Technical Report # 1313

easyCBM CCSS Math Item Scaling and Test Form Revision (2012 – 2013): Grades 6 - 8

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Published by

Behavioral Research and Teaching
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http://brt.uoregon.edu

Note: Funds for this data set used to generate this report come from a federal grant awarded to the UO from the Institute of Education Sciences, U.S. Department of Education: Developing Middle School Mathematics Progress Monitoring Measures (R324A100026 funded from June 2010 - June 2014).

Abstract

The purpose of this technical report is to document the piloting and scaling of new easyCBM mathematics test items aligned with the Common Core State Standards (CCSS) and to describe the process used to revise and supplement the 2012 research version easyCBM CCSS math tests in Grades 6-8. For all operational 2012 research version test forms (10 progress monitoring and 3 benchmark) five items were selected for removal based on statistics indicating less than optimal functioning. Items from the current pilot were used to replace the five selected items. Additionally, five items previously written to the National Council of Teachers of Mathematics Focal Point Standards, but rated as aligned with the CCSS, were added to each form. Finally, an additional fifteen items were included in benchmark tests to link forms across grades, in preparation for future vertical scaling of tests. Common items were also included between benchmark forms within each grade for planned horizontal scaling analyses.

easyCBM CCSS Math Item Scaling and Test Form Revision (2012 – 2013): Grades 6-8

During the 2010-2011 school year, we hired middle school math teachers to write 900 mathematics test items in each of grades 6-8 to align with the Common Core State Standards (CCSS; Anderson, Irvin, Patarapichayatham, Alonzo, & Tindal, 2012). Originally, we planned to pilot and scale all 2700 items in the same year, but we were unable to recruit a large enough sample to provide robust scaling. Thus, we split the items into two groups of approximately equal size, and included roughly equal proportions of items from across the CCSS areas in each grade. Approximately 50% of the total item bank was piloted during the 2011-2012 school year and calibrated on a common vertical scale with a Rasch model. The remaining items were retained in the item bank for piloting with new samples of students in subsequent years. Initial scaling results guided test form development, as 13 alternate forms were constructed, designed to measure equivalent content and be of comparable difficulty. All test forms were designed for use within a school-wide response to intervention (RTI) system (see Deno et al., 2009), with three test forms designated for seasonal benchmark screening and ten designated for progress monitoring.

All test forms were initially released for use during the 2012-2013 school year. An investigation into the reliability of the test forms, conducted during the winter of 2013, suggested some items were functioning at less than optimal levels (Anderson, Alonzo, & Tindal, 2013). During the winter of the same year, an additional pilot study was conducted to calibrate a portion of the remaining items not piloted during 2011-2012. In this technical report, we present the results of the scaling pilot conducted during the winter of 2013. We further discuss how we used the information gained through item piloting, in conjunction with the reliability study, to revise

and supplement the CCSS math tests in grades 6-8. The purpose of this revision was to increase the reliability and accessibility of the test forms while maintaining alternate form comparability.

Methods

Procedures

The purpose of this study was twofold: to (a) calibrate additional items onto the vertical scale created during the initial item development (Anderson et al., 2012) and (b) revise the operational test forms to enhance their psychometric properties. Below, we first describe our piloting plan, followed by the procedures taken during form revisions.

Item piloting. Our piloting plan included a minimum of 200 responses per item to obtain stable and reliable estimates. Thus, the number of items piloted at each grade varied, based on the number of students recruited for participation in the study, with 106 items piloted in grade 6, 132 piloted at grade 7, and 141 piloted in grade 8. Items for this study were randomly selected from the pool of items not previously piloted.

During the actual piloting of the items, all students first took the Winter CCSS math benchmark form from their respective grades. Immediately following the final item of the Winter CCSS math benchmark, students were presented with 25 pilot items. Students thus did not experience a transition between tests. Rather, it appeared as though they were taking one continuous 50-item test, instead of two 25 item tests. Pilot items were presented to students based on a conditional random sampling built into the online test administration programming: Students' were presented items conditional on the number of students having previously responded to the item. Further, no students were presented the same item twice. For a detailed description of the development of all items, see Anderson et al. (2012).

Operational test form revisions. Analyses conducted during a reliability study of the 2012 research version of the CCSS middle school math tests indicated that some items were poorly discriminating between high and low ability students (Anderson et al., 2013). Across all 13 test forms within each grade, the five items with the lowest discrimination were identified and removed from the test. Five items from the current pilot were used to replace these five items, all of which displayed statistics that fit the Rasch model and correlated highly with the latent trait (additional details are reported in the analyses section).

Analyses from Anderson et al. (2013) also suggested that the CCSS mathematics items were, on average, more difficult than mathematics items previously available as part of the easyCBM system, which were written to align with the National Council of Teachers of Mathematics (NCTM) Focal Point Standards. To enhance the accessibility of the tests and address the potential that the 2012 research version of the tests were too difficult to reliably assess struggling students' math knowledge and skills, we decided to embed five additional items from the NCTM-based easyCBM item bank that were also aligned with the CCSS. Irvin, Park, Alonzo, and Tindal (2012) conducted a study examining the alignment of a portion of the NCTM-based mathematics items to the CCSS in mathematics. The results of Irvin et al. were thus used as the basis for selecting which NCTM-based easyCBM mathematics items to include.

Finally, forms designated for benchmark screening were constructed with additional common items linking between forms both within and across grades. Within each grade, five items were selected to be common between the fall and winter benchmark, while a different set of five items was selected to be common between the winter and spring benchmark. Additionally, each benchmark test form contained five items in common with the same seasonal benchmark in both the grade above and below. For example, the seventh grade fall benchmark

test was constructed to include five items from Grade 6 and five items from Grade 8. A common item design was followed across grades K-8 (see Irvin, Alonzo, Saven, Park, & Tindal, 2013) to allow for later calibration of a common scale both within and across grades.

Participants

Five schools from five districts participated in this study, with four located in the Pacific Northwest and one located in the Southwest. The southwestern school was quite large, including 300-350 students in each of grades 7 and 8. Of the remaining four schools participating in the study, one was of similar size and included students in grades 6-8, while all others included fewer than 200 students per grade. Table 1 displays the number of students participating in the study by school and grade.

All participants in this study were subscribers of the district version of easyCBM – an online formative assessment system designed for use within an RTI framework (Riverside, Fall 2012). All District easyCBM subscribers who had previously participated in a study with Behavioral Research and Teaching were emailed a participant recruitment letter, as displayed in Figure 1. Participation was incentivized by providing District easyCBM to the district for the following year at a free or reduced price, depending on the level of participation. Additionally, payments were made to the district at a rate of $50 per participating classroom. Teachers were eligible to participate with all classrooms (e.g., class periods) and the district was compensated for each separately. The money paid to the district was then provided to the teachers for the purchase of classroom supplies.

Analyses

In this section we describe the analyses for calibrating all items onto the vertical scale established during the original item development (Anderson et al., 2013), and identification of items for removal from operational test forms.

Scaling analysis. All items were piloted in conjunction with the Winter CCSS math benchmark so that items could be calibrated onto the existing scale through a non-equivalent groups anchor test (NEAT) equating design. A Rasch model was used for calibration of all items and persons, defined as

$$P(X_{is} = 1|\theta_s, \beta_i) = \frac{exp[(\theta_s - \beta_i)]}{1 + exp[(\theta_s - \beta_i)]} \quad (1)$$

where P = probability,

X_{is} = the response of student s to item i,

θ_s = the estimated ability of student s, and

β_i = the estimated difficulty of item i.

During calibration of the pilot items, students' responses to both the operational benchmark items and the pilot items were used concurrently. The item difficulties for the Winter CCSS benchmark, β_i, were then anchored to the values estimated during the 2010-2011 pilot (e.g., the vertical scale values). The item difficulties for the pilot items were then freely estimated *relative to* the anchored values, by using person estimates from the anchored items to calibrate the non-anchored items (DeMars, 2004). The anchored items thus adjusted the calibrations (e.g., item difficulties, β_i) of the pilot items to reflect the 2011-2012 vertical scale.

Winsteps version 3.68 was used for all analyses. Winsteps uses a two-stage estimation process. The first stage consists of a preliminary estimation through PROX, which according to the users manual "capitalizes on the similar shapes of the logistic and normal ogives. [The

algorithm] models both the persons and the items to be normally distributed" (Linacre, 2011, p. 488). PROX is run to create initial estimates of person and item locations. These estimates are used as the starting point for the second stage of estimation with joint maximum likelihood estimation (JMLE). Strict convergence criteria were used when running all analyses and no maximum iteration level was set. When equating test forms, common item difficulties and step values were anchored between forms.

Item analyses. Anderson et al. (2013) report item discrimination statistics for test forms 6-10 for each of grades 6-8 by means of the point-biserial correlation. Statistics from that report are reproduced here, as those were the five items selected for removal. For the remaining test forms (1-5 and seasonal benchmarks) items were selected for removal based on a combination of extant data, when available, and items statistics from the original pilot. Point-biserial (in the case of extant data) and point-measure correlations (in the case of pilot data) were the primary selection criteria for item removal. CCSS items from the current pilot replaced all items removed from the 2012 research version of the test forms.

