Linking the ACT ASPIRE Assessments to NWEA MAP Assessments

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Introduction

Northwest Evaluation Association™ (NWEA™) is committed to providing partners with useful tools to help make inferences from Measures of Academic Progress® (MAP®) interim assessment scores. One important tool is the concordance table between MAP and state summative assessments. Concordance tables have been used for decades to relate scores on different tests measuring similar but distinct constructs. These tables, typically derived from statistical linking procedures, provide a direct link between scores on different tests and serve various purposes. Aside from describing how a score on one test relates to performance on another test, they can also be used to identify benchmark scores on one test corresponding to performance categories on another test, or to maintain continuity of scores on a test after the test is redesigned or changed. Concordance tables provide a useful tool for educators, parents, administrators, researchers, and policy makers to evaluate and formulate academic standing and growth.

Recently, NWEA completed a concordance study to connect the scales of ACT® Aspire™ reading and math with those of the MAP Reading and MAP for Mathematics assessments. In this report, we present the 3rd through 8th grade cut scores on MAP reading and mathematics scales that correspond to the benchmarks on the Aspire reading and math tests. Information about the consistency rate of classification based on the estimated MAP cut scores is also provided, along with a series of tables that estimate the probability of receiving a Level 3 (i.e., "Ready") or higher performance designation on the Aspire assessments, based on the observed MAP scores taken during the same school year. A detailed description of the data and analysis method used this study is provided in the Appendix.

Overview of Assessments

ACT Aspire includes a series of vertically scaled achievement tests linked to the ACT College Readiness Benchmarks in English, mathematics, reading, science, and writing for grades 3-8 and early high school (grades 9-10). ACT Aspire can be delivered online or in the paper-and-pencil form. For each grade and subject, there are three cut scores: high cut above the benchmark, the benchmark, and low cut below the benchmark. These cut scores classify student performance into four performance levels, also called ACT Readiness Level, which includes Level 1: *In Need of Support*, Level 2: *Close*, Level 3: *Ready*, and Level 4: *Exceeding*. The Benchmark cut score demarks the minimum level of performance considered to be "Proficient" for accountability purposes.

MAP tests are vertically scaled interim assessments that are administered in the form of a computerized adaptive test (CAT). MAP tests are constructed to measure student

achievement from grades K to 12 in reading, math, language usage, and science and aligned to the Common Core State Standards (CCSS). MAP scores are reported with **R**asch Un**it** (RIT) scale with a range from 100 to 350. Each subject has its own RIT scale.

To aid interpretation of MAP scores, NWEA periodically conducts norming studies of student and school performance on MAP. For example, the NWEA 2015 RIT Scale norming study by Thum and Hauser (2015) employed multi-level growth models on nearly 500,000 student longitudinal test scores from over 100,000 students that were weighted to create large, nationally representative norms for reading, math, language arts, and general science.

Estimated MAP Cut Scores Associated with ACT Aspire Readiness Levels

The use of equipercentile linking to derive concordant MAP cut-scores for grades 3 to 8 in reading and math is driven by the published proportion of students in each of the four Aspire performance levels in the target population. A detailed description about how the concorded cut scores were derived is provided in the Appendix.

Tables 1 to 4 report the ACT Aspire scaled scores associated with each of the four performance levels, as well as the estimated cut scores on the MAP tests associated with the Aspire readiness levels. Specifically, Tables 1 and 2 apply to MAP scores obtained during spring testing season for reading and math, respectively. Tables 3 and 4 apply to MAP tests taken in a prior testing season (fall or winter) for reading and math, respectively. The tables also show the percentile rank (based on the *NWEA 2015 MAP Norms*) associated with each estimated MAP cut score. The cut scores can be used to predict students' most probable Aspire performance level, based on their observed MAP scores. For example, a 3rd grade student who obtained a MAP math score of 204 in the spring testing season would be predicted to be at the very high end of Level 2 (Close) on the Aspire taken during that same testing season (see Table 2). Similarly, a 6th grade student who obtained a MAP reading score of 220 in the fall testing season would be predicted to be at Level 3 (Ready) on the Aspire taken in the spring of 6th grade (see Table 3).

We note that all three cut-scores recommended for grade 8 reading and the cut score for "Benchmark" recommended for grade 6 are revised from their equipercentile concordance estimates by vertical moderation to offer developmentally appropriate performance standards consistent with vertical scales such as MAP. A description of vertical moderation is provided in the Appendix.

TABLE 1. CONCORDANCE OF PERFORMANCE LEVEL SCORE RANGES BETWEEN ASPIRE AND MAP READING (WHEN MAP IS TAKEN IN SPRING)

	ASPIRE			
Grade	Level 1 *In Need of Support*	Level 2 *Close*	Level 3 *Ready*	Level 4 *Exceeding*
3	400-410	411-414	415-418	419-442
4	400-411	412-416	417-421	422-442
5	400-414	415-419	420-424	425-442
6	400-415	416-420	421-425	426-442
7	400-416	417-422	423-428	429-442
8	400-417	418-423	424-429	430-442

	MAP							
Grade	Level 1 *In Need of Support*		Level 2 *Close*		Level 3 *Ready*		Level 4 *Exceeding*	
	RIT	%ile	RIT	%ile	RIT	%ile	RIT	%ile
3	100-197	1-47	198-206	48-69	207-218	70-90	219-350	91-99
4	100-200	1-35	201-212	36-67	213-224	68-89	225-350	90-99
5	100-207	1-38	208-220	39-72	221-231	73-90	232-350	91-99
6	100-209	1-33	210-221	34-65	222*-231	66-85	232-350	86-99
7	100-213	1-37	214-226	38-70	227-244	71-95	245-350	96-99
8	100-214	1-36	215*-227	37-68	228*-245	69-94	246*-350	95-99

Note. %ile=percentile

* indicates that MAP cut scores are adjusted via vertical moderation. A description of vertical moderation is provided in the Appendix.

