	39.69
65	65 – 78.3	176.89
67	67 – 78.3	127.69
80	80 – 78.3	2.89
95	95 – 78.3	278.89
$\sum X = 783$		$\sum X^2 = 1{,}049.41$
$\bar{X} = \frac{\sum X}{N} = \frac{783}{10} = \mathbf{78.3}$		

Therefore, using the formula

$$\sigma = \frac{\Sigma x^2}{N}$$

The variance is calculated as follows:

$$\frac{1,049.41}{10} = \mathbf{104.94}$$

The Standard Deviation is calculated by determining the square root of the variance, illustrated in the following formula:

$$SD = \sqrt{\frac{\sum (X - \overline{X})^2}{N}}$$

Where SD = Standard Deviation

$\sqrt{\ }$ = "Take the square root of"

$\sum$ = "Add the values of"

X = Raw score on CLCP exam

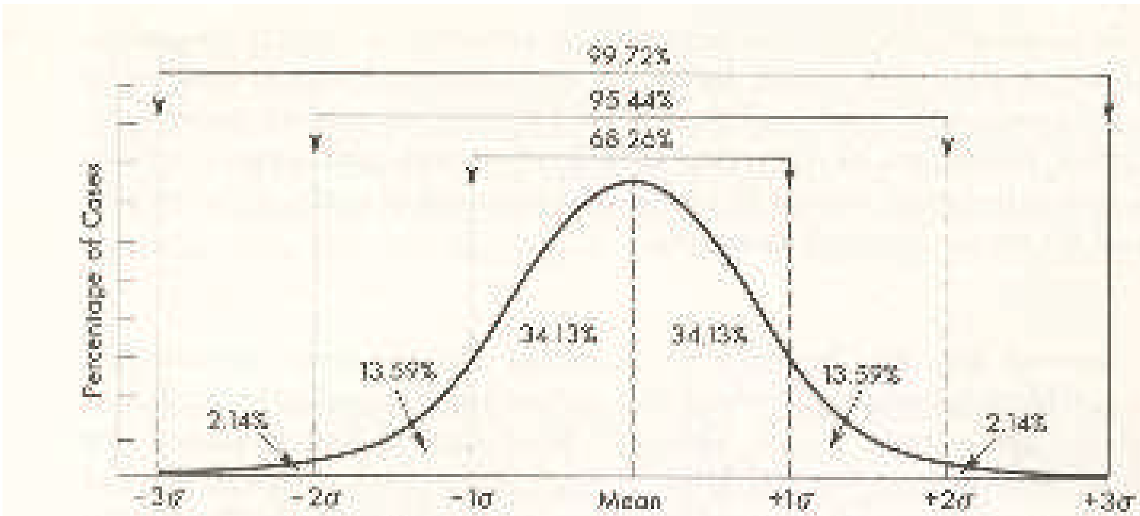
$\overline{X}$ = Mean of Group of Scores

N = Population of test scores

Thus, the square root of the variance of 104.94 totals 10.244022647378324, rounded to a standard deviation of 10.

Cut Score Determination: The cut score for the CLCP examination is based on the standard deviation and the central tendency of the group mean within the standard deviation. A closer review of the central tendency curve is warranted to better understand how the cut score is determined and applied after each test administration. The standard deviations that comprise the "normal" curve, or distribution of scores is illustrated in Figure 2.

Figure 2 – Standard Deviation and Score Distributions of the Normal Curve



The "central tendency" of population trait factors and test scores evolved from the work of the Belgian mathematician Adolf Quetelet (1796-1874), who was the first scientist to apply Gauss' normal law of error to the distribution of human data, both biological and social (Shertzer & Linden, 1979). Quetelet hypothesized that he middle of the distribution curve (Figures 1 and 2) is where the smallest distribution of errors occur, which reflects the ideal that nature sought in human life development. Thus, the "average" person was Quetelet's belief of nature's ideal creation, while deviations away from the average were nature's errors (Shertzer & Linden, 1976). Thus, Quetelet encouraged systematic studies of individual differences and the application of statistical methods in the study of human behavior.

Bolton (1987) noted that most values, whether they be test scores, human characteristics (i.e., height, weight, age), or psychological variables cluster around the central point of the Bell curve (Figures 1 & 2), with fewer values at greater distances from the average. Regarding interpretations based on the "normal" distribution of traits or scores, 34.13% of the area under the curve lies between the mean and a point that is one standard deviation away from it. When considering two standard deviations, one above and one below the mean, 68.26% of the population falls within this range (Lyman, 1978). In short, approximately two thirds of the area (scores, etc.) will fall within one standard deviation of the mean in most distributions, either above the mean or below the mean. Only one third of the cases will be more than one standard deviation away from the mean. Thus, the CHCC accepts test scores as meeting the cut-off range within one standard deviation below the mean.

A review of the earlier test-scores will illustrate the application of the standard deviation towards determining the cut score. Please note the scores in Table 2.

Table 2 – Cut Score Determination

Scores	Standard Deviation Relationship to the Mean
71 66 90 88 89 72 65 67 80 95	$\overline{X}$ = 78.3 SD = 10 1 SD Below the $\overline{X}$ = 68.3

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A review of Figure 2 suggests that roughly 68% of the population of scores should fall within one standard deviation from the mean score. This constitutes one standard deviation above and below the mean. We know that one standard deviation above the mean is without doubt a passing score because this is where approximately 34% of the population should have scored, and that it remains above the mean suggesting an acceptable demonstration of knowledge as presented on the test. The key issue remains with one standard deviation below the mean. Approximately 34% of the population should have fallen within this distance below the mean, suggesting a total of 68% of the test scores should accumulate at this point on the "normal" distribution curve. Given the standard deviation of 10 and the mean score of 78.3, one standard deviation below the mean reveals a test-score of 67.7, rounded up to 68 ($\overline{X} - SD = Minimum \quad Acceptable \quad Score$). Thus, a test score of 68 suggests that this person meets the cut score for passing the exam, while anyone achieving a 67 score and lower will not be credited with a passing score. After reviewing our example one finds CLCP candidates with scores of 65, 66, and 67 failed to meet the cut score and will have to retake the exam.

The current statistical review regarding the cut score is illustrated in Figure 3.

Figure 3 – Current Cut Score Statistical Data

N of cases	**868**
Minimum	**55.00**
Maximum	**93.00**
Mean	**74.20**
Standard Dev	**6.900**
Std. Error	**0.234**
C.V.	**0.093**
Cut-Score ($\bar{X}$-*SD*)	**67.3**

References

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