To be included in the revised test forms, all items had to have a mean square outfit ranging from 0.8 to 1.2, and a point measure correlation of *at least* .2. Generally, the point measure correlations were above .3, and were maximized wherever possible. Forms were then constructed by examining the average item difficulty within a form. Each time a new item was added, the mean difficulty for that form was recalculated. Item difficulties were balanced across forms to bring test form averages as close to equivalent as possible.

NCTM Item Selection

Five NCTM-based items were also added to each of the CCSS test forms. During the alignment study by Irvin et al. (2012), items from the seasonal NCTM-based mathematics

benchmarks were rated for alignment with the CCSS. When multiple items from a common domain were rated as aligning with the same CCSS, generalizations were made to all NCTM items measuring the same domain. These items were then used to supplement the operational CCSS test forms. Because the NCTM items were calibrated on a different scale, efforts were made to make the five items added to the forms as comparable in difficulty as possible. In other words, items were not added relative to the difficulty of CCSS items, but rather by means of adding a "constant" set of item difficulties to maintain form comparability.

Irvin et al. (2012), however, only gauged the alignment of items within seasonal benchmarks. We planned to include five NCTM items in our blueprint for revising the CCSS math operational test forms. Thus, generalizations had to be made from the items that were rated as aligned to the full NCTM item bank. Tables 2-10 provide a summary of how generalization decisions were made. In each table, the NCTM domain is listed, followed by the number of items within that domain that were selected for review. The third column provides the number of items reviewed that were rated as aligned with a CCSS, along with which CCSS specifically (e.g., EE.1 = Expressions and Equations, Standard 1). Finally, the fourth column denotes the decision applied. In cases where the majority of items were all rated as aligning with the same CCSS (e.g., four of the six items originally written to align with NCTM domain *Develop meaning and use of variables* were rated as aligned with CCSS EE.2), all remaining items in the NCTM item bank were coded as aligning with the corresponding CCSS. In cases where items aligned to multiple standards but a common domain, the remaining items were coded as aligning with the domain generally. However, if the majority of items were not aligned with a common domain, or if the items were rated as aligned with multiple clusters, all items were removed from consideration.

Results

We first present the results of our scaling analysis, followed by form revisions. We provide an appendix with complete scaling results and tables and figures of test form revisions.

Scaling Analysis

The results of our scaling analyses are presented for Grade 6-8 in Appendix A. Note that in the *Status* column a value of "F" indicates the item was freely estimated (i.e., pilot items) while a value of "A" indicates the item was anchored (i.e., benchmark items anchored at the original scale value). In the *Name* column, any item with 6 in the second column represents a sixth grade item, while items with a 7 or 8 in the second column represent Grade 7 and 8 items, respectively. Figures 2-4 show the distribution of anchored and freely estimated item difficulties for grades 6-8, respectively. For Grades 6 and 7 the distribution of freely estimated items was quite similar to the distribution of anchored items, though the mean of the anchored items was slightly below the mean of the freely estimated items. For Grade 8, the item distributions and means were quite similar.

Form Construction

The item difficulties for each form are presented in Tables 11-13 (pp. 25-30). Note that all progress monitoring forms were constructed to contain 25 grade-level CCSS-based items and 5 NCTM-based items, while the benchmarks contained an additional 15 items for vertical linking. In all tables, we first present the average difficulty of the 25 CCSS-based items, followed by the overall item difficulty within the test form. All test forms (including the benchmarks) were constructed to have a similar mean difficulty among the 25 CCSS-based items. Five NCTM-based items of approximately comparable difficulty were then added to the test forms. Thus, all 13 test forms within each grade were constructed to be of comparable

difficulty across the first 30 test items. However, because off grade-level items were added to the benchmark test forms, no efforts were made to keep the benchmark forms comparably difficult to the progress monitoring forms across all 45 items. Rather, 45 items in the three benchmark forms were constructed to be of comparable difficulty, while the first 30 benchmark items were constructed to be of comparable difficulty to the 30-item progress monitoring forms. Benchmark forms, therefore, by design were routinely offset in their overall mean difficulty from the progress monitoring forms, but could be compared to progress monitoring forms by calculating students' score on only the first 30 items.

New CCSS items added to test forms are displayed in blue font in Tables 11-13, while horizontally-linking items are displayed in green font. Items 26-30 represent the newly-added NCTM items on each form. Items 31-45 on the benchmark test forms represent vertical linking items, with 31-35 representing on-grade items, 35-40 representing above-grade items (or additional on-grade items for Grade 8), and 41-45 representing below-grade items. The point-biserial or point-measure correlation for the removed items are displayed in Tables 14-17. Point-measure correlations from the original item pilot (see Anderson et al., 2012) are displayed in red font, while point-biserial correlations are displayed for all other items, calculated from data collected during the 2012-13 school year.

The distribution of item difficulties within all forms are displayed in Figures 5-7 for grades 6-8 respectively. For each boxplot, a solid black line represents the median item difficulty, while a hatched red line represents the mean item difficulty. Note that although the median differed across forms, the mean was nearly identical across all forms. Further, the interquartile range was quite close across forms and there were very few outlier items overall.

The offset difficulty of the benchmark forms was clearly evident in Grades 7 and 8, while the benchmark forms in Grade 6 exhibited a more subtle difference.

Discussion

Measurement development is an iterative process that hinges on balancing accessibility, practical feasibility (e.g., test length), and psychometric characteristics. The revisions made to the easyCBM CCSS math tests, as reported here, should help increase the technical adequacy of the measures while simultaneously increasing accessibility, particularly for students struggling with mathematics. The revisions should not hinder the practical usability of the measures. While a 45-item benchmark test is a bit lengthy, these measures generally should not take longer than 30 minutes to administer. Further, for students in need of progress monitoring, the benchmark measure score can easily be transformed to the progress monitoring scale (by removing the final 15 items) so these data points can be included in progress monitoring decisions. The progress monitoring measures themselves remain quite short, at only 30 items, with a balanced representation of items aligned to each CCSS domain.

In future years, it will be important to continue to monitor the technical adequacy of the measures. Much of the structure of the CCSS mathematics assessment forms in grades 6-8 were based on a pilot study conducted when teachers' instruction was generally not aligned specifically to the CCSS. Thus, the difficulty of these items may "drift" as students have more opportunity to learn the content. If this happens, alternate form comparability may be compromised. Annual inspections of form difficulties, as well as item analyses, should thus be completed, with minor revisions to the test forms made as necessary.

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Table 1

Participant Sampling Plan

			n students		
District	*n* classrooms	*n* teachers	Grade 6	Grade 7	Grade 8
A	11	6	51	115	136
B	28	8	-	297	352
C	38	17	388	364	361
D	20	7	191	187	190
E	11	3	99	98	83
Total	108	41	729	1061	1122

Table 2

Grade 6 Number & Operations – Understanding & Fluency

Domain	*n* items rated	*n* items aligned	Decision
Develop, analyze, & apply strategies – powers of 10	4	1 - EE.1	Exclude
Develop, analyze, & apply strategies – mixed numbers	9	3 – NS.1	Exclude
Use inverse relationship between multiplication & Division	8	1 – NS.1 1 – NS.3 1 – EE.5	Exclude
Use relationship between decimals & fractions to solve problems	10	1 – NS.1	Exclude

Table 3

Grade 6 Algebra

Domain	*n* items rated	*n* items aligned	Decision
Develop meaning & use of variables	6	4 – EE.2	Include
Identify & represent equivalent expressions	6	1 – EE.2 2 – EE.2 1 – EE.3 1 – EE.5	Include (as EE generally)
Recognize that the solutions of an equation are the values of the variables that make the equation true.	9	3 – EE.2 2 – EE.5 2 – EE.6	Include (as EE generally)
Represent, analyze and determine relationships and patterns using tables, graphs, words and when possible, symbols.	2	1 – EE.2	Include
Solve one-step equations by using number sense, properties of operations and the idea of maintaining equality on both sides of an equation.	8	4 – EE.2 2 – EE.7	Include (as EE generally)
Use order of operations to simplify expressions, including exponents and grouping symbols.	8	5 – EE.1 1 – EE.3	Include (as EE.1)
Write, evaluate, and use expressions, formulas, and equations to solve problems.	4	2 – EE.2 1 – EE.6 1 – RP.3	Exclude (RP item)

Table 4

Grade 6 Number & Operation – ratio & rate

Domain	*n* items rated	*n* items aligned	Decision
Determine simple probabilities, both experimental and theoretical.	11	1 – RP.3	Exclude
Develop and apply the meaning of ratios, rate and percent.	17	5 – RP.1 9 – RP.3	Include (as RP generally)
Solve a variety of problems involving ratios and rate.	18	16 – RP.3	Include

Table 5

Grade 7 Number & Operations & Algebra

Domain	*n* items rated	*n* items aligned	Decision
Develop and use strategies to estimate the result of rational number computations and judge the reasonableness of results.	15	1 – SP.5	Exclude
Develop, analyze, and apply models, strategies and procedures to compute with integers.	6	1 – SP.5	Exclude
Extend knowledge of integers and positive rational numbers to solve problems involving negative rational numbers.	11	2 – SP.5 1 – G.6 1 – EE.4	Exclude
Use properties of rational numbers and algebra to solve problems, which involve writing and/or solving linear equations in one variable.	12	2 – G.1 1 – RP.2	Exclude

