



TWO NORMING

2.1 OVERVIEW OF CLT10 NATIONAL NORMS

THE CLT10 NATIONAL NORMS WERE developed to provide a norm referenced interpretation for CLT10 total scores. A normative sample, resembling the national demographics of the target student population, forms the peer group with whom a student's CLT10 score can be compared. A percentile rank represents the percentage of scores that are at or below it, indicating that the student performs at a higher level than that percentage of students in the population. The percentile norm also allows education legislators to identify low performing students and provide them with additional learning resources and remedial instructional help in preparation for college.

For a test that does not have widespread coverage of the target population, conducting a national norming study requires deliberately recruiting a representative sample of the target population. For this norming study, the data used was taken from the spring 2019 administration of the CLT10, which may not be fully representative of the CLT10 student population. In addition, as the CLT10 evolves in the upcoming years, it is likely that the sample used for this current study will be superseded. This initial exploration of norms based on the available sample provides preliminary information about the normative standing of CLT10 scores relative to the targeted population.

This study employed the following method to obtain a representative sample. First, a set of exclusion rules were applied in cleaning the data. Sample stratification was conducted to match the national population of students in home schools, private schools, and charter schools. Several key demographic variables such as gender, ethnicity, geographic region, locale, and school type, were compared during stratification. The stratified sample was then used to create the CLT10 national percentile norms.

2.2 NATIONAL TARGET POPULATIONS

The CLT10 national target population demographics were derived from the 2016 national survey by the National Center for Education Statistics (NCES) for private schools and home schooling households. Specifically, Table 206.10 (retrieved from https://nces.ed.gov/programs/digest/d17/tables/dt17_206.10.asp) and Table 206.30 (retrieved from https://nces.ed.gov/programs/digest/d18/tables/dt18_206.30.asp), published in the Digest of Education Statistics, were used. Table 206.10 reports 3.76% of grade 9-12 students were home schooled in 2016. Table 206.30 indicates grades 9-12 students in public and private school systems, including 3% in charter schools and 9.03% in private schools. Thus, the entire grade 9-12 NDE student population includes 3.76% home schooled, 2.89% (or $.03 \times (1 - 0.0376)$) in charter, and 8.69% (or $.0903 \times (1 - 0.0376)$) in private schools. That is, 15.34% (i.e., $3.76 + 2.89 + 8.69$) of grade 9-12 students in the US in 2016 make up the CLT10's target population. Within the CLT10's target population, 24.51% (or $3.76 / 15.34$) are home schooled, 18.84% (or $2.89 / 15.34$) attend charter schools, and 56.65% (or $8.69 / 15.34$) attend private schools.

