



FastBridge CBMmath Automaticity Level 3 Norms Update

Updated 06/16/2020

Illuminate Education FastBridge Technical Manual

FastBridge CBMmath Automaticity Level 3 Norms Update

Copyright © 2019 by Illuminate Education, Inc. All rights reserved.

Warning: No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, now known or later developed, including, but not limited to, photocopying, recording, or the process of scanning and digitizing, transmitted, or stored in a database or retrieval system, without permission in writing from the copyright owner.

Published and Distributed by Illuminate Education, Inc

150 South Fifth Street, Suite 600

Minneapolis, MN 55402

Email: sales@fastbridge.org

Website: www.fastbridge.org

Phone: [612.254.2534](tel:612.254.2534)

Table of Contents

List of Figures	3
List of Tables	3
Introduction	4
Methods.....	4
Assessment	4
Data.....	5
Procedures	6
Results.....	7

List of Figures

Figure 1. Distribution of national percentiles and L3 scores	7
Figure 2. Plot of L3 scores by national percentile and percentile derived from the sampling procedure. ..	8
Figure 3. Plot of L3 scores by national percentile and percentile derived from equipercentile equating with aMath.....	9
Figure 4. Comparison of national ROI percentiles with those obtained from random sampling procedure.	10

List of Tables

Table 1. CBMmath Automaticity L3 Content Blueprint	5
Table 2. Descriptive statistics of CBMmath L3 by grade and season.....	Error! Bookmark not defined.
Table 3. Mean and SD of aMath scale score and median national percentile by grade and season.	6
Table 4. Correlation of aMath and L3 scores by grade and season.	7

FastBridge CBMmath Automaticity Level 3 Norms Update

Introduction

The new FastBridge FASTtrack Math assessment and the new Screening to Intervention report for math released in the summer of 2020 include CBMmath Automaticity as a required assessment for grades 2 through 12. Initially, normed in Grade 3 only, due to the anticipated expanded use of this measure, FastBridge researchers extended the national seasonal and growth norms through Grade 6. The Grade 6 norms will be the basis for national percentiles and risk benchmarks through Grade 12.

FastBridge CBMmath Automaticity is a set of brief (less than 5 minutes) 30- or 40-item fixed form tests comprised of one- and two-digit constructed response computation problems. There are screening forms: Level 1, Level 2, and Level 3 that align to math fluency standards in Grades 1, 2, and 3. This test is timed and results in a rate-based, corrects per 10-minute score.

The Level 3 form of the test includes addition, subtraction, multiplication, and division items. Performance on this form correlates moderately with broad math achievement (see Table 4 below) and serves as an indicator for math computation deficits. Research shows that deficits on basic computation can persist into adulthood. In middle school from 5% to 15% of students still have not developed automaticity on math facts and basic 2-digit math operations. Considering this, and the importance of basic math skills as a gateway for success in formal Algebra and beyond, the CBMmath Automaticity Level 3 is a required FASTtrack math assessment through Grade 12.

National norms represent the performance of students in the national population for a given test and usually at a given grade. Despite that, national norms are rarely based on data from the *entire* population. For obvious reasons it is not practical to assess all students in the population. As an alternative, test publishers rely on carefully selected student samples that reflect the composition of the total population of students. Sometimes this is done through prospective data collection, but frequently it is done using test score data that have already been collected (i.e., extant). By randomly sampling scores from extant databases, such that the final sample represents overall population characteristics, the resulting score distribution should approximate the true population.

Access to the full spectrum of student-level demographic data necessary to generate a representative sample is not always possible. An alternative approach is to use school level demographic data. This is appropriate when the test is administered universally (to all students) in the school at the targeted grade levels. The U.S. Department of Education annually publishes counts of students by grade and demographic for all U.S. schools. This was the source of the student demographic information that FastBridge used to develop national norms (see FastBridge Demographically Matched National Norms, 2019).

Methods

Assessment

CBMmath Automaticity Level 3 (L3) is a digitally administered math computation assessment. Students solve open-ended basic addition, subtraction, multiplication and division problems for up to 4 minutes. Problems are presented vertically, and students use the 0 through 9-digit keypad on the screen to

provide their answer. The total score is reported as a percent correct and as corrects per 10 minutes; thus, providing an indication of the student’s accuracy and efficiency solving basic math computation problems. Table 1 shows the item distribution by math operation.