Table 6

Grade 7 Measurement, Geometry, and Algebra

Domain	*n* items rated	*n* items aligned	Decision
Solve a variety of problems involving areas and circumference of circles, surface areas of 3-dimensional shapes and volumes of prisms and cylinders.	14	10 – G.4 3 – G.6 1 – NS.2	Include (as G generally)
Use models to explain the reasonableness of formulas for the circumference and area of circles.	24	13 – G.4 4 – G.6	Include (as G generally)
Use models to explain the reasonableness of formulas for the surface area and volume of prisms and cylinders.	6	5 – G.4	Include

Table 7

Grade 7 Number & Operations, Algebra, & Geometry

Domain	*n* items rated	*n* items aligned	Decision
Convert among different units of measurement to solve problems, including rates.	11	3 – NS.1 1 – G.6 1 – EE.4	Exclude
Develop and use proportional reasoning to solve problems.	4	3 – NS.1	Include
Represent graphically and with tables, proportional relationships and identify unit rate as the slope of the related line.	3	2 – NS.1 1 – NS.3	Include
Use proportional reasoning, drawings, models or technology to demonstrate congruence and/or similarity of objects.	8	5 – EE.4	Include
Use ratio and proportion to solve a wide variety of problems , including percent and simple probability.	9	2 – NS.1 1 – NS.2 1 – G.4 1 – EE.4	Exclude
Use scale factors or proportional relationships to solve problems involving similarity and congruency.	5	1 – NS.1	Exclude
Use tables, graphs, and equations to distinguish proportional relationships from other relationships, including inverse proportionality.	6	2 – NS.2	Exclude

Table 8

Grade 8 Algebra

Domain	*n* items rated	*n* items aligned	Decision
Determine the slope of a line and understand that it is a constant rate of change.	8	8 – F.3	Include
Recognize how the properties (i.e. slope, intercepts, continuity, and discreteness) of linear relationships are shown in the different representations.	7	4 – F.3 2 – F.4	Include (as F generally)
Relate systems of two linear equations in two variables to pairs of lines that are intersecting, parallel, or the same line.	3	2 – EE.8 1 – F.4	Exclude
Translate among verbal, tabular, graphical, and algebraic representations of linear functions.	12	3 – F.1 3 – F.3 4 – F.4	Include (as F generally)
Use linear functions and equations to represent, analyze and solve a variety of problems, and to make predictions and inferences.	4	3 – F.4	Include
Use systems of linear equations in two variables to represent, analyze, and solve a variety of problems.	5	4 – EE.8 1 – F.4	Exclude

Table 9

Grade 8 Geometry & Measurement

Domain	*n* items rated	*n* items aligned	Decision
Analyze and apply the Pythagorean Theorem to find distances in a variety of 2- and 3-dimensional contexts.	9	9 – G.7	Include
Use models to explore the validity of the Pythagorean Theorem using a variety of methods.	10	9 – G.7	Include
Use models to show that the sum of the angles of any triangle is 180 degrees and apply this fact to find unknown angles.	9	1 – G.5	Exclude
Use properties of parallel lines, transversals and angles to solve problems, including determining similarity or congruence of triangles.	9	1 – G.5	Exclude
Data Analysis, Number and Operation, and Algebra	14	2 – SP.1	Exclude
Data Analysis, Number and Operation, and Algebra	7	1 – SP.1	Exclude

Table 10

Grade 8 Data Analysis, Number & Operations, & Algebra

Domain	*n* items rated	*n* items aligned	Decision
Data Analysis, Number and Operation, and Algebra	14	2 – SP.1	Exclude
Data Analysis, Number and Operation, and Algebra	7	1 – SP.1	Exclude

Table 11
Grade 6 Item Difficulties

	Form												
Item#	1	2	3	4	5	6	7	8	9	10	Fall	Winter	Spring
1	-1.24	-0.89	-0.89	-1.53	-1.46	-0.81	-0.79	-0.76	-0.74	-0.72	-0.71	-0.71	-0.71
2	-0.44	-0.48	-0.44	-0.56	-0.57	-0.58	-0.59	-0.59	-0.61	-0.61	-0.62	-0.62	-0.63
3	-0.22	-0.31	-0.44	-0.26	-0.91	-0.91	-0.30	-0.32	-0.34	-0.83	-0.62	-0.37	-0.36
4	-0.09	-0.03	-0.31	-0.06	-0.09	-0.12	-0.21	-0.05	-0.02	0.07	-0.44	-0.17	0.01
5	0.67	0.83	0.20	0.39	0.40	0.39	0.35	0.87	0.29	0.19	-0.38	-1.28	-0.84
6	-1.11	-0.55	-0.57	-1.81	-1.51	-1.10	-0.74	-0.71	-0.62	-0.53	-2.05	-0.43	-0.41
7	0.16	-0.08	-0.11	-1.17	0.06	0.09	-0.04	0.03	-0.09	-0.13	-0.17	0.41	0.49
8	0.34	0.26	0.26	0.34	0.27	0.35	0.53	0.24	0.25	0.28	0.18	0.49	0.50
9	0.59	0.43	0.64	0.56	0.52	0.56	0.98	0.73	0.44	1.15	0.47	0.90	0.83
10	1.25	1.67	1.20	0.73	0.75	0.77	1.29	1.32	1.48	1.34	0.49	-1.25	-1.25
11	-1.17	-1.35	-1.17	-1.13	-1.12	-1.23	-1.47	-1.49	-1.31	-1.30	0.9	-0.86	-0.76
12	-0.85	-0.81	-0.96	-0.86	-0.86	-0.72	-0.69	-0.68	-0.86	-0.80	-0.86	-0.45	-0.62
13	-0.45	-0.55	-0.59	-0.55	-0.54	-0.63	-0.62	-0.64	-0.66	-0.55	-0.77	-0.24	-0.45
14	-0.23	-0.18	-0.17	-0.18	-0.20	-0.15	-0.11	-0.15	-0.24	-0.21	-0.64	-0.11	-0.11
15	0.14	-0.09	0.41	0.32	0.38	0.56	0.12	0.18	0.14	0.33	0.1	0.83	0.83
16	-1.53	-1.88	-1.95	-1.92	-1.92	-1.72	-1.44	-1.71	-1.49	-1.84	-1.35	-1.56	-1.41
17	-1.23	-0.97	-1.07	-0.96	-1.04	-1.18	-1.38	-1.17	-1.29	-1.13	-0.73	-1.20	-1.38
18	-0.88	-0.95	-0.84	1.37	-0.89	-0.79	-0.60	-0.56	-0.82	-0.67	-0.41	-0.92	-0.76
19	-0.31	-0.26	-0.34	-0.2	1.28	-0.39	-0.48	-0.49	-0.05	-0.44	0.04	-0.01	-0.39
20	0.01	-0.08	0.16	-0.08	0.08	0.17	-0.07	-0.52	0.07	-0.01	0.52	-0.51	0.07
21	-0.85	-0.79	-1.24	-0.85	-1.34	-1.27	-0.73	-0.85	-1.21	-0.86	-0.96	-0.50	-1.09
22	-0.64	-0.67	-0.45	-0.61	-0.31	-0.43	-0.69	-0.66	-0.32	-0.61	-0.51	-0.48	-0.50
23	-0.24	-0.23	-0.15	-0.29	-0.26	-0.15	-0.30	-0.23	-0.81	-1.51	-0.31	-0.22	-0.25
24	-0.11	-0.91	-0.14	0.52	-0.07	0.46	-1.55	-1.34	0.01	0.89	0.00	0.09	0.25
25	0.30	0.37	0.30	0.15	0.23	0.26	0.11	0.22	0.32	0.14	0.21	0.21	0.30
Average	-0.33	-0.34	-0.35	-0.35	-0.36	-0.34	-0.38	-0.37	-0.34	-0.33	-0.34	-0.36	-0.35

Table 11 (continued)
Grade 6 Item Difficulties

	Form												
Item#	1	2	3	4	5	6	7	8	9	10	Fall	Winter	Spring
26	-1.36	-1.34	-1.32	-1.31	-1.33	-1.33	-1.27	-1.29	-1.34	-1.35	-1.31	-1.31	-1.39
27	-0.88	-0.87	-0.86	-0.87	-0.81	-0.87	-0.80	-0.81	-0.88	-0.88	-0.82	-0.84	-0.89
28	-0.22	-0.16	-0.05	-0.05	-0.05	-0.13	-0.04	-0.05	-0.16	-0.21	-0.06	-0.13	-0.22
29	0.30	0.32	0.32	0.30	0.40	0.35	0.41	0.40	0.30	0.30	0.39	0.39	0.30
30	0.79	0.81	0.86	0.87	0.90	0.84	0.91	0.90	0.85	0.81	0.89	0.87	0.77
31										On	-1.93	-1.92	-1.92
32										On	-0.43	-0.42	-0.38
33										On	0.03	0.01	-0.03
34										On	0.12	0.15	0.11
35										On	1.11	1.12	1.15
36										Above	-1.73	-1.85	-1.81
37										Above	-1.08	-1.04	-1.04
38										Above	-0.58	-0.58	-0.60
39										Above	0.17	0.22	0.18
40										Above	1.13	1.05	1.07
41										Below	-1.24	-1.24	-1.25
42										Below	-0.33	-0.33	-0.33
43										Below	-0.15	-0.14	-0.15
44										Below	0.63	0.62	0.62
45										Below	1.00	0.98	1.01
Overall Average	-0.32	-0.33	-0.32	-0.32	-0.33	-0.32	-0.34	-0.34	-0.32	-0.32	-0.29	-0.30	-0.30