TABLE 2. CONCORDANCE OF PERFORMANCE LEVEL SCORE RANGES BETWEEN ASPIRE AND MAP MATH (WHEN MAP IS TAKEN IN SPRING)

ASPIRE

Grade	Level 1 *In Need of Support*	Level 2 *Close*	Level 3 *Ready*	Level 4 *Exceeding*
3	400-408	409-412	413-416	417-460
4	400-410	411-415	416-420	421-460
5	400-411	412-417	418-423	424-460
6	400-413	414-419	420-425	426-460
7	400-415	416-421	422-427	428-460
8	400-418	419-424	425-430	431-460

MAP

Grade	Level 1 *In Need of Support*		Level 2 *Close*		Level 3 *Ready*		Level 4 *Exceeding*	
	RIT	%ile	RIT	%ile	RIT	%ile	RIT	%ile
3	100-192	1-21	193-205	22-56	206-219	57-87	220-350	88-99
4	100-198	1-15	199-218	16-63	219-235	64-92	236-350	93-99
5	100-204	1-14	205-226	15-62	227-242	63-90	243-350	91-99
6	100-211	1-20	212-230	21-62	231-245	63-88	246-350	89-99
7	100-223	1-38	224-237	39-69	238-251	70-90	252-350	91-99
8	100-228	1-44	229-241	45-70	242-252	71-87	253-350	88-99

TABLE 3. CONCORDANCE OF PERFORMANCE LEVEL SCORE RANGES BETWEEN ASPIRE AND MAP READING (WHEN MAP IS TAKEN IN FALL OR WINTER PRIOR TO SPRING ASPIRE TESTS)

	ASPIRE			
Grade	Level 1 *In Need of Support*	Level 2 *Close*	Level 3 *Ready*	Level 4 *Exceeding*
3	400-410	411-414	415-418	419-442
4	400-411	412-416	417-421	422-442
5	400-414	415-419	420-424	425-442
6	400-415	416-420	421-425	426-442
7	400-416	417-422	423-428	429-442
8	400-417	418-423	424-429	430-442

	MAP FALL							
Grade	Level 1 *In Need of Support*		Level 2 *Close*		Level 3 *Ready*		Level 4 *Exceeding*	
	RIT	%ile	RIT	%ile	RIT	%ile	RIT	%ile
3	100-186	1-45	187-197	46-71	198-211	72-92	212-350	93-99
4	100-191	1-33	192-205	34-68	206-219	69-91	220-350	92-99
5	100-200	1-36	201-215	37-74	216-228	75-93	229-350	94-99
6	100-203	1-30	204-217	31-66	218-229	67-89	230-350	90-99
7	100-209	1-37	210-223	38-72	224-242	73-96	243-350	97-99
8	100-210	1-32	211-225	33-69	226-243	70-95	244-350	96-99

	MAP WINTER							
Grade	Level 1 *In Need of Support*		Level 2 *Close*		Level 3 *Ready*		Level 4 *Exceeding*	
	RIT	%ile	RIT	%ile	RIT	%ile	RIT	%ile
3	100-194	1-47	195-204	48-72	205-216	73-91	217-350	92-99
4	100-197	1-34	198-210	35-67	211-223	68-90	224-350	91-99
5	100-205	1-38	206-219	39-74	220-230	75-92	231-350	93-99
6	100-207	1-32	208-220	33-66	221-230	67-86	231-350	87-99
7	100-212	1-38	213-225	39-71	226-243	72-96	244-350	97-99
8	100-213	1-35	214-226	36-68	227-244	69-95	245-350	96-99

TABLE 4. CONCORDANCE OF PERFORMANCE LEVEL SCORE RANGES BETWEEN ASPIRE AND MAP MATH (WHEN MAP IS TAKEN IN FALL OR WINTER PRIOR TO SPRING ASPIRE TESTS)

	ASPIRE			
Grade	Level 1 *In Need of Support*	Level 2 *Close*	Level 3 *Ready*	Level 4 *Exceeding*
3	400-408	409-412	413-416	417-460
4	400-410	411-415	416-420	421-460
5	400-411	412-417	418-423	424-460
6	400-413	414-419	420-425	426-460
7	400-415	416-421	422-427	428-460
8	400-418	419-424	425-430	431-460

	MAP FALL							
Grade	Level 1 *In Need of Support*		Level 2 *Close*		Level 3 *Ready*		Level 4 *Exceeding*	
	RIT	%ile	RIT	%ile	RIT	%ile	RIT	%ile
3	100-178	1-18	179-192	19-56	193-207	57-90	208-350	91-99
4	100-186	1-12	187-207	13-65	208-224	66-94	225-350	95-99
5	100-194	1-12	195-216	13-63	217-232	64-92	233-350	93-99
6	100-203	1-18	204-222	19-62	223-238	63-91	239-350	92-99
7	100-217	1-37	218-231	38-70	232-245	71-91	246-350	92-99
8	100-223	1-43	224-237	44-73	238-248	74-89	249-350	90-99

	MAP WINTER							
Grade	Level 1 *In Need of Support*		Level 2 *Close*		Level 3 *Ready*		Level 4 *Exceeding*	
	RIT	%ile	RIT	%ile	RIT	%ile	RIT	%ile
3	100-187	1-21	188-200	22-56	201-214	57-88	215-350	89-99
4	100-193	1-14	194-213	15-63	214-230	64-93	231-350	94-99
5	100-200	1-13	201-222	14-63	223-238	64-91	239-350	92-99
6	100-208	1-19	209-227	20-63	228-242	64-89	243-350	90-99
7	100-221	1-39	222-235	40-70	236-249	71-91	250-350	92-99
8	100-226	1-44	227-239	45-71	240-250	72-87	251-350	88-99

Consistency Rate of Classification

Consistency rate of classification (Pommerich, Hanson, Harris, & Sconing, 2004), expressed in the form of a rate between 0 and 1, provides a means to measure the departure from equity for concordances (Hanson et al., 2001). For each pair of concordance scores, a classification is considered consistent if the examinee is classified the same in spite of the test used for making classification. Consistency rate provided in this report can be calculated as, for the "proficient" performance category concordant scores, the percentage of examinees who score at or above both concordant scores plus the percentage of examinees who score below both concordant scores on each test. Higher consistency rate indicates stronger congruence between MAP and Aspire scores. The results in Table 5 indicate that MAP reading scores can consistently classify students' proficiency (Level 3 or higher) status on Aspire about 80-84% of the time, depending on grade. MAP math scores can consistently classify students' proficiency status on Aspire math test about 85% of the time in particular for Grades 7 and 8.