Table 1. CBMmath Automaticity L3 Content Blueprint

Skill	Number of Items
2-digit addition through 100	4
2-digit subtraction through 100	4
Multiplication math facts through 12	16
Division facts with dividends through 100	16

Data

All screening administrations of CBMmath L3 in Grades 4 – 6 during the 2017-18 and 2018-19 school years were used in the analysis. Table 2 shows the number of administrations and mean and standard deviation of the correct per 10-minute score by grade and season. Most students completed the test in all three seasons.

Table 2. Descriptive statistics of CBMmath L3 by grade and season

Grade	Season	Count	Mean	SD
4	1	6624	29.17	22.79
4	2	6094	45.05	30.10
4	3	6541	53.74	34.47
5	1	5531	45.19	29.30
5	2	5527	60.60	35.60
5	3	5525	70.67	40.86
6	1	2520	62.02	37.07
6	2	2549	77.32	44.49
6	3	2528	89.73	51.36

CBMmath L3 was designed to assess skills commonly included in core math instruction in Grade 3. Even so, this assessment has application for older students, especially those who are at-risk in math computation or general math skills. The steady increase in the mean score within and across grades is noteworthy as it indicates that accuracy and efficiency on basic computational skills continue to develop through 6th Grade.

Because it targets Grade 3 standards and because FastBridge includes other math assessments based on standards taught in Grades 4 – 6, CBMmath Automaticity L3 has had far less usage in these grades than in Grade 3. This poses a challenge for the development of national norms. First, it is unlikely that the population of students completing CBMmath Automaticity L3 in higher grades is demographically representative of the national student sample. Second, it is reasonable to expect that it is used more frequently with struggling students, therefore, biasing the distribution of scores downward. This biasing can be seen in Table 3 which shows the average performance on FastBridge aMath for students who also completed CBMmath Automaticity L3 in Grades 4 – 6. The median percentile by grade and season

ranges from the mid-30s to mid-40s. In a representative sample, the median is 50. Thus, the overall sample has slightly lower math ability relative to the general population.

Table 3. Mean and SD of aMath scale score and median national percentile by grade and season.

Grade	Season	n	aMath Scale Score		National Percentile	
			Mean	SD	Median	SD
4	1	6624	207.57	8.27	39	28.14
4	2	6094	210.61	8.61	42	28.28
4	3	6541	213.71	10.20	42	28.35
5	1	5531	212.05	9.07	36	26.75
5	2	5527	214.89	10.20	37	26.95
5	3	5525	217.41	11.45	39	27.19
6	1	2520	215.80	9.74	42	25.71
6	2	2549	218.81	11.02	43	26.67
6	3	2528	220.83	11.83	45	27.12

Procedures

To address the lower scores observed in the sample for Grades 4 through 6, FastBridge researchers used aMath scores to identify a sample representative of the national population. Because aMath assesses the full range of math standards, performance on aMath is a good indicator of general math ability.

For each grade 4 – 6 and season 50 student scores were selected randomly with replacement at each aMath national percentile from 1 to 99, resulting in 4,950 CBMmath Automaticity L3 scores per grade and season. Figure 1 shows the distribution of aMath national percentiles and the CBMmath Automaticity L3 corrects per 10-minute score for the Grade 5 winter sample. The flat teal curve represents the percentage of students at each national percentile. Because exactly 50 students were sampled from each percentile the height is constant from 1 to 99. The smooth red curve represents the distribution of CBMmath Automaticity L3 scores (labeled l3.sc) for this sample. Because this sample was selected using aMath national percentiles it provides a very good approximation of the distribution of the CBMmath Automaticity L3 scores in the national population for this grade and season.