Table 12
Grade 7 Item Difficulties

	Form												
Item#	1	2	3	4	5	6	7	8	9	10	Fall	Winter	Spring
1	-0.32	-0.44	-0.30	-0.28	-0.28	-0.24	0.34	-0.23	-0.17	-0.15	-0.14	-0.11	-0.63
2	0.27	0.27	0.27	0.26	0.23	0.11	0.09	0.08	0.07	0.06	0.04	0.01	-0.11
3	-1.00	0.42	0.40	0.43	0.43	0.51	0.54	0.86	0.48	0.48	0.50	0.52	1.01
4	0.29	0.70	0.77	-0.37	1.53	0.66	-0.47	0.59	0.63	0.59	0.58	0.55	-0.90
5	0.88	0.88	0.88	0.88	0.89	0.90	0.96	-0.57	0.91	1.00	1.01	0.58	-0.02
6	-1.19	-0.49	-0.92	-0.85	-0.53	-0.46	-0.49	-0.61	-0.46	-0.75	-1.40	1.01	0.13
7	1.63	-0.36	-0.02	-0.08	-0.25	-0.38	-0.32	-0.25	-0.31	-0.41	-0.97	1.01	0.44
8	-0.01	0.14	0.17	0.16	0.02	0.14	-0.49	0.42	0.08	0.17	-0.95	-0.97	0.95
9	0.57	0.35	0.02	0.30	-1.39	-0.37	-0.67	0.44	0.36	-1.26	-0.12	-0.48	-0.51
10	0.73	0.58	1.03	1.04	1.54	1.27	0.63	0.83	-1.21	1.31	0.12	-0.02	-0.40
11	-0.78	-1.14	-0.83	-1.02	-0.79	-1.16	-0.74	-0.79	-1.00	-0.68	0.19	0.19	-0.22
12	-0.43	-0.38	-0.55	-0.38	-0.42	-0.38	-0.50	-0.45	-0.39	-0.58	1.38	-0.83	0.08
13	-0.29	-0.14	-0.22	-0.15	-0.29	-0.15	-0.25	-0.28	-0.21	-0.16	-0.83	-0.51	0.39
14	0.12	0.15	0.11	-0.02	0.08	-0.01	0.13	0.01	0.03	-0.05	-0.53	0.15	-0.44
15	0.26	-0.36	-0.12	0.40	-0.08	0.54	0.29	0.45	0.55	0.52	-0.25	0.23	-0.08
16	-0.32	-0.37	-0.49	-0.38	-0.49	-0.54	-0.34	-0.43	-0.39	-0.50	0.12	-0.31	0.08
17	-0.14	-0.07	-0.01	-0.14	-0.04	-0.04	-0.17	-0.07	0.24	-0.05	0.34	0.42	0.10
18	0.20	0.08	0.22	0.19	0.18	0.14	0.20	-0.73	0.16	0.05	-0.40	0.68	0.42
19	0.34	0.45	0.48	0.35	0.33	0.39	0.36	0.50	0.35	0.51	-0.09	-1.08	0.45
20	0.73	0.64	-0.04	0.24	0.71	0.09	0.70	0.67	0.69	0.56	0.12	-0.97	-0.97
21	-1.09	-0.73	-0.91	-1.10	-1.08	-0.85	-1.00	-0.84	-0.65	-0.66	0.66	-0.28	-0.74
22	-0.21	-0.30	-0.23	-0.19	-0.15	-0.24	-0.21	-0.26	-0.27	-0.31	0.79	-0.14	-0.05
23	0.08	-0.04	0.00	0.11	0.04	-0.01	0.05	-0.01	-0.01	-0.05	-0.28	0.00	0.00
24	0.39	0.08	0.27	0.34	0.33	-0.41	0.28	0.24	0.21	-0.62	-0.22	0.03	0.17
25	-0.92	-0.23	-0.12	-0.35	-0.31	0.24	0.55	0.52	-0.28	0.75	0.09	0.09	0.58
Average	-0.01	-0.01	-0.01	-0.02	0.01	-0.01	-0.02	0.00	-0.02	-0.01	-0.01	-0.01	-0.01

Table 12 (continued)
Grade 7 Item Difficulties

	Form												
Item#	1	2	3	4	5	6	7	8	9	10	Fall	Winter	Spring
26	-0.82	-0.81	-0.92	-0.78	-0.97	-0.81	-0.79	-0.98	-0.80	-0.81	-0.83	-0.92	-0.95
27	-0.30	-0.25	-0.26	-0.24	-0.30	-0.26	-0.24	-0.30	-0.24	-0.27	-0.30	-0.26	-0.29
28	0.15	0.18	0.12	0.18	0.09	0.12	0.16	0.10	0.19	0.11	0.11	0.12	0.15
29	0.27	0.28	0.32	0.33	0.25	0.31	0.33	0.26	0.33	0.30	0.26	0.29	0.27
30	0.64	0.64	0.62	0.66	0.62	0.60	0.66	0.52	0.66	0.62	0.63	0.65	0.65
31										On	-1.73	-1.85	-1.81
32										On	-1.08	-1.04	-1.04
33										On	-0.58	-0.58	-0.60
34										On	0.17	0.22	0.18
35										On	1.13	1.05	1.07
36										Above	-1.17	-1.18	-1.19
37										Above	-0.94	-0.94	-0.85
38										Above	-0.44	-0.44	-0.46
39										Above	0.02	0.03	0.01
40										Above	1.44	1.43	1.42
41										Below	-1.93	-1.92	-1.92
42										Below	-0.43	-0.42	-0.38
43										Below	0.03	0.01	-0.03
44										Below	0.12	0.15	0.11
45										Below	1.11	1.12	1.15
Overall Average	-0.01	-0.01	-0.01	-0.02	0.00	-0.01	-0.01	-0.01	-0.02	-0.01	-0.10	-0.10	-0.11

Table 13
Grade 8 Item Difficulties

	Form												
Item#	1	2	3	4	5	6	7	8	9	10	Fall	Winter	Spring
1	-0.43	-0.57	-0.49	-0.28	-0.26	-0.23	-1.63	-0.16	-0.15	-0.14	-0.14	-1.09	-0.12
2	0.12	0.08	0.07	0.00	-1.16	-0.03	-0.03	-0.03	-0.04	-0.07	-0.11	-0.13	0.29
3	-1.03	0.41	0.39	0.44	0.34	0.49	0.31	-1.20	0.17	0.22	0.01	-0.11	0.58
4	0.47	0.46	0.49	0.58	0.15	0.59	1.57	0.42	0.67	0.65	0.24	0.25	1.26
5	1.25	0.53	-0.01	0.48	1.14	0.59	1.14	1.65	-0.81	0.87	0.62	0.61	-0.75
6	-0.34	-0.34	-0.34	-0.16	-1.49	-0.14	-0.27	-0.11	-0.07	-0.12	0.99	0.98	-0.47
7	-1.23	-0.03	-1.09	0.18	0.05	0.17	-0.01	0.19	0.00	-1.92	-0.25	-0.75	-0.20
8	-0.62	0.40	-0.53	0.34	0.36	0.32	0.39	0.35	-0.68	-0.53	0.33	-0.25	0.01
9	0.57	-0.67	0.60	0.49	-0.28	0.57	-0.48	0.48	0.61	0.49	0.54	-0.21	0.24
10	1.28	0.74	0.79	-0.05	0.75	0.74	0.58	0.98	0.68	1.16	-0.46	-0.20	0.28
11	-0.66	-0.28	-0.37	-0.57	-0.34	-0.34	-0.34	-0.92	-0.43	-0.73	-0.45	0.28	0.31
12	0.06	-0.25	-0.09	0.03	-0.16	-0.18	-0.19	0.11	-0.07	0.07	0.17	0.72	-0.52
13	0.19	0.36	0.18	0.12	1.19	-1.09	0.27	0.44	-0.82	0.22	0.99	-0.04	0.00
14	0.72	0.77	1.35	0.79	0.77	0.60	0.62	0.57	0.76	1.03	-0.47	0.00	0.02
15	0.90	1.10	0.96	0.12	0.84	0.20	0.10	1.07	0.84	0.79	-0.32	0.18	0.15
16	0.50	-0.57	-0.51	-0.30	-0.31	-0.43	-0.54	-0.56	-0.30	-0.26	-0.13	0.77	0.88
17	-0.19	0.02	0.09	-0.06	-0.07	-0.01	0.09	0.03	-0.17	-0.17	0.24	0.88	0.93
18	0.30	0.24	0.11	0.12	0.12	0.16	0.13	0.23	0.25	0.30	0.34	-0.47	-0.46
19	0.33	0.34	0.38	0.39	0.42	0.38	0.42	-0.44	0.35	0.32	0.36	0.19	0.19
20	0.63	0.51	0.69	0.04	0.58	0.65	0.51	0.52	0.65	0.63	0.59	0.36	0.37
21	-0.72	-0.48	-0.84	-0.80	-0.57	-0.70	-0.49	-0.49	-0.68	-0.68	-0.55	-0.58	0.56
22	-0.12	-0.41	-0.10	-0.11	-0.32	-0.15	-0.38	-0.40	1.02	-0.61	-0.40	-0.40	-0.58
23	-0.09	0.18	-0.01	-0.05	0.03	-0.09	0.03	0.07	0.13	0.13	0.10	0.38	-0.13
24	0.49	-0.02	0.44	0.49	0.32	0.34	0.51	-0.60	0.20	0.21	0.22	0.53	-0.06
25	0.52	0.64	0.58	0.52	0.61	0.54	0.55	0.58	0.82	0.73	0.60	0.60	0.40
Average	0.12	0.13	0.11	0.11	0.11	0.12	0.11	0.11	0.12	0.10	0.12	0.10	0.13