TABLE 5. CONSISTENCY RATE OF CLASSIFICATION FOR MAP AND ACT ASPIRE LEVEL 3 EQUIPERCENTILE CONCORDANCES

Grade	READING	Math
	Consistency Rate	Consistency Rate
3	0.84	0.77
4	0.84	0.79
5	0.81	0.77
6	0.82	0.71
7	0.83	0.84
8	0.80	0.86

Proficiency Projection

Proficiency projection tells how likely a student is classified as "proficient" based on the student's observed MAP score. The conditional growth norms provided in the 2015 MAP Norms were used to calculate this information (Thum & Hauser, 2015). The results of proficiency status projection and probability of an observed MAP score predicted as "proficient" on the ASPIRE test are reported in Tables 6 to 8. These tables estimate the probability of scoring at Level 3 or

higher on the Aspire in the spring, based on an observed MAP score from the spring or the prior fall or winter testing season. For example, if a 3rd grade student obtained a MAP math score of 197 in the fall, the probability of obtaining a Level 3 or higher Aspire score in the spring of 3rd grade is 71%. Table 6 presents the estimated probability of meeting Level 3 benchmark when MAP is taken in the spring, whereas Tables 7 and 8 present the estimated probability of meeting Level 3 benchmark when MAP is taken in the fall or winter prior to taking the Aspire tests.

TABLE 6. PROFICIENCY PROJECTION AND PROBABILITY FOR PASSING ASPIRE READING LEVEL 3 (READY) WHEN MAP IS TAKEN IN THE SPRING

Grade	READING					Math				
	Start %ile	RIT Spring	Projected Proficiency			Start %ile	RIT Spring	Projected Proficiency		
			Cut Score	Level 3	Prob.			Cut Score	Level 3	Prob.
3	5	174	207	No	<0.01	5	181	206	No	<0.01
	10	179	207	No	<0.01	10	186	206	No	<0.01
	15	183	207	No	<0.01	15	189	206	No	<0.01
	20	186	207	No	<0.01	20	192	206	No	<0.01
	25	189	207	No	<0.01	25	194	206	No	<0.01
	30	191	207	No	<0.01	30	196	206	No	<0.01
	35	193	207	No	<0.01	35	198	206	No	<0.01
	40	195	207	No	<0.01	40	200	206	No	0.02
	45	197	207	No	<0.01	45	202	206	No	0.08
	50	199	207	No	0.01	50	204	206	No	0.25
	55	201	207	No	0.03	55	205	206	No	0.37
	60	203	207	No	0.11	60	207	206	Yes	0.63
	65	205	207	No	0.27	65	209	206	Yes	0.85
	70	207	207	Yes	0.50	70	211	206	Yes	0.96
	75	209	207	Yes	0.73	75	213	206	Yes	0.99
	80	212	207	Yes	0.94	80	215	206	Yes	>0.99
	85	214	207	Yes	0.99	85	218	206	Yes	>0.99
	90	218	207	Yes	>0.99	90	221	206	Yes	>0.99
	95	224	207	Yes	>0.99	95	226	206	Yes	>0.99
4	5	182	213	No	<0.01	5	189	219	No	<0.01
	10	187	213	No	<0.01	10	194	219	No	<0.01
	15	191	213	No	<0.01	15	198	219	No	<0.01
	20	194	213	No	<0.01	20	201	219	No	<0.01
	25	196	213	No	<0.01	25	204	219	No	<0.01
	30	198	213	No	<0.01	30	206	219	No	<0.01
	35	200	213	No	<0.01	35	208	219	No	<0.01
	40	202	213	No	<0.01	40	210	219	No	<0.01
	45	204	213	No	<0.01	45	212	219	No	0.01
	50	206	213	No	0.01	50	214	219	No	0.04
	55	208	213	No	0.06	55	216	219	No	0.15
	60	210	213	No	0.17	60	218	219	No	0.37
	65	212	213	No	0.38	65	220	219	Yes	0.63
	70	214	213	Yes	0.62	70	222	219	Yes	0.85
	75	216	213	Yes	0.83	75	224	219	Yes	0.96
	80	219	213	Yes	0.97	80	226	219	Yes	0.99
	85	222	213	Yes	>0.99	85	229	219	Yes	>0.99
	90	225	213	Yes	>0.99	90	233	219	Yes	>0.99
	95	231	213	Yes	>0.99	95	238	219	Yes	>0.99

TABLE 6. (CONTINUED)

Grade	READING					Math				
	Start %ile	RIT Spring	Projected Proficiency			Start %ile	RIT Spring	Projected Proficiency		
			Cut Score	Level 3	Prob.			Cut Score	Level 3	Prob.
5	5	188	221	No	<0.01	5	195	227	No	<0.01
	10	193	221	No	<0.01	10	201	227	No	<0.01
	15	197	221	No	<0.01	15	205	227	No	<0.01
	20	200	221	No	<0.01	20	208	227	No	<0.01
	25	202	221	No	<0.01	25	211	227	No	<0.01
	30	204	221	No	<0.01	30	213	227	No	<0.01
	35	206	221	No	<0.01	35	215	227	No	<0.01
	40	208	221	No	<0.01	40	218	227	No	<0.01
	45	210	221	No	<0.01	45	220	227	No	0.01
	50	212	221	No	<0.01	50	222	227	No	0.04
	55	214	221	No	0.01	55	224	227	No	0.15
	60	216	221	No	0.06	60	226	227	No	0.37
	65	218	221	No	0.17	65	228	227	Yes	0.63
	70	220	221	No	0.38	70	230	227	Yes	0.85
	75	222	221	Yes	0.62	75	233	227	Yes	0.98
	80	224	221	Yes	0.83	80	235	227	Yes	>0.99
	85	227	221	Yes	0.97	85	238	227	Yes	>0.99
	90	231	221	Yes	>0.99	90	242	227	Yes	>0.99
	95	236	221	Yes	>0.99	95	248	227	Yes	>0.99
6	5	192	222	No	<0.01	5	198	231	No	<0.01
	10	197	222	No	<0.01	10	204	231	No	<0.01
	15	201	222	No	<0.01	15	208	231	No	<0.01
	20	204	222	No	<0.01	20	211	231	No	<0.01
	25	206	222	No	<0.01	25	214	231	No	<0.01
	30	208	222	No	<0.01	30	217	231	No	<0.01
	35	210	222	No	<0.01	35	219	231	No	<0.01
	40	212	222	No	<0.01	40	221	231	No	<0.01
	45	214	222	No	0.01	45	224	231	No	0.01
	50	216	222	No	0.03	50	226	231	No	0.04
	55	218	222	No	0.11	55	228	231	No	0.15
	60	220	222	No	0.27	60	230	231	No	0.37
	65	222	222	Yes	0.50	65	232	231	Yes	0.63
	70	224	222	Yes	0.73	70	234	231	Yes	0.85
	75	226	222	Yes	0.89	75	237	231	Yes	0.98
	80	228	222	Yes	0.97	80	240	231	Yes	>0.99
	85	231	222	Yes	>0.99	85	243	231	Yes	>0.99
	90	235	222	Yes	>0.99	90	247	231	Yes	>0.99
	95	240	222	Yes	>0.99	95	253	231	Yes	>0.99