Figure 1. U.S. students, 9-12th grade by school type

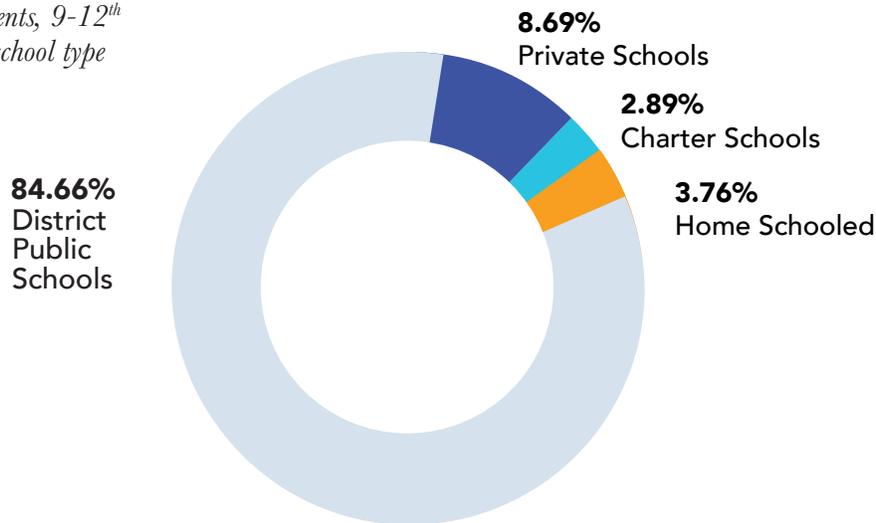


Figure 2. Non-district U.S. students, 9-12th grade by school type

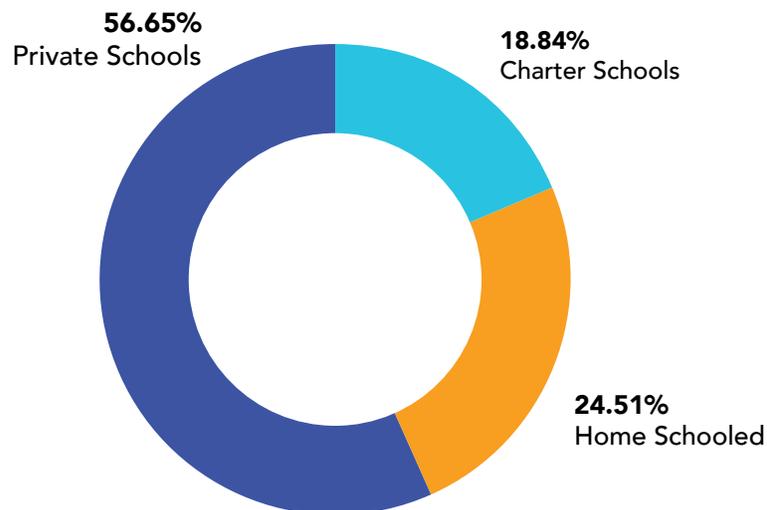


Table 2.1. Demographics of Population Targets by School Type for the CLT10

	SCHOOL TYPE			WEIGHTED CLT10 POPULATION TARGET %
	CHARTER ² (18.84%)	PRIVATE ² (56.65%)	HOMESCHOOL ¹ (24.51%)	
<i>Gender</i>				
Male	51.4	50.3	47.8	49.9
Female	48.6	49.7	52.5	50.1
<i>Ethnicity</i>				
White	30.4	62.1	59.2	55.4
Black	26.2	12.1	7.8	13.7
Hispanic	36.0	15.0	26.3	21.7
Asian/Pacific islander	4.7	6.3	2.6	5.1
Other	2.7	4.4	4.1	4.0
<i>Region</i>				
Northeast	16.8	26.1		23.8
South	16.7	23.3		21.7
Midwest	20.6	26.5		25.0
West	45.9	24.1		29.6
<i>Locale</i>				
City	57.8	37.2	29.2	39.1
Suburb	34.8	48.1	38.5	43.2
Town	3.4	3.0	10.5	4.9
Rural	4.0	11.8	21.8	12.8

The available demographics for each school type were obtained from each NCES Figure. These demographic percentages were weighted, based on the above calculated proportion of school types, to find the population demographic targets. Regional information was not available for homeschool students; hence, regional percentages were weighted based on charter and private school proportions only.

Table 2.1 presents the student demographic percentages available from NCES Tables 206.10 and 206.30 and the weighted percentages used as CLT10's target population demographics. (For example, the percentage for Male is obtained as $0.1884*51.4 + 0.5665*50.3 + 0.2451*47.8 = 49.9$.)

2.3 CLT10 INITIAL SAMPLE

The norming sample was drawn from the CLT10 spring 2019 administration. A total of 3,029 students had valid CLT10 scores. Several exclusion rules were first applied in data cleaning, including:

1. Removing all paper-and-pencil test scores.
2. Removing students from grades other than 9 and 10.
3. Removing students with missing demographic data in gender, ethnicity, or geographic area.

After data cleaning, the remaining 2,269 students were included in the initial sample. Table 2.2 presents the demographics for the initial sample. The initial sample is unbalanced in several categories, especially in ethnicity and geographic region.

Table 2.2. Student Demographics by School Type: Initial Sample vs. Target Population

	INITIAL SAMPLE %	POPULATION TARGET %	DIFFERENCE IN %
<i>School Type</i>			
Charter	4.8	18.8	-14.0
Private	56.5	56.7	-.2
Homeschool	38.7	24.5	14.2
<i>Gender</i>			
Male	45.7	49.9	-4.2
Female	54.3	50.1	4.2
<i>Ethnicity</i>			
White	79.3	55.4	23.9
Black	3.3	13.7	-10.4
Hispanic	6.6	21.7	-15.1
Asian/Pacific islander	5.2	5.1	.1
Other	5.7	4.0	1.7
<i>Region</i>			
Northeast	8.5	23.8	-15.3
South	51.4	21.7	29.7
Midwest	18.7	25.0	-6.3
West	21.4	29.6	-8.2
<i>Locale</i>			
City	19.2	39.1	-19.9
Suburb	27.1	43.2	-16.1
Town	0.9	4.9	-4.0
Rural	52.9	12.8	40.1

Note: Total percentage may not add up to 100% due to rounding.

2.3.1 SAMPLE STRATIFICATION

In order to prepare a representative sample while maintaining a sufficient sample size for norming, sample stratification involved duplicating scores of students from under-represented categories and eliminating scores from over-represented categories.

Both duplication and elimination have inherent limitations. Duplication process implies the assumption that students from the same demographics would perform the same. Given the large score range in CLT10 (i.e., 0-120), this assumption would probably not hold at the individual score point being duplicated. Elimination, on the other hand, risks removing information from the score distribution.

To limit the impact of the stratification process on the test score distribution and avoid introducing systemic bias, controls were used in both steps. Duplication was strictly used and was capped at 3, that is no single score could be counted more than 3 times. For elimination, when multiple scores were candidates for elimination, random selection was used. The stratification process triplicated 56 students, duplicated 224 students, and eliminated 1445 students, resulting in a total of 1160 students in the normative sample. Table 2.3 shows descriptive statistics for CLT10 scores from both the initial sample and the stratified sample. The score range and shape of the score distribution in the stratified sample remain similar to the original initial sample.