Table 13 (continued)
Grade 8 Item Difficulties

	Form												
Item#	1	2	3	4	5	6	7	8	9	10	Fall	Winter	Spring
26	-0.73	-0.88	-0.69	-0.70	-0.68	-0.78	-0.73	-0.70	-0.76	-0.63	-0.79	-0.65	-0.68
27	-0.14	-0.20	-0.13	-0.13	-0.12	-0.18	-0.15	-0.14	-0.17	-0.11	-0.18	-0.11	-0.10
28	0.10	0.19	0.18	0.18	0.19	0.14	0.13	0.15	0.12	0.21	0.13	0.20	0.23
29	0.34	0.36	0.36	0.36	0.36	0.35	0.36	0.37	0.36	0.39	0.34	0.38	0.37
30	0.56	0.58	0.57	0.57	0.57	0.55	0.55	0.57	0.55	0.58	0.55	0.58	0.58
31										Extra	-1.67	-1.30	-1.44
32										Extra	-1.11	-1.13	-1.11
33										Extra	-0.71	-0.73	-0.71
34										Extra	-0.53	-0.55	-0.57
35										Extra	-0.20	-0.25	-0.23
36										On	-1.17	-1.18	-1.19
37										On	-0.94	-0.94	-0.85
38										On	-0.44	-0.44	-0.46
39										On	0.02	0.03	0.01
40										On	1.44	1.43	1.42
41										Below	-1.73	-1.85	-1.81
42										Below	-1.08	-1.04	-1.04
43										Below	-0.58	-0.58	-0.60
44										Below	0.17	0.22	0.18
45										Below	1.13	1.05	1.07
Overall Average	0.10	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	-0.10	-0.10	-0.08

Table 14

Point Biserial Correlation of Items Removed: Grade 6

Test Form	Item	Point Biserial *r*
1	i6EE2012	0.28
1	i6EE6017	0.19
1	i6G1001	0.07
1	i6G3002	0.16
1	i6G3017	0.23
2	i6EE2014	0.25
2	i6EE9004	0.19
2	i6G3023	0.32
2	i6RP3043	0.22
2	i6SP3035	0.10
3	i6EE6016	0.12
3	i6G3018	0.21
3	i6G4020	0.10
3	i6G4028	0.14
3	i6NS4007	0.24
4	i6EE6013	0.32
4	i6G2002	0.14
4	i6G3012	0.18
4	i6RP1040	0.22
4	i6SP4006	0.17
5	i6EE1001	0.40
5	i6EE3012	0.24
5	i6G2028	0.33
5	i6G3040	0.31
5	i6RP2029	0.09
6	6EE5018	.201
6	6EE8017	.220
6	6NS3001	.241
6	6SP5014	0.042
6	6SP1010	.228
7	6EE9002	.199
7	6G3043	.156
7	6G3025	-0.003
7	6G1013	.188
7	6SP1028	0.138

Note. Items displayed in red font were excluded based on the point measure correlation (from a Rasch analysis) from the original pilot data.

Table 14 (continued)

Point Biserial Correlation of Items Removed: Grade 6

Test Form	Item	Point Biserial *r*
8	6EE6018	.198
8	6G2025	0.137
8	6G4026	0.007
8	6RP2043	.148
8	6SP5023	.156
9	6G1026	.144
9	6NS8001	0.063
9	6RP1004	.195
9	6SP1034	.174
9	6SP4029	.184
10	6EE3019	0.126
10	6G4005	0.124
10	6G4025	0.081
10	6SP4025	.154
10	6SP5013	0.048
fall	i6EE8014	0.24
fall	i6G1006	0.02
fall	i6G4004	0.27
fall	i6NS8005	0.17
fall	i6RP1036	0.19
winter	i6EE8005	0.30
winter	i6G3013	0.18
winter	i6G3039	0.07
winter	i6SP4020	0.03
winter	i6SP5020	0.25
spring	I6G1035	0.22
spring	I6G1040	0.2
spring	I6NS6016	0.26
spring	I6SP2027	0.26
spring	I6SP1035	0.2

Note. Items displayed in red font were excluded based on the point measure correlation (from a Rasch analysis) from the original pilot data.

Table 15

Point Biserial Correlation of Items Removed: Grade 7

Test Form	Item	Point Biserial *r*
1	I7EE2014	0.1
1	I7EE4003	0.08
1	I7G2005	0.16
1	I7G4017	0.18
1	I7SP3011	0.11
2	I7EE2011	0.22
2	I7G4030	0.16
2	I7NS3027	0.21
2	I7SP7011	0.19
2	I7SP1002	0.24
3	I7G4018	0.07
3	I7NS3023	0.11
3	I7RP3033	0.19
3	I7RP3040	0.08
3	I7SP7008	0.17
4	I7EE3013	0.19
4	I7EE1011	0.12
4	I7RP1009	0.15
4	I7SP6008	0.21
4	I7SP7016	0.19
5	I7EE3024	0.11
5	I7EE4011	0.11
5	I7G2026	0.15
5	I7RP1012	0.21
5	I7SP1005	0.14
6	7G2014	0.046
6	7G4019	-0.039
6	7RP3016	0.09
6	7SP4017	-0.049
6	7SP4019	0.134
7	7EE2044	0.015
7	7EE1029	.163
7	7G2015	.144
7	7G5027	0.134
7	7G4015	0.091

Note. Items displayed in red font were excluded based on the point measure correlation (from a Rasch analysis) from the original pilot data.

Table 15 (continued)

Point Biserial Correlation of Items Removed: Grade 7

Test Form	Item	Point Biserial *r*
8	7EE3037	0.043
8	7EE4043	0.13
8	7G2011	0.045
8	7RP3056	0.11
8	7RP2010	0.099
9	7G5004	0.068
9	7NS3031	0.042
9	7RP3031	.150
9	7SP4014	.153
9	7SP3008	0.098
10	7G2006	0.107
10	7G2010	0.04
10	7G5029	0.135
10	7SP7019	-0.053
10	7SP2018	0.139
fall	I7G3011	0.15
fall	I7G5023	0.11
fall	I7G1008	0.15
fall	I7RP3003	0.18
fall	I7SP2017	0.19
winter	I7EE2010	0.2
winter	I7EE1042	0.22
winter	I7EE2002	0.18
winter	I7G2017	0.24
winter	I7RP1010	0.24
spring	I7EE1045	0.26
spring	I7EE2042	0.28
spring	I7G5007	0.14
spring	I7G2018	0.05
spring	I7SP7017	0.23

Note. Items displayed in red font were excluded based on the point measure correlation (from a Rasch analysis) from the original pilot data.

Table 16

Point Biserial Correlation of Items Removed: Grade 8

Test Form	Item	Point Biserial *r*
1	i8EE5007	0.23
1	i8F1010	0.31
1	i8F1031	0.22
1	i8F5025	0.25
1	i8NS2014	0.29
2	i8EE4021	0.18
2	i8EE6013	0.25
2	i8F3002	0.19
2	i8G3016	0.18
2	i8SP1029	0.19
3	i8EE5008	0.26
3	i8EE6003	0.29
3	i8F2005	0.24
3	i8F3020	0.25
3	i8G8018	0.17
4	i8EE2022	0.15
4	i8EE3003	0.25
4	i8F2001	0.13
4	i8G3001	0.06
4	i8NS1066	-0.08
5	i8EE3021	0.37
5	i8EE4023	0.11
5	i8F1004	0.21
5	i8F2017	0.29
5	i8G9005	0.01
6	8EE4001	0.094
6	8EE6014	.189
6	8G8014	.204
6	8G4007	0.068
6	8SP2032	.169
7	8EE2012	.204
7	8EE1009	.199
7	8F1035	0.112
7	8F1034	.176
7	8G2015	0.124

Note. Items displayed in red font were excluded based on the point measure correlation (from a Rasch analysis) from the original pilot data.