TABLE 6. (CONTINUED)

| Grade | READING | | | | | Math | | | | |
| | Start %ile | RIT Spring | Projected Proficiency | | | Start %ile | RIT Spring | Projected Proficiency | | |
			Cut Score	Level 3	Prob.			Cut Score	Level 3	Prob.
7	5	193	227	No	<0.01	5	200	238	No	<0.01
	10	199	227	No	<0.01	10	206	238	No	<0.01
	15	203	227	No	<0.01	15	210	238	No	<0.01
	20	206	227	No	<0.01	20	214	238	No	<0.01
	25	208	227	No	<0.01	25	217	238	No	<0.01
	30	211	227	No	<0.01	30	220	238	No	<0.01
	35	213	227	No	<0.01	35	222	238	No	<0.01
	40	215	227	No	<0.01	40	224	238	No	<0.01
	45	217	227	No	<0.01	45	227	238	No	<0.01
	50	218	227	No	<0.01	50	229	238	No	<0.01
	55	220	227	No	0.01	55	231	238	No	0.01
	60	222	227	No	0.06	60	233	238	No	0.04
	65	224	227	No	0.17	65	236	238	No	0.25
	70	226	227	No	0.38	70	238	238	Yes	0.50
	75	229	227	Yes	0.73	75	241	238	Yes	0.85
	80	231	227	Yes	0.89	80	244	238	Yes	0.98
	85	234	227	Yes	0.99	85	247	238	Yes	>0.99
	90	238	227	Yes	>0.99	90	251	238	Yes	>0.99
	95	243	227	Yes	>0.99	95	258	238	Yes	>0.99
8	5	194	228	No	<0.01	5	200	242	No	<0.01
	10	200	228	No	<0.01	10	206	242	No	<0.01
	15	204	228	No	<0.01	15	211	242	No	<0.01
	20	207	228	No	<0.01	20	215	242	No	<0.01
	25	210	228	No	<0.01	25	218	242	No	<0.01
	30	212	228	No	<0.01	30	221	242	No	<0.01
	35	214	228	No	<0.01	35	224	242	No	<0.01
	40	216	228	No	<0.01	40	226	242	No	<0.01
	45	218	228	No	<0.01	45	229	242	No	<0.01
	50	220	228	No	0.01	50	231	242	No	<0.01
	55	222	228	No	0.03	55	234	242	No	<0.01
	60	224	228	No	0.11	60	236	242	No	0.02
	65	226	228	No	0.27	65	239	242	No	0.15
	70	229	228	Yes	0.62	70	241	242	No	0.37
	75	231	228	Yes	0.83	75	244	242	Yes	0.75
	80	234	228	Yes	0.97	80	247	242	Yes	0.96
	85	237	228	Yes	>0.99	85	251	242	Yes	>0.99
	90	240	228	Yes	>0.99	90	255	242	Yes	>0.99
	95	246	228	Yes	>0.99	95	263	242	Yes	>0.99

TABLE 7. PROFICIENCY PROJECTION AND PROBABILITY FOR PASSING ASPIRE READING LEVEL 3 (READY) WHEN MAP IS TAKEN IN THE FALL OR WINTER PRIOR TO SPRING ASPIRE TESTS

Grade	Start %ile	RIT Fall	Projected Proficiency			Start %ile	RIT Winter	Projected Proficiency		
			Cut Score	Level 3	Prob.			Cut Score	Level 3	Prob.
3	5	162	207	No	<0.01	5	171	207	No	<0.01
	10	168	207	No	<0.01	10	176	207	No	<0.01
	15	172	207	No	<0.01	15	180	207	No	<0.01
	20	175	207	No	<0.01	20	183	207	No	<0.01
	25	178	207	No	0.01	25	185	207	No	<0.01
	30	180	207	No	0.02	30	188	207	No	<0.01
	35	182	207	No	0.03	35	190	207	No	<0.01
	40	184	207	No	0.05	40	192	207	No	0.01
	45	186	207	No	0.07	45	194	207	No	0.03
	50	188	207	No	0.11	50	196	207	No	0.06
	55	190	207	No	0.16	55	198	207	No	0.12
	60	192	207	No	0.23	60	199	207	No	0.16
	65	194	207	No	0.30	65	201	207	No	0.26
	70	197	207	No	0.44	70	204	207	No	0.46
	75	199	207	Yes	0.53	75	206	207	Yes	0.60
	80	202	207	Yes	0.67	80	208	207	Yes	0.73
	85	205	207	Yes	0.79	85	211	207	Yes	0.87
	90	209	207	Yes	0.90	90	215	207	Yes	0.97
	95	215	207	Yes	0.98	95	221	207	Yes	>0.99
4	5	173	213	No	<0.01	5	179	213	No	<0.01
	10	178	213	No	<0.01	10	184	213	No	<0.01
	15	182	213	No	<0.01	15	188	213	No	<0.01
	20	185	213	No	<0.01	20	191	213	No	<0.01
	25	188	213	No	0.01	25	194	213	No	<0.01
	30	190	213	No	0.02	30	196	213	No	<0.01
	35	192	213	No	0.03	35	198	213	No	0.01
	40	194	213	No	0.06	40	200	213	No	0.02
	45	196	213	No	0.09	45	202	213	No	0.05
	50	198	213	No	0.14	50	204	213	No	0.10
	55	200	213	No	0.21	55	205	213	No	0.13
	60	202	213	No	0.29	60	207	213	No	0.22
	65	204	213	No	0.38	65	209	213	No	0.35
	70	206	213	No	0.48	70	211	213	NO	0.49
	75	209	213	Yes	0.63	75	214	213	Yes	0.70
	80	211	213	Yes	0.72	80	216	213	Yes	0.81
	85	214	213	Yes	0.83	85	219	213	Yes	0.93
	90	218	213	Yes	0.93	90	223	213	Yes	0.99
	95	224	213	Yes	0.99	95	228	213	Yes	>0.99