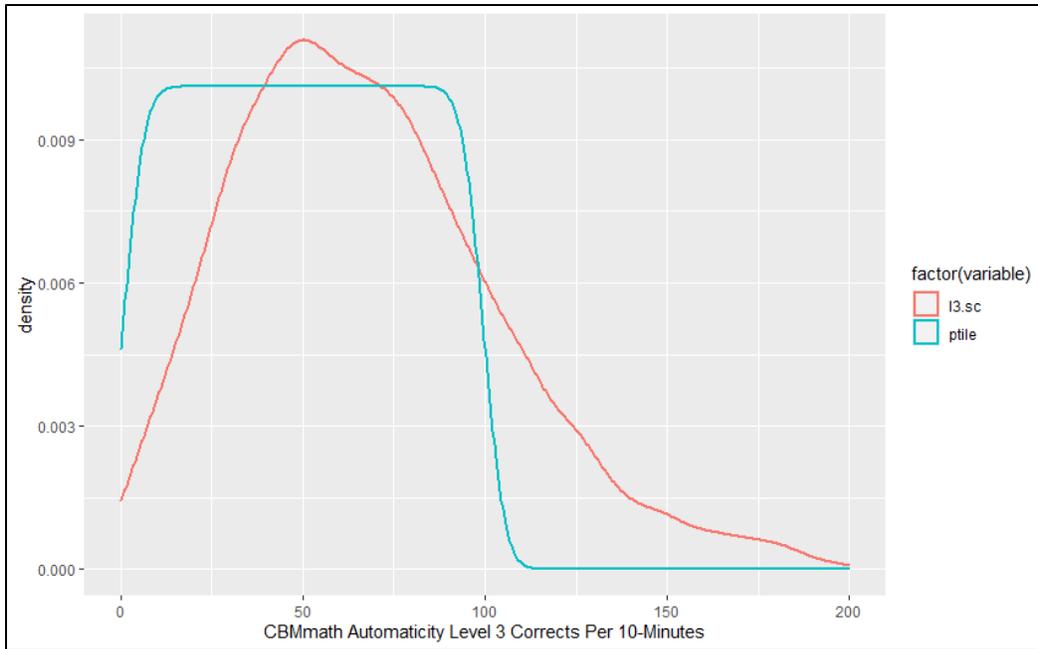


Figure 1. Distribution of national percentiles and L3 scores

The logic for this method is premised on the fact that CBMmath Automaticity L3 scores are moderately correlated with aMath scores (see Table 4). Because each sample is representative of the national population with respect to aMath scores, by extension it should be representative of the computational skills measured in CBMmath Automaticity L3 for these additional grades. Interestingly, the correlation with aMath scores is modestly higher in Grades 4 – 6 than in Grade 3.

Table 4. Correlation of aMath and L3 scores by grade and season.

Grade	Season	Corr.
3	1	0.49
3	2	0.55
3	3	0.59
4	1	0.53
4	2	0.60
4	3	0.61
5	1	0.56
5	2	0.60
5	3	0.62
6	1	0.55
6	2	0.61
6	3	0.63

Results

To verify the effectiveness of the random sampling approach, we applied the same sampling procedure to Grade 3 data where we already have national CBMmath Automaticity L3 norms. Figure 2 shows the

correspondence between CBMmath Automaticity L3 scores and percentile ranks using the current L3 national (natl) norms and those derived from the sample selected from aMath national percentiles (amath), resulting in two curves per season. Although there is a small difference between the two methods in the winter sample, for each season the curves are nearly identical.