Table 16 (continued)

Point Biserial Correlation of Items Removed: Grade 8

Test Form	Item	Point Biserial *r*
8	8EE7011	.181
8	8EE3006	.231
8	8EE1001	.139
8	8NS2040	.262
8	8SP4027	0.137
9	8EE7016	.171
9	8F3033	.235
9	8F1011	.192
9	8G5004	0.131
9	8SP1041	.173
10	8F1013	0.13
10	8F2033	0.101
10	8F1015	0.117
10	8G7002	.156
10	8SP1014	.163
fall	i8EE1010	0.16
fall	i8F2036	0.26
fall	i8F3022	0.25
fall	i8G3011	0.11
fall	i8G8007	0.17
winter	i8EE3022	0.30
winter	i8F2003	0.19
winter	i8F3029	0.17
winter	i8F5017	0.25
winter	i8SP2029	0.28
spring	I8EE5004	0.1
spring	I8F4029	0.24
spring	I8NS1070	0.28
spring	I8SP3045	0.28
spring	I8G8017	0.31

Note. Items displayed in red font were excluded based on the point measure correlation (from a Rasch analysis) from the original pilot data.

UNIVERSITY OF OREGON
College of Education

easyCBM Common Core Math Scaling: 2012 – 2013: Grades 6-8

Recruitment Status: Actively Recruiting Participants

Purpose: Screening and progress monitoring assessments depend on alternate forms to be of equivalent difficulty to accurately reflect student growth. If equivalent alternate forms do not present the same degree of difficulty, then changes in student performance over time may be due to features of the measures, as opposed to student learning. The purpose of this study is to calibrate the difficulty and functioning of newly-created middle school math items so that alternate forms of comparable difficulty and with comparable psychometric properties may be created and used as part of a response to intervention (RTI) system. These new mathematics measures were written by middle school math teachers to align to the Common Core State Standards.

Teacher-student samples: We need approximately 3,500 students in each of grades 6 and 8, and 3,600 students in grade 7. To participate in this study, teachers will use a study-specific website to first administer the Winter CCSS Math benchmark test. Immediately following the benchmark test on the study-specific site, a random selection of 25 pilot test items will be provided. Teachers will ensure that students take all 50 items during a single testing occasion.

Description of Logistics: Begin Jan. 1 – End Feb. 28

1. Once the teacher has been accepted into the study, BRT will provide a web link to a site that has been set up specifically for use during the study.
2. The teacher will (a) assist students in logging into the website, and (b) monitor students throughout the testing session.
3. The teacher will ensure that all students take all 50 test items in one sitting. We estimate approximately 45 minutes to one hour for participation.
4. Teachers complete a brief survey and return their tax forms so payment can be issued.

Benefits or payments (if any): Payment will be issued at a rate of $50 per class, with a minimum of 20 students necessary for participation. Payment will be sent upon completion of the study and receipt of all forms required for tax recording purposes. Teachers with multiple classes are encouraged to participate. Additionally, participation will count towards districts' research partner status, by which districts are eligible to receive easyCBM the following year at a reduced or free rate, depending on the level of participation.

Contact: email your interest in participation to Steffani Mast (steffani@uoregon.edu).

BEHAVIORAL RESEARCH AND TEACHING
5262 University of Oregon, Eugene OR 97403-5262 T (541) 346-3535 F (541) 346-5689 http://brt.uoregon.edu

Figure 1. Call for participants.

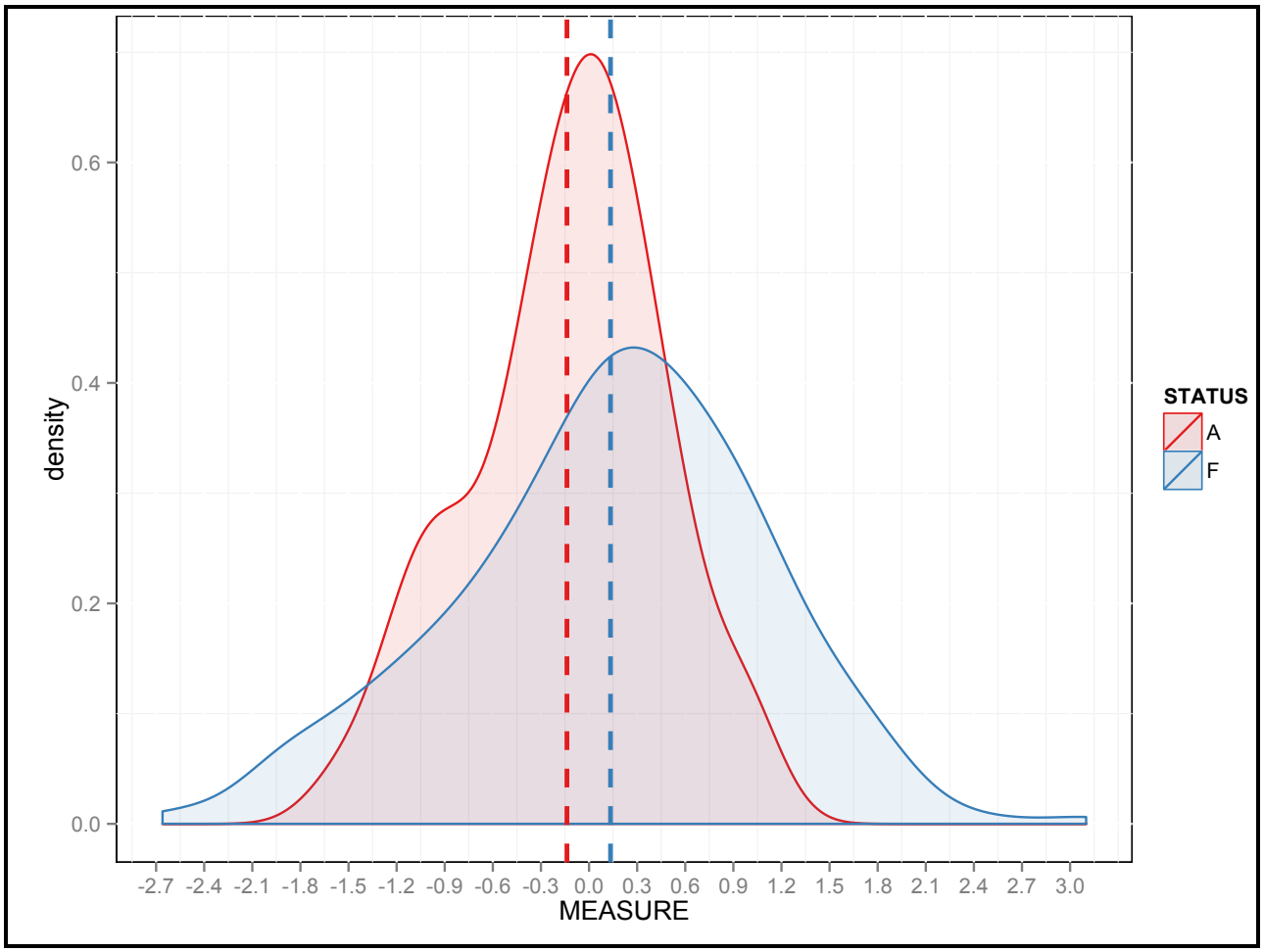

Figure 2. Distribution of Grade 6 item difficulties for anchored and freely estimated items.