TABLE 7. (CONTINUED)

Grade	Start %ile	RIT Fall	Projected Proficiency			Start %ile	RIT Winter	Projected Proficiency		
			Cut-Score	Level 3	Prob.			Cut-Score	Level 3	Prob.
5	5	181	221	No	<0.01	5	186	221	No	<0.01
	10	186	221	No	<0.01	10	191	221	No	<0.01
	15	190	221	No	<0.01	15	195	221	No	<0.01
	20	193	221	No	<0.01	20	197	221	No	<0.01
	25	195	221	No	<0.01	25	200	221	No	<0.01
	30	198	221	No	0.01	30	202	221	No	<0.01
	35	200	221	No	0.02	35	204	221	No	<0.01
	40	202	221	No	0.04	40	206	221	No	0.01
	45	204	221	No	0.06	45	208	221	No	0.02
	50	206	221	No	0.10	50	210	221	No	0.04
	55	208	221	No	0.15	55	212	221	No	0.08
	60	210	221	No	0.21	60	214	221	No	0.15
	65	212	221	No	0.29	65	215	221	No	0.20
	70	214	221	No	0.39	70	218	221	No	0.39
	75	216	221	No	0.48	75	220	221	Yes	0.53
	80	218	221	Yes	0.58	80	222	221	Yes	0.67
	85	221	221	Yes	0.72	85	225	221	Yes	0.84
	90	225	221	Yes	0.86	90	229	221	Yes	0.96
	95	231	221	Yes	0.97	95	234	221	Yes	>0.99
6	5	187	222	No	<0.01	5	190	222	No	<0.01
	10	192	222	No	<0.01	10	196	222	No	<0.01
	15	196	222	No	<0.01	15	199	222	No	<0.01
	20	198	222	No	0.01	20	202	222	No	<0.01
	25	201	222	No	0.02	25	204	222	No	<0.01
	30	203	222	No	0.03	30	207	222	No	0.01
	35	205	222	No	0.05	35	209	222	No	0.02
	40	207	222	No	0.08	40	211	222	No	0.04
	45	209	222	No	0.12	45	212	222	No	0.05
	50	211	222	No	0.18	50	214	222	No	0.11
	55	213	222	No	0.26	55	216	222	No	0.19
	60	215	222	No	0.35	60	218	222	No	0.30
	65	217	222	No	0.44	65	220	222	No	0.44
	70	219	222	Yes	0.54	70	222	222	Yes	0.59
	75	221	222	Yes	0.64	75	224	222	Yes	0.72
	80	224	222	Yes	0.77	80	226	222	Yes	0.83
	85	226	222	Yes	0.83	85	229	222	Yes	0.93
	90	230	222	Yes	0.93	90	233	222	Yes	0.99
	95	235	222	Yes	0.98	95	238	222	Yes	>0.99

TABLE 7. (CONTINUED)

Grade	Start %ile	RIT Fall	Projected Proficiency			Start %ile	RIT Winter	Projected Proficiency		
			Cut-Score	Level 3	Prob.			Cut-Score	Level 3	Prob.
7	5	189	227	No	<0.01	5	192	227	No	<0.01
	10	195	227	No	<0.01	10	198	227	No	<0.01
	15	199	227	No	<0.01	15	202	227	No	<0.01
	20	202	227	No	<0.01	20	204	227	No	<0.01
	25	204	227	No	<0.01	25	207	227	No	<0.01
	30	206	227	No	0.01	30	209	227	No	<0.01
	35	209	227	No	0.02	35	211	227	No	<0.01
	40	211	227	No	0.04	40	213	227	No	0.01
	45	213	227	No	0.07	45	215	227	No	0.02
	50	214	227	No	0.09	50	217	227	No	0.04
	55	216	227	No	0.14	55	219	227	No	0.09
	60	218	227	No	0.20	60	221	227	No	0.17
	65	220	227	No	0.28	65	223	227	No	0.28
	70	222	227	No	0.37	70	225	227	No	0.41
	75	225	227	Yes	0.53	75	227	227	Yes	0.56
	80	227	227	Yes	0.62	80	230	227	Yes	0.76
	85	230	227	Yes	0.76	85	232	227	Yes	0.86
	90	234	227	Yes	0.89	90	236	227	Yes	0.96
	95	240	227	Yes	0.98	95	242	227	Yes	>0.99
8	5	192	228	No	<0.01	5	194	228	No	<0.01
	10	197	228	No	<0.01	10	199	228	No	<0.01
	15	201	228	No	<0.01	15	203	228	No	<0.01
	20	204	228	No	0.01	20	206	228	No	<0.01
	25	207	228	No	0.02	25	209	228	No	<0.01
	30	209	228	No	0.03	30	211	228	No	<0.01
	35	211	228	No	0.05	35	213	228	No	0.01
	40	213	228	No	0.07	40	215	228	No	0.01
	45	215	228	No	0.11	45	217	228	No	0.03
	50	217	228	No	0.15	50	219	228	No	0.07
	55	219	228	No	0.21	55	221	228	No	0.13
	60	221	228	No	0.28	60	223	228	No	0.22
	65	223	228	No	0.35	65	225	228	No	0.34
	70	225	228	No	0.44	70	227	228	No	0.48
	75	228	228	Yes	0.57	75	229	228	Yes	0.61
	80	230	228	Yes	0.65	80	232	228	Yes	0.79
	85	234	228	Yes	0.80	85	235	228	Yes	0.91
	90	237	228	Yes	0.88	90	239	228	Yes	0.98
	95	243	228	Yes	0.97	95	245	228	Yes	>0.99

TABLE 8. PROFICIENCY PROJECTION AND PROBABILITY FOR PASSING ASPIRE MATH LEVEL 3 (READY) WHEN MAP IS TAKEN IN THE FALL OR WINTER PRIOR TO SPRING ASPIRE TESTS