Table 2.3. CLT10 Score Statistics: Initial vs. Stratified Sample

SAMPLE	N	MEAN	STD	MIN	MAX
Initial	2269	75.7	16.5	22	117
Stratified	1160	74.7	16.9	22	117

2.3.2 CLT10 NORMING SAMPLE

The final national norm sample includes 1160 students. Table 2.4 shows the comparison in school type and other key demographics between the national norm sample and the population target. The national norm sample matches the target perfectly in school type distribution and resembles it closely in gender and ethnicity. The largest discrepancies are in geographic categories, with Southern and rural student proportions diverging by 10.5% and 12.9%, respectively. However, these were markedly improved from the initial sample, where the South is over-represented by 29.7% and rural by 40.1%. These national norm sample demographics and sample size are adequate for percentile norm development.

Table 2.4. CLT10 Student Demographics: Weighted Sample vs. Target Population

	NATIONAL NORM SAMPLE %	POPULATION TARGET %	DIFFERENCE %
<i>School Type</i>			
Charter	18.8	18.8	0
Private	56.7	56.7	0
Homeschool	24.5	24.5	0
<i>Gender</i>			
Male	45.8	49.9	-4.1
Female	54.2	50.1	4.1

<i>Ethnicity</i>			
White	56.5	55.4	1.1
Black	12.8	13.7	-.9
Hispanic	21.7	21.7	0
Asian/Pacific islander	5.1	5.1	0
Other	4.0	4.0	0
<i>Region</i>			
Northeast	24.5	23.8	.7
South	32.2	21.7	10.5
Midwest	19.5	25.0	-5.5
West	23.8	29.6	-5.8
<i>Locale</i>			
City	31.4	39.1	-7.7
Suburb	41.1	43.2	-2.1
Town	1.8	4.9	-3.1
Rural	25.7	12.8	12.9

Note: Total percentage may not add up to 100% due to rounding.

Table 2.5 presents the percentile rank correspondence to each obtainable CLT10 score. For ease of use, scores associated with the same percentile rank are grouped together in the Table.

Table 2.5. CLT10 National Percentile Norms (Target Population)

CLT10 Total Score	National Percentile Rank	CLT10 Total Score	National Percentile Rank
0-38	1	76	51
39-41	2	77	54
42-44	3	78	56
45-46	4	79	58
47-48	6	80	61
49	7	81	62
50-51	8	82	65
52	9	83	67
53	11	84	70
54	12	85	72
55	13	86	74
56	15	87	76
57	16	88	77
58-59	19	89	79
60	20	90	81
61	21	91	82
62	23	92	84
63	25	93	86
64	27	94	87
65	28	95	88
66	31	96	90
67	34	97	92
68	36	98	93
69	38	99-101	94
70	40	102	95
71	42	103	96
72	44	104-106	97
73	46	107-109	98
74	47	110-120	99
75	50		

2.4 CLT10 NATIONAL PERCENTILE NORMS (TARGET POPULATION)

Percentile norms are established for the CLT10. First, the 1st-99th percentile ranks for each total score in the normative sample were calculated. Then, the correspondence between each unique total score and percentile was obtained. If a score was associated with more than one percentile rank, the higher percentile value was used. For example, both the 10th percentile and 11th percentile were associated with total score 53, thus, 11 was chosen as the percentile rank for 53. Scores not directly associated with a percentile rank were placed in the adjacent rank down: for example, a total score of 50 was associated with the 8th percentile and a score of 52 was associated with the 9th percentile, so a score of 51 was placed in the score category of 50, i.e., the 8th percentile.

Percentile norms map each performance level directly to the distribution of CLT10 scores for the normative sample. This norm score has a straightforward interpretation. A norm score indicates the percentage of students in the sample with a score at or above it. For example, a CLT10 score of 79 is normed at the 58th percentile, i.e. a student who gets a score of 79 performed as well as or better than 58% of students in the normative sample. This interpretation of performance with reference to peers makes it easy to identify students in need of academic assistance, and provides legislators empirical data for allocating education resources to them.

2.5 LIMITATIONS AND FUTURE CONSIDERATIONS

A limitation in the current norming study lies in the sample size and imbalance of the CLT10 user base as of spring 2019. The initial sample, as presented in Table 2.2, was unbalanced in several demographic categories. Most of the imbalance was smoothed out through stratification and weighting, but at the cost of rather substantial sample size reduction. Although random selection was used during sample stratification and the stratified normative sample is of sufficient size with close resemblance to the national targets for school type, gender, and ethnicity, and displays satisfactory resemblance to geographic targets, a more representative initial sample would be desirable.

In addition, it is expected that the CLT10's user base is in the growing phase. As a result, a shift in performance could happen. Such a shift is often upward, as more information and resources become available to students taking the exam. A shift downward could also take place, as a broader demographic range of students gain access to the test. During the period of rapid user growth for a test like CLT10, norm updating studies should be conducted, at least once per year, to track any significant performance shifts among examinees and to ensure that the national norms are referencing the most current CLT10 population performance. Norm updates could become less frequent once the CLT10 user base reaches equilibrium.

2.6 CONCLUSIONS

This study is the first step in creating CLT10 national norms, based on the sample available from the spring 2019 test administration. A CLT10 percentile norm score links the student's total score to the percentile rank in the normative sample. Allowing for the limitations discussed above, this provides serviceable norms for present use.