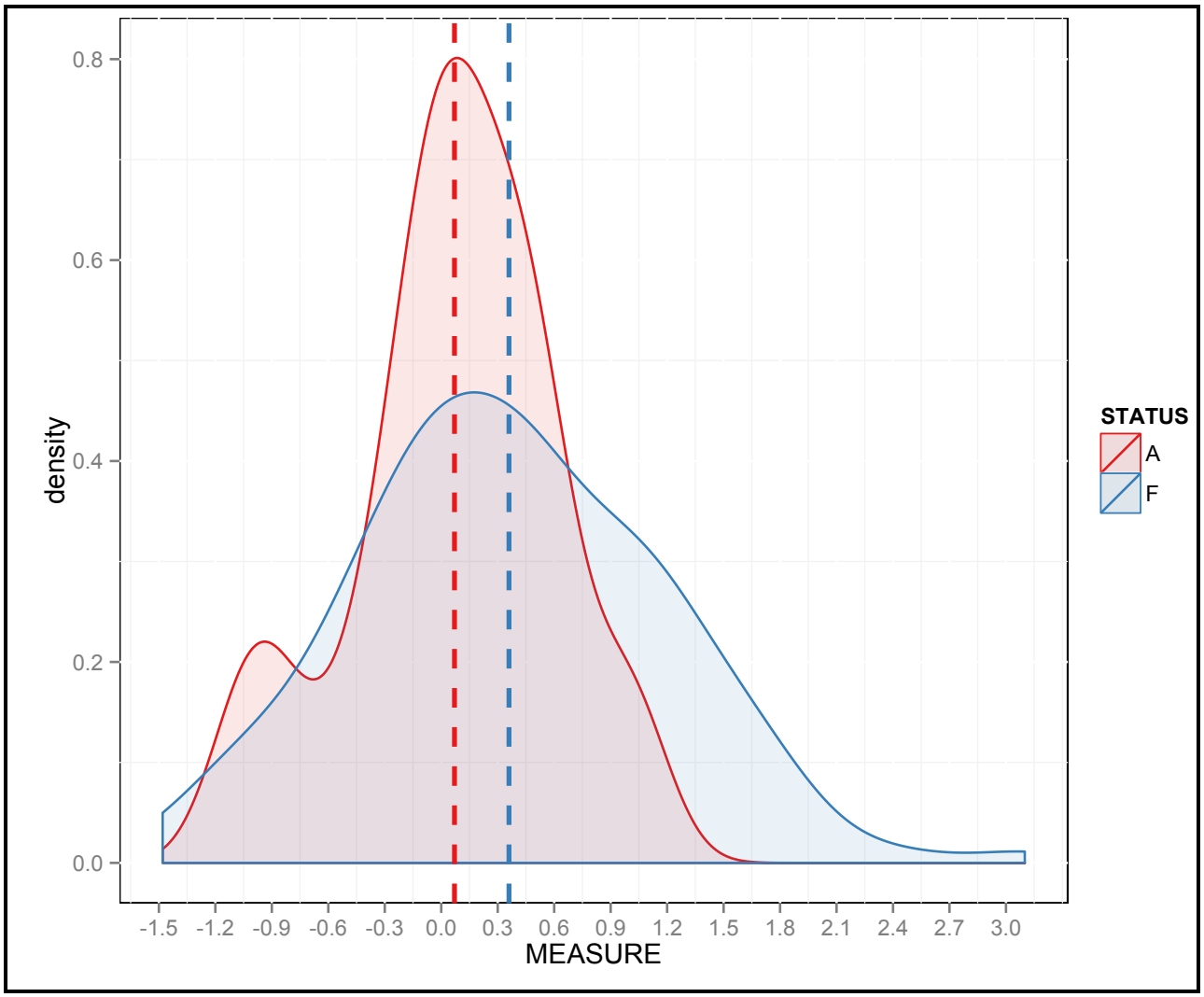

Figure 3. Distribution of Grade 7 item difficulties for anchored and freely estimated items.

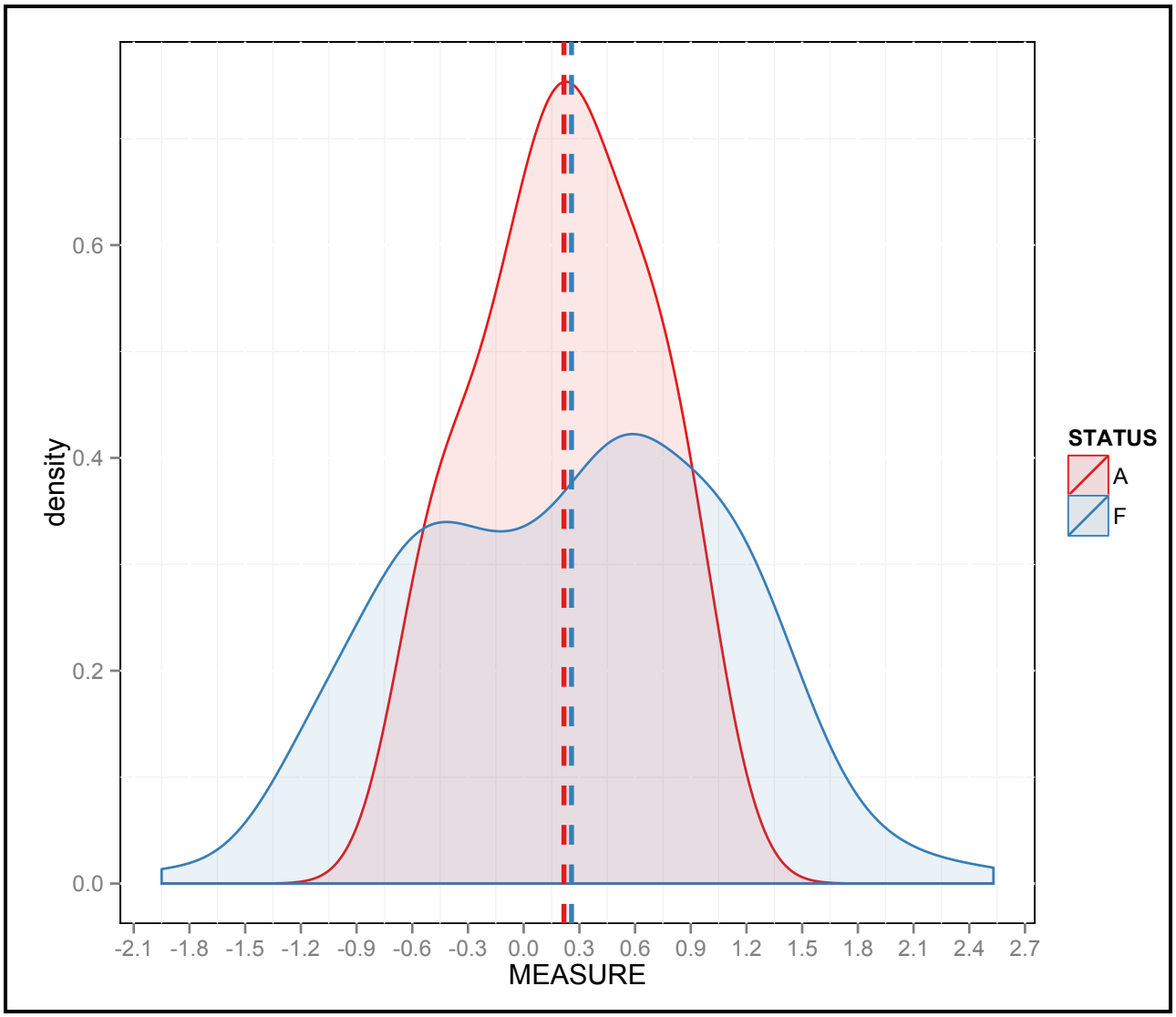

Figure 4. Distribution of Grade 8 item difficulties for anchored and freely estimated items.

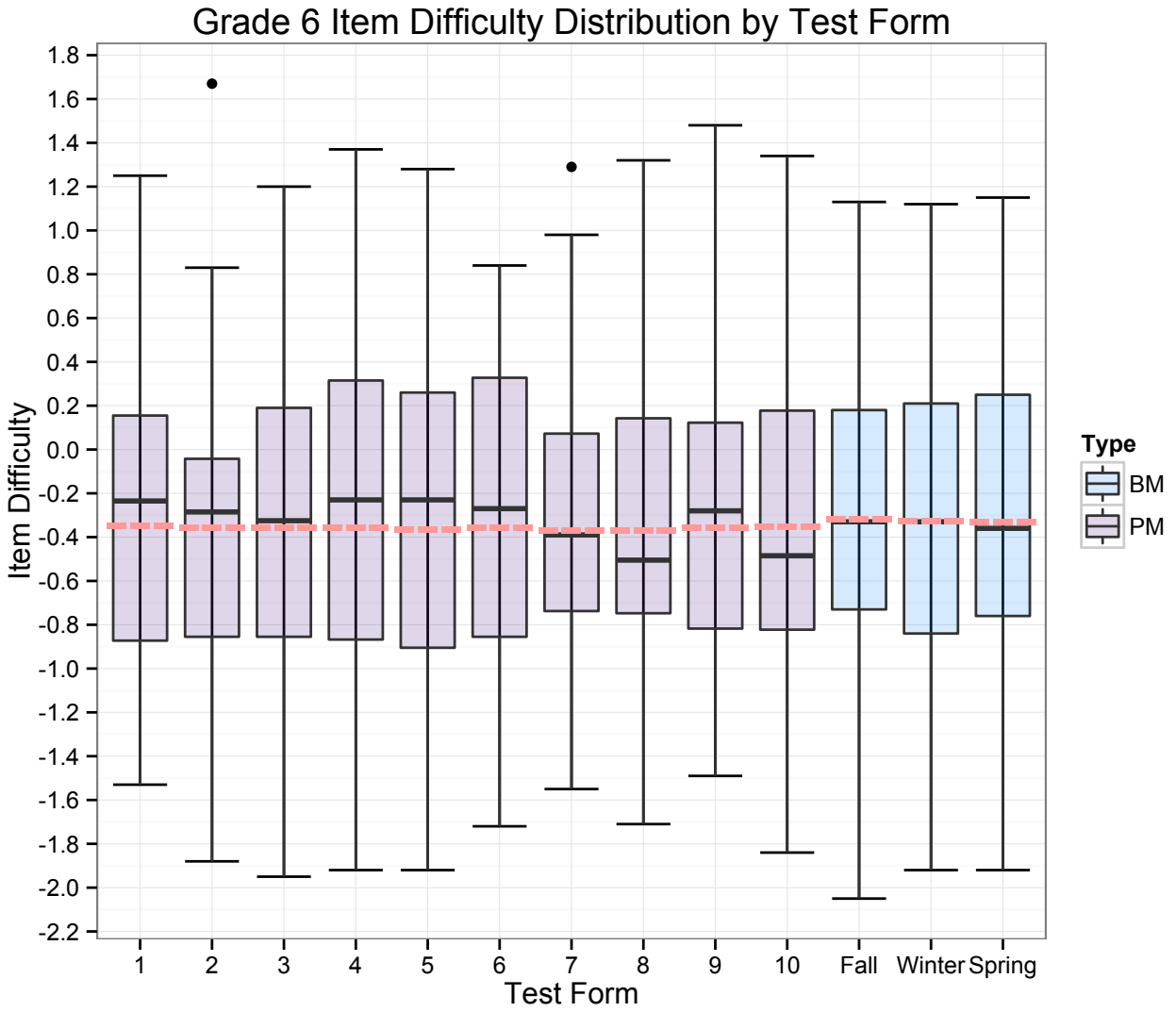

Figure 5. Distribution of item difficulties within Grade 6 test forms. Note that the solid black line within each boxplot represents the median item difficulty for the respective test form, while the hatched red line represents the mean.