Grade	Start %ile	RIT Fall	Projected Proficiency			Start %ile	RIT Winter	Projected Proficiency		
			Cut-Score	Level 3	Prob.			Cut-Score	Level 3	Prob.
3	5	169	206	No	<0.01	5	176	206	No	<0.01
	10	174	206	No	<0.01	10	181	206	No	<0.01
	15	177	206	No	0.01	15	185	206	No	<0.01
	20	179	206	No	0.02	20	187	206	No	<0.01
	25	182	206	No	0.05	25	189	206	No	0.01
	30	184	206	No	0.09	30	191	206	No	0.02
	35	185	206	No	0.12	35	193	206	No	0.05
	40	187	206	No	0.18	40	195	206	No	0.11
	45	189	206	No	0.27	45	197	206	No	0.21
	50	190	206	No	0.32	50	198	206	No	0.28
	55	192	206	No	0.43	55	200	206	No	0.43
	60	194	206	Yes	0.55	60	202	206	Yes	0.59
	65	195	206	Yes	0.60	65	203	206	Yes	0.67
	70	197	206	Yes	0.71	70	205	206	Yes	0.80
	75	199	206	Yes	0.80	75	207	206	Yes	0.90
	80	201	206	Yes	0.87	80	209	206	Yes	0.95
	85	204	206	Yes	0.94	85	212	206	Yes	0.99
	90	207	206	Yes	0.98	90	215	206	Yes	>0.99
	95	212	206	Yes	>0.99	95	220	206	Yes	>0.99
4	5	179	219	No	<0.01	5	185	219	No	<0.01
	10	184	219	No	<0.01	10	190	219	No	<0.01
	15	188	219	No	<0.01	15	194	219	No	<0.01
	20	190	219	No	<0.01	20	197	219	No	<0.01
	25	193	219	No	0.01	25	199	219	No	<0.01
	30	195	219	No	0.03	30	201	219	No	<0.01
	35	197	219	No	0.05	35	203	219	No	0.01
	40	198	219	No	0.07	40	205	219	No	0.03
	45	200	219	No	0.12	45	207	219	No	0.06
	50	202	219	No	0.20	50	209	219	No	0.13
	55	204	219	No	0.29	55	211	219	No	0.25
	60	205	219	No	0.35	60	212	219	No	0.32
	65	207	219	No	0.47	65	214	219	No	0.48
	70	209	219	Yes	0.59	70	216	219	Yes	0.64
	75	211	219	Yes	0.70	75	218	219	Yes	0.79
	80	214	219	Yes	0.84	80	221	219	Yes	0.92
	85	216	219	Yes	0.90	85	224	219	Yes	0.98
	90	220	219	Yes	0.97	90	227	219	Yes	>0.99
	95	225	219	Yes	>0.99	95	232	219	Yes	>0.99

TABLE 8. (CONTINUED)

Grade	Start %ile	RIT Fall	Projected Proficiency			Start %ile	RIT Winter	Projected Proficiency		
			Cut-Score	Level 3	Prob.			Cut-Score	Level 3	Prob.
5	5	187	227	No	<0.01	5	192	227	No	<0.01
	10	193	227	No	<0.01	10	198	227	No	<0.01
	15	196	227	No	<0.01	15	202	227	No	<0.01
	20	199	227	No	<0.01	20	204	227	No	<0.01
	25	202	227	No	0.01	25	207	227	No	<0.01
	30	204	227	No	0.03	30	209	227	No	<0.01
	35	206	227	No	0.05	35	211	227	No	0.01
	40	208	227	No	0.09	40	213	227	No	0.02
	45	210	227	No	0.15	45	215	227	No	0.05
	50	211	227	No	0.19	50	217	227	No	0.11
	55	213	227	No	0.27	55	219	227	No	0.21
	60	215	227	No	0.38	60	221	227	No	0.35
	65	217	227	Yes	0.50	65	223	227	Yes	0.51
	70	219	227	Yes	0.61	70	225	227	Yes	0.68
	75	221	227	Yes	0.72	75	228	227	Yes	0.86
	80	224	227	Yes	0.85	80	230	227	Yes	0.93
	85	227	227	Yes	0.93	85	233	227	Yes	0.98
	90	230	227	Yes	0.97	90	237	227	Yes	>0.99
	95	236	227	Yes	>0.99	95	243	227	Yes	>0.99
6	5	192	231	No	<0.01	5	196	231	No	<0.01
	10	198	231	No	<0.01	10	202	231	No	<0.01
	15	202	231	No	<0.01	15	206	231	No	<0.01
	20	205	231	No	<0.01	20	209	231	No	<0.01
	25	207	231	No	0.01	25	211	231	No	<0.01
	30	209	231	No	0.02	30	214	231	No	<0.01
	35	212	231	No	0.05	35	216	231	No	0.01
	40	214	231	No	0.09	40	218	231	No	0.02
	45	216	231	No	0.14	45	220	231	No	0.05
	50	218	231	No	0.22	50	222	231	No	0.12
	55	220	231	No	0.31	55	224	231	No	0.22
	60	222	231	No	0.42	60	226	231	No	0.36
	65	224	231	Yes	0.54	65	228	231	Yes	0.52
	70	226	231	Yes	0.65	70	230	231	Yes	0.68
	75	228	231	Yes	0.75	75	233	231	Yes	0.86
	80	231	231	Yes	0.87	80	236	231	Yes	0.96
	85	234	231	Yes	0.94	85	239	231	Yes	0.99
	90	238	231	Yes	0.98	90	243	231	Yes	>0.99
	95	243	231	Yes	>0.99	95	249	231	Yes	>0.99

TABLE 8. (CONTINUED)