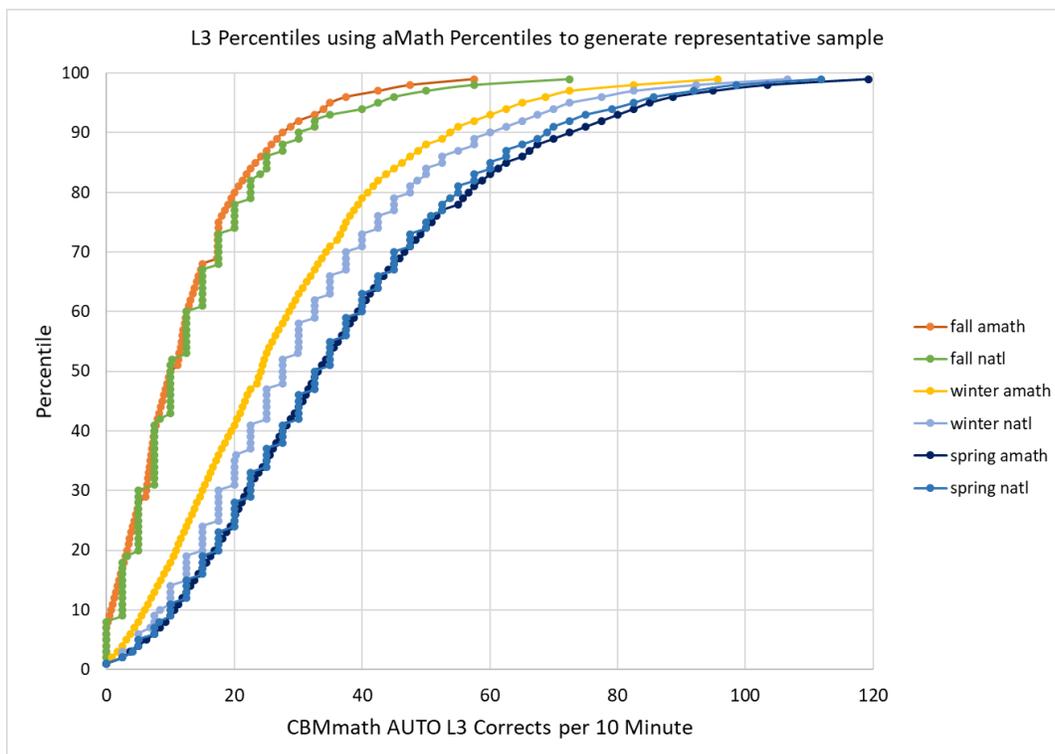


Figure 2. Plot of L3 scores by national percentile and percentile derived from the sampling procedure.

To put this in context, we compared the results generated from the random sampling procedure with what would be obtained using equipercentile equating with aMath. Figure 3 shows the relationship between CBMmath Automaticity L3 scores and actual national percentiles and those estimated from equipercentile equating. The equipercentile equating results show a substantial level of overlap with the actual national percentiles; however, the deviations are larger than those derived from the random sampling method. Thus, although equipercentile equating could have sufficed, we opted to use the random sampling method because it provides greater consistency. Furthermore, we were able to use the samples from this method to generate national growth norms in Grades 4 – 6.