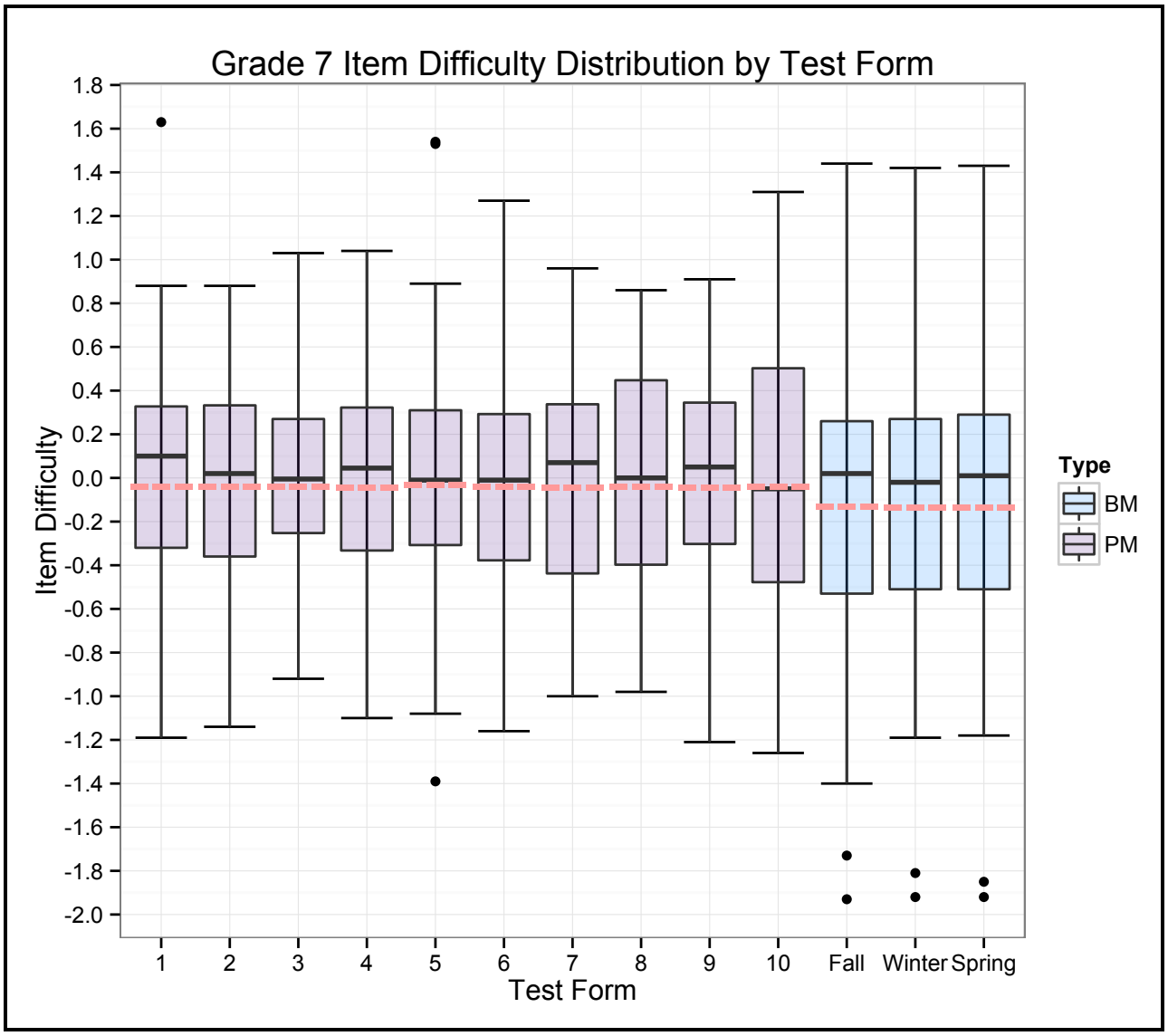

Figure 5. Distribution of item difficulties within Grade 7 test forms. Note that the solid black line within each boxplot represents the median item difficulty for the respective test form, while the hatched red line represents the mean.

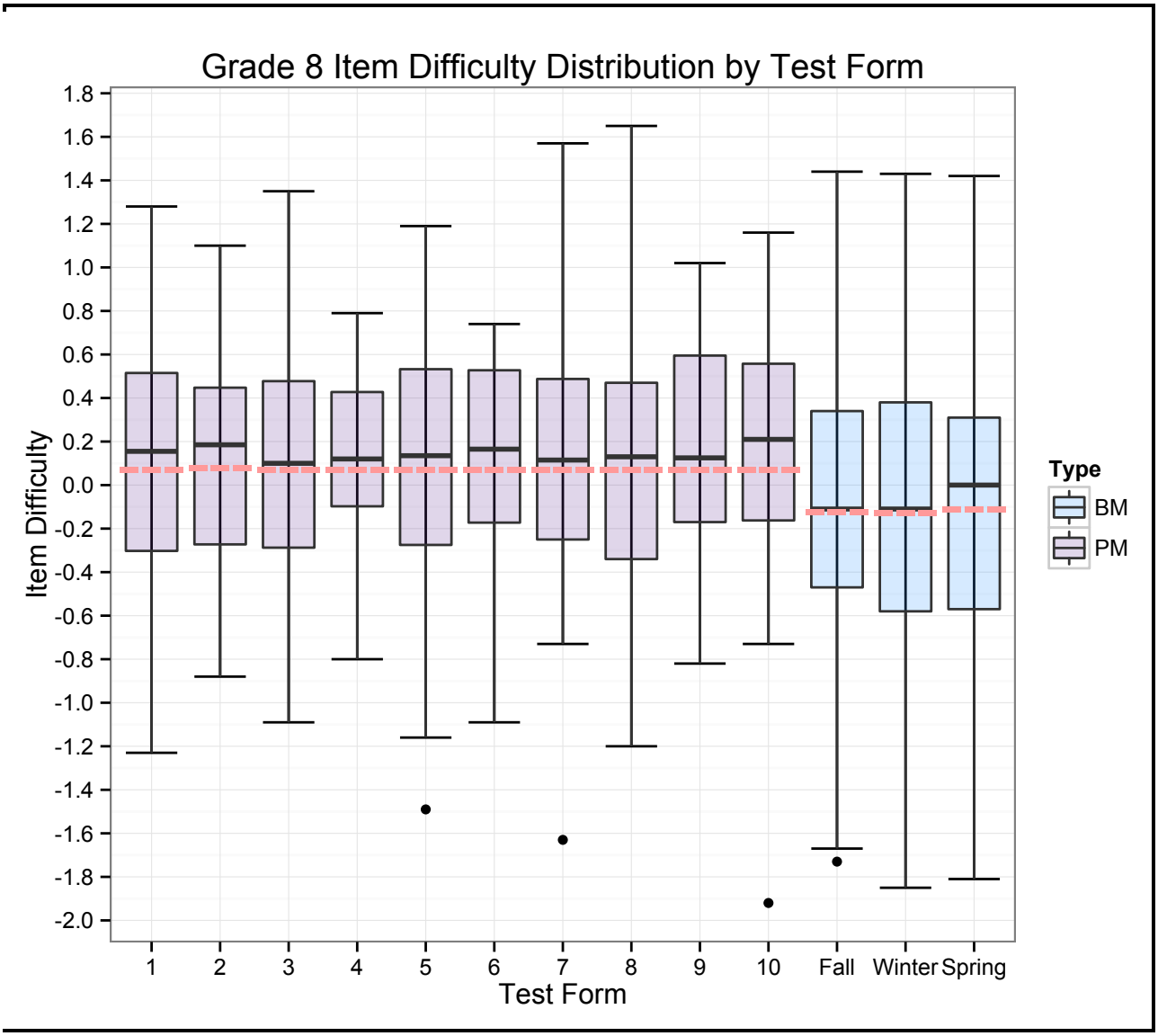

Figure 5. Distribution of item difficulties within Grade 8 test forms. Note that the solid black line within each boxplot represents the median item difficulty for the respective test form, while the hatched red line represents the mean.