Grade	Start %ile	RIT Fall	Projected Proficiency			Start %ile	RIT Winter	Projected Proficiency		
			Cut-Score	Level 3	Prob.			Cut-Score	Level 3	Prob.
7	5	196	238	No	<0.01	5	198	238	No	<0.01
	10	201	238	No	<0.01	10	204	238	No	<0.01
	15	206	238	No	<0.01	15	209	238	No	<0.01
	20	209	238	No	<0.01	20	212	238	No	<0.01
	25	211	238	No	<0.01	25	215	238	No	<0.01
	30	214	238	No	<0.01	30	217	238	No	<0.01
	35	216	238	No	0.01	35	220	238	No	<0.01
	40	218	238	No	0.02	40	222	238	No	<0.01
	45	221	238	No	0.05	45	224	238	No	0.01
	50	223	238	No	0.08	50	226	238	No	0.02
	55	225	238	No	0.14	55	228	238	No	0.06
	60	227	238	No	0.22	60	230	238	No	0.12
	65	229	238	No	0.32	65	233	238	No	0.30
	70	231	238	No	0.43	70	235	238	No	0.46
	75	234	238	Yes	0.61	75	238	238	Yes	0.70
	80	237	238	Yes	0.77	80	240	238	Yes	0.83
	85	240	238	Yes	0.88	85	244	238	Yes	0.96
	90	244	238	Yes	0.96	90	248	238	Yes	>0.99
	95	250	238	Yes	>0.99	95	255	238	Yes	>0.99
8	5	197	242	No	<0.01	5	199	242	No	<0.01
	10	203	242	No	<0.01	10	206	242	No	<0.01
	15	208	242	No	<0.01	15	210	242	No	<0.01
	20	211	242	No	<0.01	20	214	242	No	<0.01
	25	214	242	No	<0.01	25	217	242	No	<0.01
	30	217	242	No	<0.01	30	220	242	No	<0.01
	35	219	242	No	0.01	35	222	242	No	<0.01
	40	222	242	No	0.02	40	225	242	No	<0.01
	45	224	242	No	0.04	45	227	242	No	<0.01
	50	226	242	No	0.07	50	229	242	No	0.01
	55	229	242	No	0.14	55	231	242	No	0.03
	60	231	242	No	0.20	60	234	242	No	0.11
	65	233	242	No	0.28	65	236	242	No	0.20
	70	236	242	No	0.42	70	239	242	No	0.41
	75	238	242	Yes	0.52	75	242	242	Yes	0.64
	80	241	242	Yes	0.67	80	245	242	Yes	0.83
	85	245	242	Yes	0.83	85	248	242	Yes	0.94
	90	249	242	Yes	0.93	90	253	242	Yes	0.99
	95	256	242	Yes	0.99	95	260	242	Yes	>0.99

Summary and Discussion

This study produced a set of cut scores on MAP Reading and MAP for Mathematics assessments for Grades 3 to 8 that correspond to each ACT Aspire performance level. The use of equipercentile linking to derive concordant MAP cut-scores for grades 3 to 8 in reading and math was driven by the published proportion of students in each of the four performance levels in the target population. This study also used the NWEA 2015 RIT Scale norming study results to project a student's probability to meet proficiency based on that student's prior MAP scores in fall, winter, and spring. These results will help educators to predict student performance in Aspire tests as early as possible and to identify those students who are at risk of failing to meet required standards so that they can receive necessary resources and assistance to meet their goals.

While concordance tables can be helpful and informative, they have general limitations. Though the concordance tables provide information about score comparability on different tests, the scores cannot be assumed to be interchangeable or treated as a substitute for an examinee's actual score. In the case for Aspire and MAP tests, as they are not parallel in content, scores from these two tests should not be directly compared. Cautions should also be exercised if the concorded scores are used for a subpopulation.

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Appendix

Data and Analysis

Data

Data used in this study were collected from 54 schools from three school districts in South Carolina. The sample contained matched Aspire and MAP math scores from 16,269 students in Grades 3 to 8 and matched Aspire and MAP reading scores from 16,305 students in Grades 3 to 8. The students completed both Aspire and MAP in the spring of 2015.

To understand the statistical characteristics of the test scores, descriptive statistics are provided in Tables A1 and A2 below. Test score distributions of MAP and Aspire are provided in Figures A1 and A2. As Table A1 indicates, the overall correlation coefficients between MAP and Aspire test scores are 0.81 and 0.82 for reading and math respectively. For each individual grade, as Table A2 indicates, the correlation coefficients between MAP and Aspire reading scores range from 0.74 to 0.78, and the correlation coefficients between MAP and Aspire math scores range from 0.75 to 0.84. All these correlations indicate a strong relationship between MAP and Aspire test scores.

TABLE A1. DESCRIPTIVE STATISTICS OF THE OVERALL SAMPLE DATA

Subject	N	r	Aspire				MAP			
			Mean	SD	Min	Max	Mean	SD	Min	Max
Math	16,269	0.82	418.78	6.94	400	449	221	18.76	142	293
Reading	16,305	0.81	417.20	7.12	400	440	212.67	17.17	139	270

TABLE A2. DESCRIPTIVE STATISTICS OF THE SAMPLE DATA BY GRADE

Subject	Grade	N	r	ACT ASPIRE				MAP			
				Mean	SD	Min	Max	Mean	SD	Min	Max
Math	3	2,781	0.76	413.22	4.42	400	426	203.92	13.77	142	254
	4	2,704	0.77	416.40	4.51	402	436	215.03	15.43	158	264
	5	2,658	0.75	418.64	5.48	404	440	223.24	16.30	155	293
	6	2,685	0.77	421.31	6.43	400	442	224.07	16.00	153	269
	7	2,658	0.77	420.33	7.16	402	444	228.91	16.76	155	285
	8	2,783	0.84	422.88	7.94	406	449	233.37	17.81	149	282
Reading	3	2,804	0.76	411.40	5.25	401	429	198.36	15.71	139	243
	4	2,780	0.78	414.43	5.58	400	431	207.41	14.94	148	245
	5	2,645	0.75	417.18	6.12	400	434	213.50	14.46	151	263
	6	2,577	0.75	418.40	6.81	400	436	215.55	15.04	144	257
	7	2,698	0.74	419.64	6.42	400	438	218.72	15.48	147	257
	8	2,801	0.75	422.30	6.67	404	440	222.97	15.11	153	270

Equipercentile Linking Procedure

The equipercentile procedure (e.g., Kolen & Brennan, 2004) was used to establish the concordance relationship between Aspire and MAP scores for grades 3 to 8 in math and reading. This procedure matches scores on the two scales that have the same percentile rank (i.e., the proportion of scores at or below each score).

Suppose we need to establish the concorded scores between two forms. x is a score on Form X. Its equipercentile equivalent score on From Y, $e_y(x)$, can be obtained through a cumulative-distribution-based linking function defined in Equation (A1):

$$e_y(x) = G^{-1}[P(x)] \qquad\qquad (A1)$$

where $P(x)$ is the percentile rank of a given scores on Form X. G^{-1} is the inverse of the percentile rank function for scores on Form Y which indicates the scores on Form Y corresponding to a given percentile.