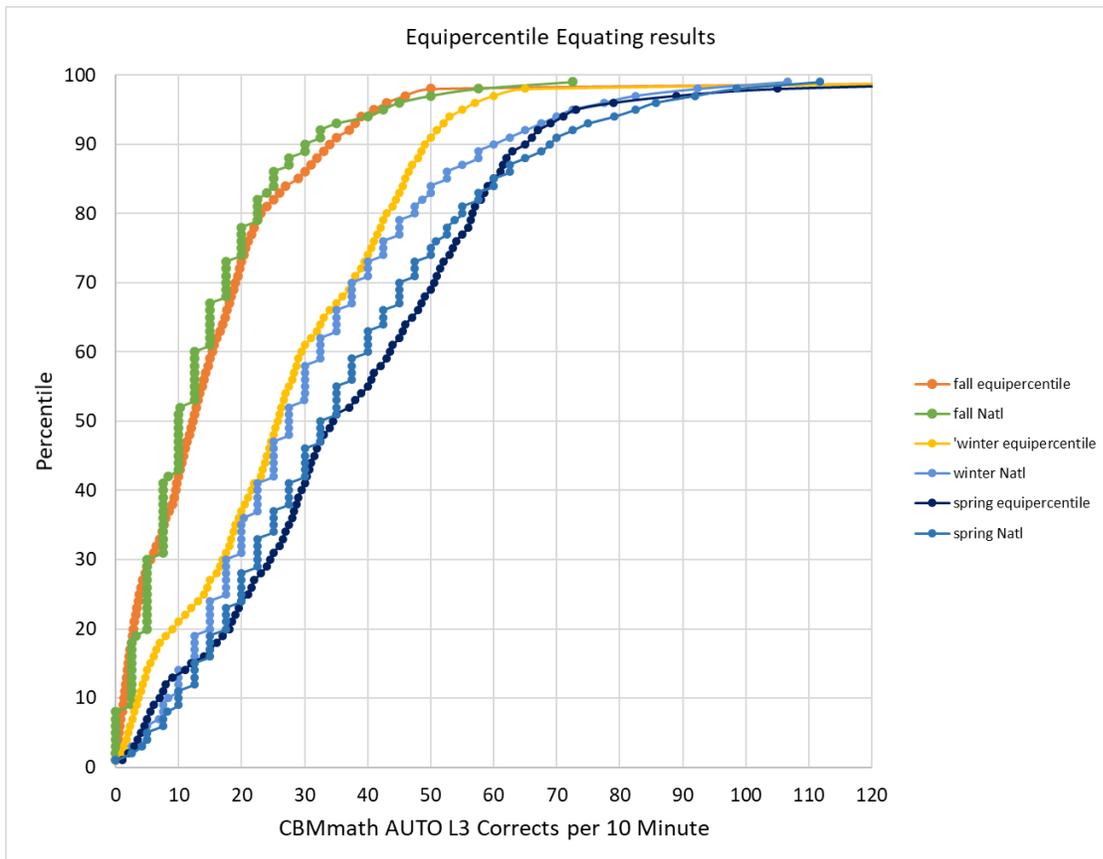


Figure 3. Plot of L3 scores by national percentile and percentile derived from equipercntile equating with aMath.

As indicated above, the samples produced from the random sampling procedure conditioned on aMath national percentiles were also used to generate national ROI growth norms. As with the seasonal national percentiles, we evaluated the effectiveness of the method by comparing it to the actual national ROI growth percentiles on CBMmath Automaticity L3 for Grade 3. In Figure 4, the curves showing the greatest similarity are those comparing existing national ROI norms and those derived from the randomly generated samples. For instance, the blue and orange lines represent the percentiles from the random sample (blue) and the current norms (orange). Notice that the lines are nearly identical. By extension we can expect that this method will result in highly accurate national growth norms on CBMmath Automaticity L3 for Grades 4 through 6.

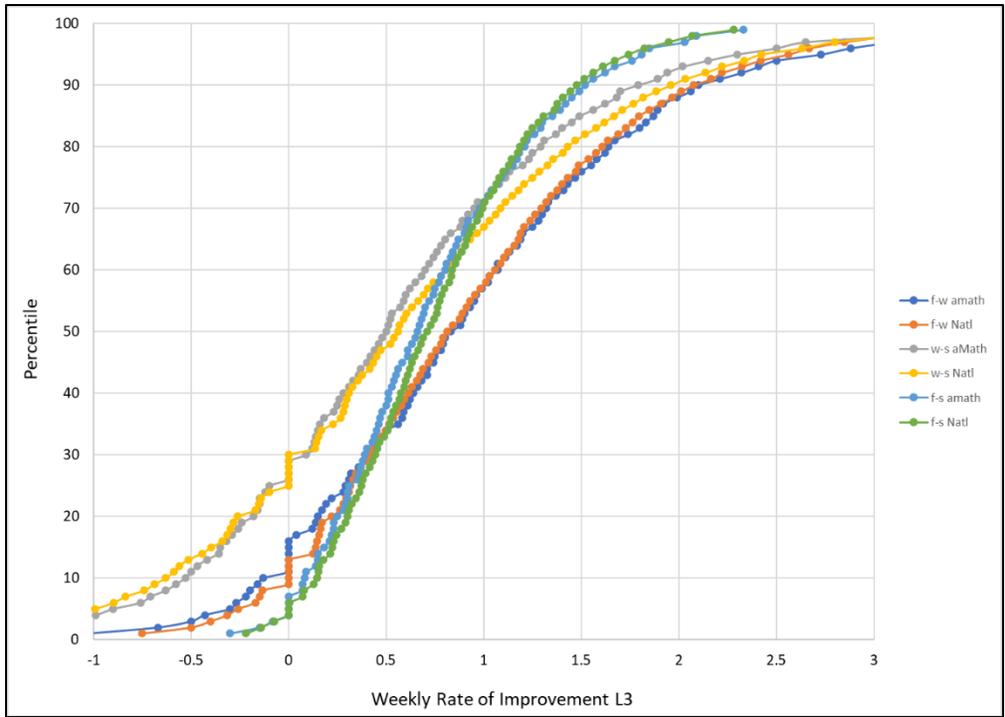


Figure 4. Comparison of national ROI percentiles with those obtained from random sampling procedure.