In the current study, the use of equipercentile linking to derive concordant MAP cut-scores was driven by the published proportion of students in each of the four performance levels in the target population (see ACT Aspire report (2014)). Specifically, to calculate the MAP score range for each of the four Aspire performance levels for the same test season, i.e., spring, we exploited the fact that both tests published national norms of the population of interest. The marginal score distributions provide information that is necessary and sufficient for equipercentile linking concorded cut scores results that generalize to the national population. The resulting MAP score equivalents were treated as the cut scores on the MAP tests.

There are several reasons behind the use of this approach (Thum & Matta, 2015). First, in many concordance studies, convenience sample data are almost always employed instead of data from a planned probability sampling. As any sample is very likely to be fallible, sample statistics are unlikely to provide unbiased estimates of the relevant population parameters. As a consequence, decisions based on those concordances might not be very accurate, in particular, if the concordance sample is not representative of the examinee population. Therefore, if the relevant population information for equipercentile linking are already available (usually based on a much larger and complete body of information as is likely to be the case in large-scale assessments), we should employ them in lieu of using likely biased sample estimates. This way, the concordance scores based on population information will be more generalizable. Another reason for using population information is that the results should achieve as closely as possible the published impact data for the target assessment. Because these merely reflect the marginal distribution of the population, population values (including impact data) make up internally consistent information set for assessing equipercentile linking results. Such a procedure would ensure that the resulting MAP cut-scores will produce the same population

proportions of students in each performance levels, an important and critical criteria for assessing the plausibility of the linking analysis in the eyes of the public. If 32% of students in a grade are proficient in reading according to their Aspire reading scores nationally, MAP concordant cut-scores should also suggest that 32% of students in that grade are indeed proficient in reading. Lastly, such an approach is free of parametric assumptions for the target scale, and does not require any pre- or post-smoothing of score distributions.

Consistency rate of Classification

Consistency rate of classification accuracy, expressed in the form of a rate between 0 and 1, measures the extent to which MAP scores (and the estimated MAP cut scores) accurately predicted whether students in the sample achieved proficiency (i.e., Level 3 or higher) on the Aspire.

To calculate consistency rate of classification, sample students were designated "Observed Not Proficient" or "Observed Proficient" based on their Aspire scores. Similarly, they were also designated as "Predicated Not Proficient" or "Predicated Proficient" based on their MAP scores and the estimated MAP cut scores. A 2-way contingency table was then tabulated as illustrated in Table A3, classifying students on the basis of their observed and predicted status. Students classified in the *true positive* (TP) category were those predicted to be Proficient based on the MAP cut scores and were also classified as Observed Proficient based on the Aspire cut scores. Students classified in the *true negative* (TN) category were those predicted to be Not Proficient based on the MAP cut scores and were also classified as Observed Not Proficient based on the Aspire cut scores. Students classified in the *false positive* (FP) category were those predicted to be Proficient based on the MAP cut scores but were classified as Observed Not Proficient based on the Aspire cut scores. Students classified in the *false negative* (FN) category were those predicated to be Not Proficient based on the MAP cut scores but were classified as Observed Proficient based on the Aspire cut scores. The overall consistency rate of classification was computed as the proportion of correct classifications among the entire sample by (TP+TN) / (TP+TN+FP+FN).

TABLE A3. PERFORMANCE CLASSIFICATION BASED ON ASPIRE AND MAP CUT SCORES

		MAP	
		Predicted Not Proficient	Predicted Proficient
ASPIRE	Observed Not Proficient	True Negative	False Positive
	Observed Proficient	False Negative	True Positive

Proficiency Projection

MAP conditional growth norms provide student's expected gain scores across testing seasons (Thum & Hauser, 2015). This information is utilized to predict a student's performance on the Aspire based on that student's MAP scores in prior seasons (e.g. fall and winter). The probability of a student achieving Level 3 (Ready) on Aspire, based on his/her fall MAP scores is given in Equation (2):

$$Pr(Achieveing\ Level\ 3\ in\ spring|a\ RIT\ score\ of\ x) = 1 - \Phi\left(\frac{x + g - c}{SD}\right) \qquad (A2)$$

where, Φ is a standardized normal cumulative distribution, x is the student's RIT score in fall or winter, g is the expected growth from fall or winter to spring corresponding to x, c is the MAP cut-score for spring, and SD is the conditional standard deviation of growth from fall or winter to spring.

For the probability of a student achieving Level 3 on the Aspire tests, based on his/her spring score s, it can be calculated by Equation (3):

$$Pr(Achieveing\ Level\ 3\ in\ spring|a\ RIT\ score\ of\ s\ in\ spring) = 1 - \Phi\left(\frac{s - c}{SE}\right) \qquad (A3)$$

where SE is standard error of measurement for MAP reading or math test.

Vertical Moderation

Vertical moderation is a common practice for achieving cross-grade coherence of cut-scores for vertical scales; see Cizek (2005) and related articles in the 2005 special edition of *Applied Measurement in Education*. It may be needed when scales are linked. When equipersentile linking is performed separately for each of several grade levels, cut-scores for a higher grade level are sometimes lower than the corresponding cut-scores for the lower grade level. This is indeed the case for the concordance MAP cut-scores for grades 7 and 8 in reading. The primary reason for such phenomenon is that cut-scores derived with a separate by-grade equipercentile linking strategy are not constrained to increase with grade level. Decreasing benchmarks with increasing grade levels are more likely to be found when the means of adjacent score distributions are close to one another and their cumulative distributions are non-parallel, or when the proportions of students in each performance level are quite different for adjacent grade levels. In the case of grade 7 and grade 8 reading for example, the proportions of student who are "In Need of Support", "Close", "Ready", and "Excellent" are 38, 33, 25, and 4 respectively for grade 7. For grade 8, these proportions are 32, 26, 31, and 11 respectively. Such differences have induced reversals in the concorded MAP cut-scores because equipercentile linking appeals to grade-level specific normative information and, on occasion, fails to reflect the kind of cross-grade coherence, i.e. monotone and increasing, expected of

vertical scales. To achieve coherence, our approach under these circumstances is to revise grade 8 reading cut-scores, using values that are 1 RIT greater than the grade 7 reading cut scores instead.